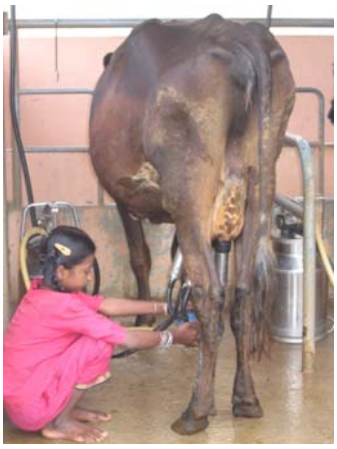
Experiences from Community Milking Centres in Rural India

- *Social, economic and technical impacts of the implementation of milking machines in Kolar district, Karnataka State*

Annegret Henriksson



SLU, Department of Economics
Degree Thesis in Business Administration
D-level, 30 ECTS credits

Thesis No 425
Uppsala, 2005

ISSN 1401-4084
ISRN SLU-EKON-EX-425-SE

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Erfarenheter av kooperativa mjölkningscenters på den indiska landsbygden

- *Sociala, ekonomiska och tekniska effekter av implementering av mjölkningsmaskiner i Kolardistriktet, Karnataka State*

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Pris: 80: - (exkl. moms)

Tryck: SLU, Institutionen för ekonomi, Uppsala 2004.

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ISSN 1401-4084
ISRN SLU-EKON-EX-425-SE

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"There is need for a long term dairy development policy in India that will facilitate not only enhanced milk production and productivity on a sustainable basis to meet both domestic and export demands in coming decades, but also promote the manufacturing of high quality dairy products that meet international standards."

~

Professor Katar Singh
Director Institute of Rural Management, Anand
Dairy Development in India
IRMA Research Paper, November 1998

Acknowledgements

Last year proved to be very instructive and challenging period of my life, both on an educational and personal level especially working on my thesis. The journey with my thesis began in February 2005, when I got the great opportunity to be part of the joint *Community Milking Centre thesis project* between DeLaval and SLU. Now, almost a year later, when I eventually reached the destination and I have finished my thesis, there are a lot of persons along the road I would like to thank. Many people have been helpful and invaluable for the work of completing this thesis – and the report would not have been the same without them!

First and foremost, I would like to express my greatest thanks to my major supervisor Professor Hans Andersson at the Department of Economics at SLU. Hans has with his obvious enthusiasm for the project, been an invaluable source of support and guidance throughout the entire process of writing my thesis. His confidence in me has several times helped me overcome the challenges that face every student writing a paper of this kind. I not only appreciate your useful feedback and constructive critique, but also your great understanding and thoughtfulness.

The project is cooperation between DeLaval and SLU and the study has been financed by DeLaval. I would like to thank the DeLaval Company for the opportunity it has given me and for its confidence in me to carry out the project. The assignment has encouraged me to use, apply and develop my theoretical skills in the real world. Furthermore, I owe great thanks to several persons within the DeLaval Company, who in different ways have facilitated my work. First I would like to thank Mr. Anders Fagerberg, for taken me on board on the project and for believing in me. Thank you for always taking your time and for adding valuable inputs to the report through out the entire process. I would also like to thank Dr. Santosh Thomas DeLaval India, for being a professional source of information and discussion partner during my field study in India and for our friendship and also for taking extra care of me while I was far away from home. Additionally, I am also grateful to Mr. Vijay Kumar and Mr. Uttam Kumar at the DeLaval office in Bangalore. You gave me a wonderful introductory taste of India and organised my stay in Kolar in a faultless manner. I would also like to express my thanks to Ole Lind and Gunnar Brostedt at DeLaval in Tumba, who have assisted me with technical equipment and support. Furthermore, I would also thank Kerstin Svennersten and Maja-Lena Främling who have been helpful as discussion partners during the whole year.

My stay in Kolar was a wonderful experience due to a number of persons. My greatest thanks go to all my interviewees and participants in the visited villages in the rural Kolar. Thanks for sharing your knowledge and experience and for welcoming me with chai tea and great openness. Your beautiful faces of India made my stay. Thanks also to KOMUL and involved persons at the dairy for sharing valuable information. My untiring interpreter, Manjunath Reddi was an incredible worker and very patient all through my six weeks of field study for he did not lost his temper a single time! Thank you for sharing work and leisure, joy, culture shocks and new experiences with me in a great way. Furthermore, thanks to my driver Kartik for safe driving and to Woody's Hotel for first classic accommodation, service and food.

Last but not least, I thank my dear family and my great friends for tireless support and consideration through out my thesis as well as in life. You are the ones giving me the courage to continue to do crazy and beautiful things in life.

Uppsala, New Year's Ewe 2005

Annegret Henriksson

Abstract

The dairy sector in India is impressive in absolute terms and the nation assumed the top position from US in 2001 as the world leader in milk production. The dairy farm system in India is characterized by small scale and labour intensive operations with hand milking, low productivity and poor hygienic quality, in comparison to international standards.

There are several challenges facing the milk production and collection system in order to facilitate development. Problems due to adulteration, poor training and education regarding animal health, herd management and hygiene routines at farm level in combination with a wide use of a traditional collection system without an unbroken chilling chain, represent some important issues.

The concept of Community Milking Centres was introduced to Kolar district in Karnataka State in 2001 and was the first of its kind in India. The centres represent new technology to be implemented at village level including bucket milking machines and cooling tanks. The system requires farmers to bring their dairy herd to the centre and milk the cows by machine. The milk is then directly cooled and stored at the centre thereby facilitating quality control.

The objective of the study is to assemble experiences from community milking in Kolar district. The study utilizes a holistic approach and intends to include the stakeholders affected by the new system; at farm, society and dairy processing level. A wide range of aspects is taken into consideration including social, economic and technical features. By surveying the impacts and outcomes facing different stakeholders, the study aspires to elicit the main issues including obstacles, opportunities, challenges and potentials. To illustrate the problem of study, the principal agent theory is used. The theory intends to explain common problem that occur in a relation with two parts where the principle hands over part of the responsibility and decision making to an agent.

Research findings are based on a field study in Kolar district during June and July 2005 and cover 15 operating Community Milking Centres in the district of Kolar. Data collection has primarily been conducted through interviews. The interviews include milk producers, society secretaries, dairy employees and a veterinarian. Questionnaires, observation and participatory activities are additional research methods used.

The research findings indicate a generally high level of satisfaction with the Community Milking System according to all stakeholders. The study reveals sociological improvements to be the main ones for the farmers. Decrease in human effort, increase in freedom and flexibility especially for women and the enhancement of self-esteem among farmers connected to the centres are findings of special importance. A more fair payment system and increase in transparency involving less harassment at society level are other interesting findings. Income and milk yield has not been affected to the same extent but when changes were found, they were positive. There is an obvious lack of training opportunities for farmers and society staff and demand for training widely exceeds supply. From the dairy industry point of view the concept until today, primarily has resulted in substantial increase in milk quality and freshness. Furthermore, the veterinary authorities indicate improvements in terms of the incidence of mastitis and general animal health awareness among the farmers who are linked to the new system. Simultaneously, they point out the lack of resources to provide sufficient veterinary services at all centres.

To improve the concept further training of farmers and society staff is crucial, including managerial, animal health and hygiene training. Implementation of herd management systems would be desirable to enable increase in awareness and to keep track of individual cows in terms of the history of disease, milk yield, artificial insemination (AI) etc. A pilot study including only a few villages implementing a herd management system would be a possible way to develop the concept further. Farmers represent a great source of information and should be genuinely participating in planning, monitoring and evaluating such a study. The community-milking centre has a great potential to be a vital element in the process of developing the dairy industry in India.

Key terms: cooperative*, milk production, milk collection*, raw milk quality, milking machine*, India, developing project*, participatory method*, rural development

Sammanfattning

I absoluta tal är den indiska mejerisektorn imponerande och Indien tog över ledarpositionen från USA under 2001 som världens största mjölkproducent. Gårdsstrukturen i Indien karakteriseras av småskalig och arbetsintensiv jordbruksverksamhet, mjölkavkastningen är låg och den hygieniska kontrollen bristfällig i jämförelse med internationella normer.

Flera utmaningar kantar utvecklingen inom mjölkproduktion och insamlingssystem för mjölk i Indien. Problemen kommer bland annat av att det är vanligt att främmande tillsatser blandas i mjölken och det finns en bristande utbildningsnivå bland mjölkproducenter i djurhälsa, utfodring och hygienrutiner. Dessa problem i kombination med att ett traditionellt system för att samla in mjölk fortfarande används i stor utsträckning, bidrar till de viktigaste svårigheterna i dagens indiska mjölkproduktion.

Konceptet med kooperativa mjölkningscenters (CMC) introducerades i Kolardistriktet i provinsen Karnataka under 2001 och var det första av sitt slag i Indien. Konceptet innebär att ny teknik implementeras på by-nivå i form av kyltankar och mjölkningsmaskiner. Systemet medför att mjölkproducenten tar sin besättning till mjölkningscentret i mitten av byn för att mjölka sina kor maskinellt. Mjölken kyls och förvaras direkt efter mjölkning i centrets kyltank vilket underlättar och förbättrar kontroll och kvalité.

Syftet med studien är att inhämta erfarenhet från kooperativ mjölkning i Kolardistriktet. Studien utgår från en holistisk ansats och försöker i möjligaste mån inkludera alla intressenter som påverkas av det nya systemet, det vill säga; bönder, samhälle och mejeri. Arbetet granskar sociala, ekonomiska och tekniska aspekter av systemet. Genom en kartläggning av effekter och resultat som möter olika parter, strävar studien att tydliggöra viktiga möjligheter, hinder, utmaningar och potential för systemet i framtiden.

För att belysa problemet i studien har agentteorien använts. Teorin beskriver problem som är vanligt uppkommande i en relation mellan två parter, där en agent får ett uppdrag av en principal som ska utföras på bästa sätt. Resultat bygger på en fältstudie gjord i Kolardistriktet under juni och juli månad 2005 och täcker 15 kooperativa mjölkningscenter i området. Huvudsakligen har data inhämtats genom intervjuer, både mjölkproducenter och anställda vid CMC och mejeri har intervjuats. Enkäter, observationer och deltagande aktiviteter har också använts som metoder för datainsamlingen.

Studien visar på en generellt hög tillfredställelse med de kooperativa mjölkningscentren för alla inblandade parter. För mjölkproducenterna visar sig sociala förbättringar höra till den viktigaste förändringen. Viktiga iakttagelser innefattar att det dagliga arbetet förenklas och att en ökning i frihet och flexibilitet upplevs framförallt bland kvinnor, dessutom upplevs en tilltagande självkänsla bland de mjölkproducenter som är knutna till centrerna. Andra intressanta resultat visar att systemet innebär ett mer rättvist betalningssystem och en ökad insyn vilket minskar obehag och provokationer på by-nivå. Inkomst och avkastning har inte påverkats i lika hög grad som de sociala aspekterna men då en förändring har upplevts har den varit positiv. Det är en uppenbar brist i tränings- och utbildningsmöjligheter för mjölkproducenter och anställda vid CMCs och behovet av träning överstiger vida dagens utbud.

Mejeriet i studien framhäver framförallt de tydliga förbättringarna i mjölkkvalité och färskhet som viktiga förändringar i och med att de kooperativa centren byggts upp. Vidare uttrycker veterinären att förbättringar gällande både mastitfrekvens och den allmänna medvetenheten om djurhälsa kan länkas till det nya systemet. Samtidigt uttrycks bristen på resurser för at tillhandahålla adekvat veterinärservice vid alla center.

Viktiga punkter i att förbättra och utveckla konceptet vidare är träning och utbildning till mjölkproducenter och CMC anställda. Utbildningen bör innehålla driftsledning och skötsel, såväl som djurhälsa och hygien. I framtiden är en implementering av ett *herd management* system önskvärt, för att möjliggöra en ökad medvetenhet och för att kunna hålla reda på individuella kor, spåra sjukdomshistoria, följa avkastning och kontrollera inseminering etc. Genom en pilotstudie med ett fåtal utvalda byar och CMCs skulle ett lämpligt herd management system kunna provas ut och utvecklas. Berörda mjölkbönder är en värdefull källa till information och bör integreras i ett sådant projekt från första början och bör vara del i planering, utförande och utvärdering. De kooperativa mjölkningscentren har betydande potential att bli en viktig del i processen för en utveckling av mjölkproduktion och mejerisektor i Indien.

Nyckelord: kooperativ*, mjölkproduktion, mjölkinsamling*, mjölkkvalité, mjölkmaskin*, Indien, ulandsprojekt*, deltagande metod*, landsbygdsutveckling

List of Acronyms

AI	Artificial Insemination
BMC	Bulk Milk Cooler - in Kolar the definition of a site with a cooling tank
CC	Coliform Count
Cfu	Colony forming unit
CMC	Community Milking Centre, milking units and cooling tank
CMP	Clean Milk Production Programme
DCC	DeLaval cell counter DCC
DCS	Dairy Cooperative Society
FAO	Food and Agriculture Organization of the United Nations
INR	Indian Rupee
KMF	Karnataka Milk Federation
$KMnO_4$	Potassium Permanganate, a solution used as cluster disinfectant
KOMUL	Kolar Milk Union Limited
MBRT	Methylene Blue Reduction Test time
MCC	Milk Collection Centre - centre with cooling facilities, no milking units
MCP	Milk Collection Point - centre with only milk collection, no cooling tank
MPCS	Milk Producers Cooperative Society
NDDB	National Dairy Development Board in India
P&I	Procurement and input
SCC	Somatic Cell Count
SNF	Solids None Fat
SPC	Standard Plate Count
SSMCP	Small Scale Milk Collection and Processing
TBC	Total Bacteria Count
UHT milk	Ultra Heat Treatment milk, long lasting milk

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1 Introduction

The introduction aims to enable an overall outline of the coming paper. First a short background is given and furthermore the introduction illustrates the problem and gives reasons for why the chosen problem is of importance to study. The research questions are followed by the aim of the study and the limitations. Eventually a figure illustrates an outline for the following chapters.

1.1 Background

India is currently the world leader in milk production. Despite a top position in quantity, India falls far behind international standards in terms of animal health, hygiene, quality, productivity and technology. Milking is generally done by hand at farm level, adulteration is common and a lack of hygienic handling and herd management is obvious. A broken chilling chain, which prevents the milk from staying fresh, and keeping bacteria level low generally characterize the present milk collection systems.

Rural areas supply most of the milk produced in India and a large share of the milk is sold through the informal sector. Millions of rural families are dependent on income from milk sales. Dairy farm systems are currently non-intensive; farmers hold small herds and the milk yields per cow are low.

Community milking centres (CMC) imply a change in the traditional milk production and collection system and involve farmers bringing their cows to the centre in the village where they previously brought the milk. The centre is equipped with a bucket milking plant and a cooling tank. Farmers milk their cows by machine and the milk is stored and chilled directly. Kolar district in Karnataka state, south central India, as the first area in India, has since 2001 been implemented the CMC concept and presently around 60-70 centres are in operation in Kolar district. The CMC concept is established within the cooperative dairy sector in Kolar and represents a development of the current milk collection system connected to the local Milk Producers Cooperative Societies (MPCS). Through CMCs a more sophisticated technology is implemented at grass root level in the areas of milk production and dairy farming. Bucket milking plants and cooling tanks are currently central parts of the community milking concept but additional services, such as training, education and herd management system could become important parts in a future development of the system. The thesis aim to study the experiences and impacts on different stakeholders related to the concept of community milking centres.

1.2 Problem

CMCs appear to have the potential to become a successful concept within the dairy sector in India, with benefits to milk producers, dairy cooperative societies, dairies, consumers and the supplier DeLaval. CMC may be viewed as a possible alternative to the traditional milk collection system in India. It is vital that CMC is viewed as an attractive option for milk producers and other stakeholders that participate in the milk chain if the concept is

to be able to develop in a sustainable manner. Collecting accurate information and experiences about the CMC's from users and participators should facilitate the process of achieving satisfied clients, both at present and in the future. Only through satisfied stakeholders and an appropriate implementation of CMCs the concept will be able to develop in a sustainable manner.

Given the background, the central problem of the thesis is to collect and analyze information and experiences from CMCs presently operating in Kolar district. An essential part of the study is to describe and analyse the milk producers' experiences in terms of knowledge, awareness, attitudes and expectations towards CMC. Experience from CMC's employees and stakeholders downstream in the milk marketing chain are also of particular interest.

The thesis attempts to answer following questions:

- Who or which group has benefited from CMC, in what manner and why?
- What are the social, economic and technical effects and impacts on the beneficiaries using CMC?
- How may DeLaval continue to develop CMC in India, to be able to contribute towards continuous progress in the Indian dairy industry and obtain a high level of approval among CMC users?

1.3 Aim

The aim of the study is to evaluate existing CMCs operations in India through a sample survey in Kolar district. The study identifies opportunities and obstacles, proposes improvements and product development initiatives for the CMC system, which would support developments within the dairy sector in India. Such developments would tend to increase sales of CMC equipment on present and opportunities for new markets. All-important stakeholders involved in CMC's operation will be part of the investigation. The analyses and results from the study intend to be evaluated in terms of future developments of specified standard packages of CMC's.

Furthermore, the objective is to present a holistic perspective of the main parties involved in the CMC operation *and* to collect, evaluate and analyze experiences from the respective interest groups. The outcome aims to result in recommendations that are perceived to be helpful for the interesting parties in terms of developing the system further.

1.4 Limitations

To be able to understand, compile and evaluate CMCs in India, the system has to be viewed in its context. Several important groups are involved in the ongoing operation of CMC's and affect the results attributable to the concept. To contribute towards a holistic overview, all stakeholders are briefly mentioned but not all of them will be deeply investigated and evaluated within the limits of this thesis project. Among the different

stakeholders that are involved in the process surrounding the CMC concept, the study focuses on the groups that work the closest to the CMC. The relation between CMC and the milk producers, who use the centre on a daily basis, is crucial. An overview of the farm resources and access to vary production factors is a supplementary part of the analyses. The experiences obtained at the dairies, processing the milk in the subsequent steps in the marketing chain are part of the core study. In addition, experiences from managers and employees working at CMC will be gathered.

Factors and actors that are more or less excluded from the study include the alternative milk marketing chain for larger dairy farms and the milk production that takes place in the informal sector. Furthermore, activities within the dairy sector that play important roles downstream in the milk marketing chain, e.g. marketing, distribution and consumption of milk products are excluded. Furthermore, no DeLaval employees are part of the study or/and interviewed.

1.5 Definition of Terms

By a Community Milking Centre (CMC) is meant a centre, which has introduced a bucket milking plant and a bulk milk cooler, designed to be used by dairy farmers in the village. In this study, all CMCs visited but one holds a cooling tank. Those milk societies, which still have not implemented the CMC concept, are defined as a Milk Collection Point, (MCP) in the paper. A third category, Milk Collection Centre (MCC) defines a centre with chilling facilities but no milking units. Milk collection centres are not an issue of investigation in this study. In Kolar district the term Bulk Milk Cooler (BMC) is commonly used. The term refer to a site which possesses a cooling tank and therefore include both CMCs and MCCs. Irrespective of being a CMC, a MCP or a MCC, the centres are entitled as a Milk Producers Cooperative Society, (M.P.C.S). All M.P.C.S's in the district of Kolar are connected to the cooperative district dairy in Kolar, KOMUL.

In the thesis the terms farmer, milk producer and society member are used equivalent by and describes the group of people who bring their dairy cows to the CMC daily. The secretaries at the CMC/MCP are sometimes also entitled as managers.

1.6 Outline of Thesis

After this introductory chapter including the background and statement of the problem, objectives of the study, research questions, aim and limitation of the thesis, a chapter of background facts and a literature review follow. In the literature review the problem is viewed in a wider perspective and contains an extensive discussion concerning research methodology. This discussion is of importance to provide the knowledge of how to handle the problem successfully. Chapter three discusses the theory chosen for the study, the principal-agent theory. Subsequent to the theoretical explanation of principal agent theory, the model is discussed in the context of the CMC synthesis. In the next section of theories, eight hypothesis are stated which facilitate the empirical analyses. Next chapter handles the methods. Choice of method is discussed in the beginning followed by a stakeholder analysis, quantitative and qualitative methods, description of data sources, data collection and methods used in for the analysis. The study is primarily based on

interviews with milk producers, secretaries and dairy employees. Next follows a chapter that states and discusses the empirical findings followed by a section with summary of results. Last in the report the discussion is presented, where the author suggests a scope for interpreting and explaining the results. Moreover validity and reliability of findings and links to theory are discussed. Finally, several recommendations how to face the future and obtain a sustainable and successful development of community milking as a concept, are pointed out.

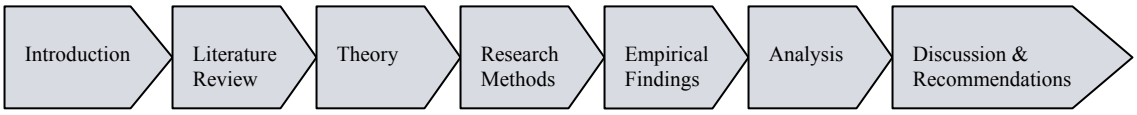


Figure 1.1: Structure of the thesis

2 Literature Review

The literature review constitutes a background for the subsequent chapter and sets the issues in a wider context. The background chapter includes general facts about India and the history behind the current structure of the dairy sector. Further, the concept of CMC is defined and explained. In the end of this chapter, the general issues concerning milk collection in developing countries are presented including experiences, opportunities, obstacles, challengers and possible solutions of current problems.

2.1 General Facts of India

The republic of India is the seventh largest country by geographical size in the world (almost seven times the size of Sweden) and is located on the Indian subcontinent in south Asia. India borders on Pakistan and Afghanistan in northwest, Nepal and China in northeast, Bangladesh, Myanmar and Bhutan in east and Sri Lanka, Maldives and Indonesia as nearby island nations in the Indian Ocean (CIA- Fact book, 2005-04-24). It is one of two countries in the world with a population over one billion people. The population is estimated to reach 1.08 billion by July 2005.

India is home to some of the world's most ancient civilizations and its history goes back at least 5000 years. The continent has given birth to four major religions; Hinduism, Buddhism, Jainism and Sikhism. Aryan tribes, Arabs, Turkish and Europeans have ruled the country and influenced its culture during different epochs through history. By the 19th century Britain had obtained political control over India and first through non-violence resistance to the British colonialism led by M. Gandhi in 1947, India became independent. India is the world's largest democracy.

India is characterized by substantial growth, in both population and strategic importance in the last twenty years (CIA- Fact book, 2005-04-24). The Indian economy is the fourth largest economy in the world in terms of purchasing power parity[1] and is currently the world's second fastest growing economy with a real growth rate of 6.2 percent. GDP per capita was in 2004 3,100 US$. One quarter of the total GDP is contributed by agriculture, one quarter from industry and the remainder from the service sector. Despite positive economic growth, the country faces several pressing issues such as the ongoing disagreement with Pakistan over Kashmir, considerable overpopulation, environmental degradation, extensive poverty where a quarter of the population lives under the poverty line, and ethnic and religious conflicts. The population growth is 1.4 percent, one third of the population is less than 14 years and life expectancy at birth is 64 years. A majority, 60 percent, of the people make their living out of agriculture. The sectors of industry and services employ representatively 23 and 17 percent of the total labour force.

Hinduism is the major religion and is practiced by over 80 percent of the population (CIA- Fact book, 2005-04-24). Furthermore twelve percent are Muslims and a minority of approximately two percent are Christians. Other religions are Buddhism and Sikhism. The long tradition of the caste system within Hinduism has had an enormous

[1] The theory that exchange rates between currencies are determined in the long run by the amount of goods and services that each can buy (Black, 2002).

impact in India and continues to be influential (Encyclopaedia, 2005-05-01). The system has been breaking down slowly and since 1947 the caste system is declared as illegal. The resistance to change has remained strong and social distinctions and cultural traditions are more persistent and still the caste matters in the daily lives of people.
Hindi is the national language and primary tongue of 30 percent of the people. English is the most widespread language for national, political and commercial communication in India and is spoken by the majority of the educated people. Additionally there are fourteen other official languages within the country.

The literacy rate of people over 15 years is 60 percent (CIA- Fact book, 2005-05-01). There is a wide range in education level among people – where a part of the population is very well educated. A wide range in income distribution is observed; when the poorest ten percent of the population have a household income that counts for 3.5 percent of the total income. The income share of the richest ten percent of the population is 33.5 percent.

2.2 The Dairy Sector and Milk Production in India

The dairying tradition in India is as old as its culture. Animal husbandry is the second most important activity in rural areas, next to agriculture based on crop production. Almost all Indian rural households hold a cow or buffalo to meet their daily need for milk. Milk production accounts four percent of the gross domestic product of India. Since 2001 India is the world leader in milk production closely followed by US. (Jiaqi and Lambert, 2002)

Milk production in India has shown a trend of noticeable growth over the last four decades. The most important explanation is the implementation of "operation flood" in the beginning of the 70s. Operation flood is built upon dairy co-operative societies at village level. Unjust treatment from private traders did cause dissatisfaction among farmers. Cooperatives in the dairy sector became a way of addressing the problem and to promote an opportunity for farmers to obtain economic influence in the milk marketing chain. The first phase of the implementation between the years of 1970 to 1981 around 13,000 villages was organized and 1.7 million farmers were enrolled. Given the success of the concept of operation flood it covers 140,000 villages and engages eleven million farmers in rural India as of today. (Jiaqi and Lambert, 2002)

India is by far the country in the world with the highest number of small-scale dairy farmers. A majority of the dairy herds consists of one or two animals with an average of 1.3 animals per farm (IFCN Dairy Report, 2005). The main size class of 1-2 cows contribute 51 percent to the total milk production in India. According to the 1987 livestock census 56 percent of the Indian cattle are raised on smallholdings with less than one hectare of arable land. Less than five percent of the livestock are raised on holdings that exceed ten hectares (Waslekar and Futehally, 1999). These numbers do clearly indicate that the majority of dairy farmers in India are small subsistence farmers. Milk production may successfully contribute towards an improvement of livelihood in rural areas, first and foremost in terms of milk being a daily source of balanced nutrition. A further, regular sale of milk increases the stability of the household income. (Hemme et al, 2003).

Currently, the Indian milk production system is in general non-intensive and non-business orientated and management and husbandry practices are curative and restrictive (Santosh, 2004). There is in general no or very little involvement of technical experts in health management and advisory activities. Exceptions in terms of big farms with very high tech equipment and business-oriented management are found around the big cities, i.e. Bombay, but are still quite rare.

Some key features of the dairy sector in India in numbers are following; the milk production in 2003 reached 88.4 million ton. Approximately 85 percent of the milk is produced and processed within the informal sector (IFCN Dairy Report, 2004), of the remaining fifteen percent, the cooperative society's account for a considerable share. During the same year, 2003, milk consumption amounted to 80 kg/capita (annual per capita consumption in Sweden is 369kg). During 1981-2001, milk production increased by 141 percent and the growth in per capita consumption amounted to 63 percent. The growth in population during the same period was 46 percent. The level of dairy self-sufficiency is said to be 100 percent, but the consumption is still below the minimum standards recommended by the Indian Council of Medical Research and far behind the per capita consumption in other countries. Hence, the self-sufficiency level may be discussed. Milk production is constantly increasing and the Indian Department of Animal Husbandry estimates the milk production to reach approximately 91 million in 2005 (Ministry of Agriculture India, 2005-04-23).

In a global context, the performance of the Indian dairy sector appears to be impressive in terms of total production but it lies behind in terms of productivity, technology and hygiene (Waslekar and Futehally, 1999). The productivity in India measured as kg/per year milk yield is on average less than 2000 kg in comparison with 8000 kg for a Swedish cow (livsmedelssverige, 2005-04-22). According to IFCN report 2005 the average annual yield per cow is 1200 kg.

There are around 75 million dairy farmers in India and approximately 200 million cows and buffaloes contributing to milk production (Waslekar and Futehally, 1999). The corresponding numbers for Sweden in 2003 would be 9700 dairy farmers and 400 000 cows contributing to the milk production (SCB, 2005-04-23). Buffaloes play a substantial role in milk production and they account for 54 percent of the total milk production (Ministry of Agriculture India, 2005-04-23). The share of milk production from cows and goats are 40 and 4 percent respectively. At present, the use of modern milking technology in India is limited. Most milking is still done by hand and machine milking is only used for two percent of total volume. (Waslekar and Futehally, 1999).

Roughly 40 percent of the Indian farm households are engaged in milk production and 40 million households are at least partially dependent on the income generated by milk production (Hemme et al, 2003). The income structure among dairy farmers is diverse – income sources are the sales of milk, cash crops in the case of land ownership and off-farm employment. Differences in income pattern are linked to location of farms; urban vs. rural, land ownership; land owning or landless farmers, education, and labour use and production costs. Annual household income ranges from 700 US$ for rural landless farms (less than 50 US cents/person/day) to 8200 US$ for larger urban farms. The income directly linked to dairy farming range from 200-8200 US$ (Hemme et al, 2003). Net cash farm income may be as low as 50 US$/year and thereby contributing to less than 10 percent to total household income, just sufficient to cover the cash costs of

the farm. A low income from dairy farming is usually associated with a low share of milk sold outside the household and high interest payments for loans from local milkmen. (Hemme et al, 2003). Dairy farms also face non-cash benefits in terms of having access to milk for home consumption and manure to use as fuel. These values may be substantial and contribute to up to a quarter of the total household income.

2.3 Development of Dairy Co-operatives in India

As mentioned in the former section, the present co-operative dairy sector in India is a result of three development programs known as Operation Flood I, II and III. The Operation Flood concept was created and developed by Dr. Kurien, who was invited by the Prime Minister of India in 1964, to serve as chairman for the newly formed National Dairy Development Board (NDDB). The major objective of the NDDB was to promote and facilitate the establishment of dairy co-operatives across India (Fulton et al, 1993) Dr Kurien used his prior experiences from co-operative unions in India and developed Operation Flood. The main objective of the Operation Flood concept was to introduce an integrated scheme for the development of the dairy industry and milk marketing in India (Singh Kahlon, 2001). An additional objective of the program was to facilitate the organization of dairy co-operatives by small-scale and often landless farmers throughout India. The co-operative Operation Flood system was implemented in 1970 and completed after three phases in 1996. It is an integrated system with organizations at three levels, local, regional and national. Each level plays an important role for the overall outcome of the eternal system.

At the local level, individual producers are members of the village milk producers' cooperatives, often called M.P.C.S, Milk Producer Cooperative Society. The cooperative makes it possible for small-scale farmers to receive frequent and stable payments when selling the milk to the cooperative. Concurrently, the cooperatives eliminate the excess market power of the middlemen, who otherwise would act as monopsonist's most often buying milk from farmers to an impudent low price. (Fulton et al, 1993).

At regional level the Milk Producers' Co-operative Societies are members of the district or union level cooperatives. (Fulton et al, 1993). The union level is responsible for milk collection, pasteurizing and processing the milk to other dairy products, packaging the milk and milk products and arranging for the sale of the final product. Services such as veterinary support, AI, cattle feeding and member training are also parts of the responsibilities of the regional level and the district unions. Marketing of milk and milk products to regional urban markets are also conducted on regional basis.

On the national level, activities associated with coordination of planning, larger investments and training of human resources for the dairy co-operatives are conducted through the NDDB.

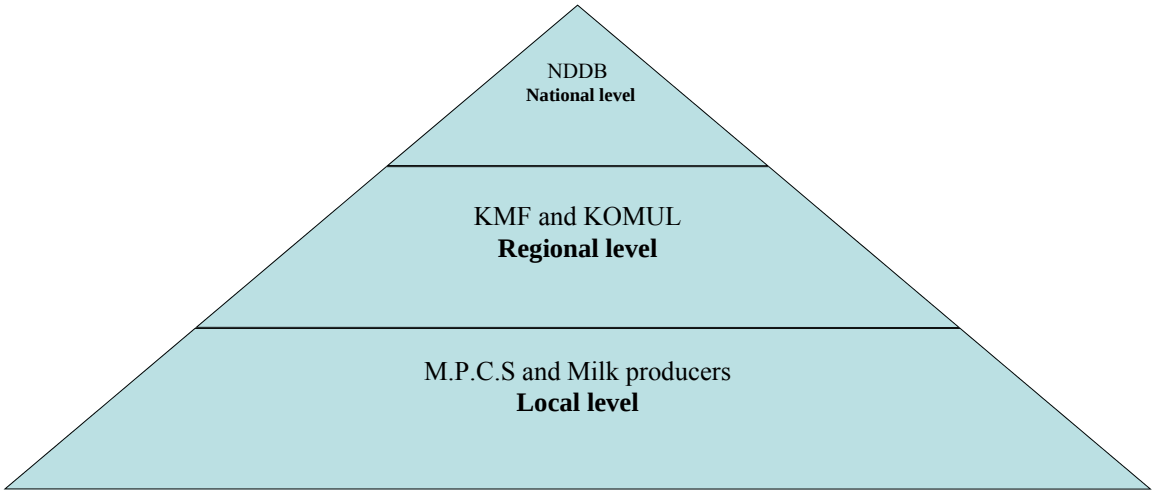


Figure 2.1: Structure of the cooperative dairy sector in India

Due to generous international funding in terms of skim milk powder and butter oil from the developed world in 1970, Operation Flood could be implemented. The gift was most welcome as there was a shortage of milk products in India at that time. (Fulton et al, 1993). NDDB was able to maintain control over product pricing and the gifted products were sold on the Indian domestic market at prices comparable to those in the local market. This ensured that the gifted imports did not cause distortions in local production. The revenue from the sales of the milk aid was used by the NDDB to finance the Operation Flood development program.

The overall performance and outcome of the Operation Flood has been disputed among person versed in the area, with both sides having their specific arguments for the level of success the concept has achieved. An increase in total milk production in India has been a direct result of the development of Operation Flood in rural India and may in that context be viewed as a benefit to the country of India. (Fulton et al, 1993). The establishment and development of cooperatives have also been shown to be important and beneficial on individual village level. Several studies have revealed the advantages of villages with cooperatives compared to other villages in terms of milk production measured per household. One study noted a 1.18 litre per day and per animal increase in production in cooperative villages compared to control villages (Fulton et al, 1993). Another important aspect of Operation Flood worth mentioning is the success of actually reaching the target group, the poorest farmers. Numerous reports have shown that the program has been successful in ensuring that the small-scale marginal producers benefit as much as larger scale farmers. For example, there is only a slight difference in the average level of milk production per animal between landless producers and other producers within cooperatives. A much larger variation in the level of milk production is observed in the control villages.

Cooperative organizations within the dairy sector in India have been demonstrated to enable improvements in welfare of their members. Members working together to reduce business risk and to act as a group in order to mitigate market power, which often makes small producers losers, have facilitated improvements. (Fulton et al, 1993).

Cooperatives may be a useful and efficient tool for economic and social development in rural areas in developing countries. Concurrently, there are many examples where cooperatives have not been very successful, which illustrates that the concept is not a universal method for rural development and poverty reduction. (Fulton et al, 1993).

Researcher that are sceptical to the performance of Operation Flood imply that the level of success can not only been measured in total milk production and a large increase of cooperative societies all around India but should also include other factors to be able to visualize the fair picture of the overall effects and results of the concept. Concurrently with the increase in total milk production and increase in numbers of cooperative societies, the milk procurement per member was shown to decrease from 2.2 litres on the completion of Operation Flood I in 1979 down to 1.1 litres in 1996, on the completion of Operation Flood III (Singh Kahlon, 2001). A decrease in milk procurement per member leads to a decrease in income, if prices per litre are not increasing – and makes the picture of the beneficiaries change. The darker side of Operation Flood also shows evidence of degenerated quality of the animal stock over the years of Operation Flood due improper feeding, poverty among owners and lack of necessary resources.

Different studies have found that member participation and commitment are important parts for the success of cooperatives. (Fulton et al, 1993). Economic theory of public goods, including the free rider problem, and open access vs. common property underlie following discussion. Greater member participation and commitment are easier attaining in a cooperative, which has a bottom-up approach, compared to those organized according to a top-down approach. Bottom-up Cooperatives have attributes of being created from the grassroots and are often established from a desire to obtain the benefits of joint action. In opposite, top-down approach often occur as an extension of state bureaucracy and too often is the result of government aid efforts to achieve certain development goals. In a co-operative which is ruled by a bottom-up approach the members are more likely to feel a sense of joint ownership, shared responsibility and do also feel more committed to the success of the operation. This occurs because they are much more involved in the decision making process compared to members joining a co-operative which is managed according to the top-down approach.

2.4 Main Issues within the White Challenge

By the white challenge is meant the challenge facing milk production, collection and procurement in India. It all has to start at the grass root level – by the farmers – for the farmers. In a research report called *The White Reality,* the future Indian milk production and three parts illustrate its development, challenges, objectives and responses (figure 2.2) The first part states the challenge including quality, productivity and availability. India has to obtain better quality, higher productivity and enhance availability to ensure domestic demand and international standards. The second part of the body includes the objectives. The objectives are high price, high yield and high esteem. Those three objectives will facilitate an improvement in standard of living and quality of life for the milk producers. The responses to achieve the objectives and manage the challenge include new technology, training and management program and new investments. (Waslekar and Futehally, 2001).

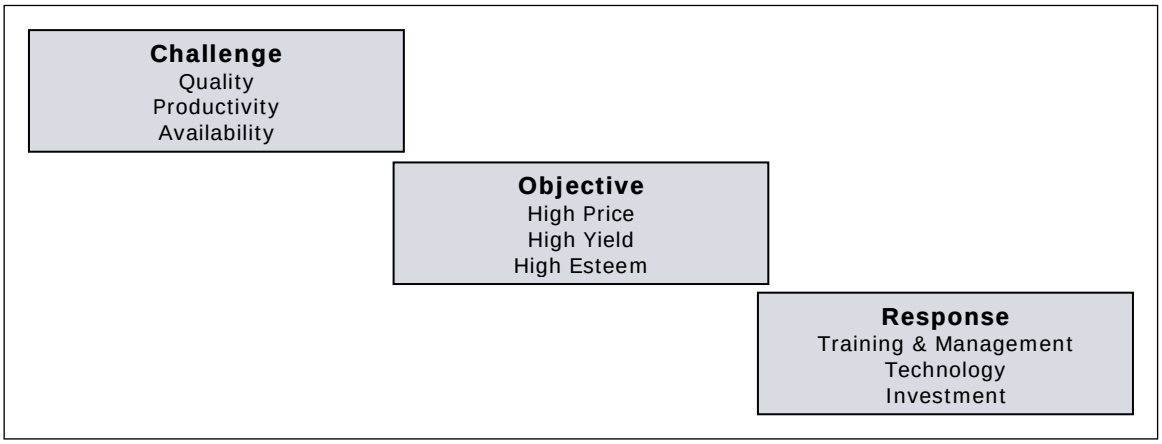


Figure 2.2: The three parts included in the white challenge

2.5 The Concept of Community Milking Centre

India, as one of the world's most populated countries and with a relatively by fast growth in milk production, naturally becomes an interesting and important market for present and future developments within the dairy sector. Today's milk collection system in India is quite obsolete and a vast majority of the milk producers use traditional methods for milking, delivering and collecting the milk. Yet, milking machines are gradually being introduced.

An example of hand milking and milk measuring and collection in a village in Kolar district operating the traditional system of milk collection. Photo: Annegret Henriksson

Traditionally, Indian farmers milk their livestock by hand at the farm. The milk is either collected at the farm or delivered to a collection point where there usually are no cooling facilities available (figure 2.3). From the first collection point the milk has to be assembled and transported to a second collecting point where cooling facilities are available. This procedure happens twice a day, morning and evening. From there, milk tankers collect the milk once a day and transport the milk to the dairy plant for further cooling and processing.

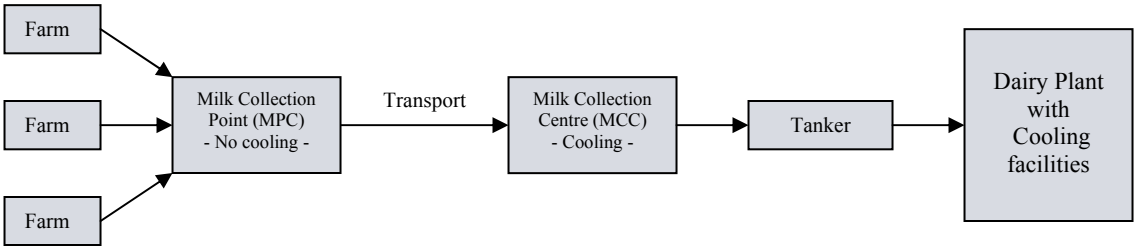


Figure 2.3: Traditional milk collection system in India

Unlike the traditional system, CMC is a system where milk producers bring their dairy herd to the CMC for machine milking twice a day. At the CMC the amount of milk will first be measured and controlled before stored and cooled in bulk milk cooler. The milk is collected once a day by a tanker from the dairy and transported to the dairy plant (figure 2.4).

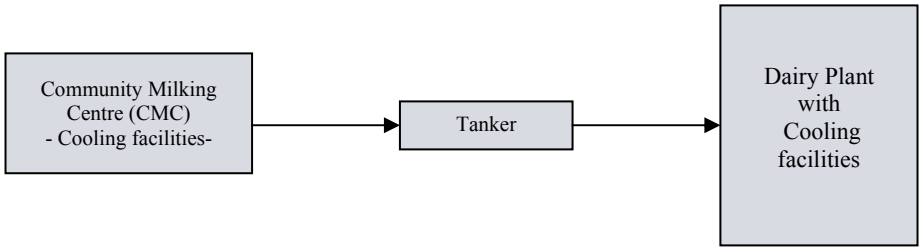


Figure 2.4: Milk collection system with Community Milking Centre

The introduction of CMCs implies fewer stages and more extensive hygienic practices within an unbroken chilling chain. The quality of the milk is always examined and the milk producer receives a fair price for the milk. In addition to the functions directly connected to milking, the centre may serve several other purposes. The CMC can be used for information, training and education of staff and milk producers. It may serve as a communication centre for the village, with phone and Internet facilities. The CMC may also be used for supplementary services such as training, vaccinations and inseminations.

The CMC system has since the beginning of 2001 gradually been developed in Kolar district by KOMUL assisted by DeLaval. There are in total 1560 M.P.C.S in Kolar district connected to the district dairy, KOMUL. Currently around 70 CMCs are in operation and approximately 300 villages are covered in the BMC routes.

The system intends to achieve several advantages on farm- and community level as well as on milk union level (Santosh, 2005). Increased milk production, fewer cases of mastitis and higher milk prices are aspects that all would benefit the farmer and might be an expected outcome of the new system. On the dairy processing plant level decreased spoilage of milk, increase in hygienic quality, easier collection and decreased adulteration may serve as benefits. Milk unions will likely decrease transport costs, decrease spoilage and receive milk of higher quality.

Ongoing milking activities at two of the visited community-milking centres
Photograph: Annegret Henriksson

2.6 Prior Experiences of Milk Collection in Developing World

2.6.1 General problems and solutions for milk collection in developing countries

The Food and Agriculture Organization, FAO of the United Nations has directed two important conferences with an agenda that deals with milk collection issues in developing countries, in the last five years. In year 2000 an e-mail conference was held on small-scale milk collection and processing in developing countries (SSMCP), in which 570 people from 97 countries participated. The aim of the conference was to gather ideas and share information on SSMCP in developing countries, to provide an overview of the present situation worldwide and establish links and facilitate cooperation between key persons working in the dairy sector. (Jiaqi and Lambert, 2002). In May 2002 a regional technical follow-up workshop was held in China, organised by FAO and the Ministry of Agriculture of China. The objectives of the workshop were to exchange information about SSMCP and address common regional constraints for the Asian region. As outcome of the meeting, ten key findings and additional twelve main recommendations were prescribed as guidelines for the future. Several of the findings and conclusions from the conference in 2000 were linked with the workshop in 2002. Below some of the key findings regarding the milk collection issue in developing countries;

- Lack of and/or access to education, information, training and support services in SSMCP.
- Milk testing and sampling systems may improve the existing weak linkages between payment and testing systems, management information system and extension services.
- Milk product safety is a major issue in SSMCP – large informal milk markets may contribute to health hazards facing the consumer.
- There is a lack of new technologies, such as low cost small-scale milk cooling and processing units.
- Regional dairy processing plant face several difficulties due to; seasonality in milk supply, poor or/and unstable milk quality and a limited range of products produced.

(Jiaqi and Lambert, 2002).

The recommendations follow from the key findings and may act as a guideline of what to focus on in order to achieve progress and development in milk collection and processing in developing countries. Below are a number of the recommendations that were formulated at the regional workshop focusing on the Asian region and pointed out:

- Introduction of an appropriate milk payment system based on hygienic and compositional quality with incentives to improve quality of milk and regular milk payments.
- Training, education and information for small-scale milk collection and processing plant should be improved.
- Guidelines for good manufacturing practices should be provided to all stakeholders in the milk chain.
- Low cost and small-scale milk cooling and processing equipment should be developed, promoted and implemented.
- Improvements of SSMCP in developing countries in the Asian region require a holistic and integrated approach.

(Jiaqi and Lambert, 2002).

Given the depicted background, key findings and recommendations for the future, which resulted from these two major conferences, issues concerning the concept of community milking centres in India seem to be even more typical. Many of the aspects and features included in the CMC concept attempt to eliminate the problems pointed out as obstacles for further progress and development within the milk collection and processing sector in developing countries. Introduction of milking machines could facilitate milking and milk collection in many ways for both milk producers and processors. Hence CMCs may improve milk quality and simultaneously elevate the technical and hygienic level at village level. If milking machines are implemented in a wide setting, the CMC concept may be able to address and solve many of today's difficulties.

2.6.2 Indian challenges, problems and solutions for milk production

In a report prepared for the Ministry for Food Processing Industries, Government of India, a number of interesting issues are pointed out related to the Indian dairy sector. Key issues concerning Indian milk production include low productivity of milk animals and the lack of quality control and monitoring mechanisms across the supply chain. Improvements in milk productivity can be achieved through enhancing production potential and superior animal care facilities and processes. (Rabo India Finance Pvt. Ldt, 2005). The bacterial quality of raw milk in India at the time of milking is comparable with that in leading milk exporting nations. However, there is substantial deterioration in milk quality along the way from farm to dairy processor. According to the report the two main reasons for the decline in quality include (1) infrastructure issues and (2) contamination through equipment, loss in time and lack of sufficient chilling facilities. (Rabo India Finance Pvt. Ldt, 2005).

The solution towards a necessary dairy development lies in identifying the problems of handling, storage and transportation practices through out the entire chain from producer to the dairy plant (Rabo India Finance Pvt. Ldt, 2005). An action plan including four points is mentioned:

1. Increasing awareness about the importance of good quality milk among farmers
2. Training of farmers on hygiene habits at farm level and collection centres
3. Incentivising farmers through higher remuneration for quality milk
4. Setting up quality testing infrastructure at the collection centre. This involves testing of bacteria count, acidity, smell/taste, conductivity, somatic cell count etc.

(Rabo India Finance Pvt. Ldt, 2005:26)

The report also proposes installation of bulk milk coolers. Bulk coolers have several benefits and facilitate and improve collection and milk quality substantial. Through implementation of bulk coolers (1) collection intervals can be extended, (2) larger flexibility in delivery and pick up time be achieved, (3) handling of cans eliminated, (4) increase in potential of collecting milk from remote areas and (5) improvements in maintenance of hygienic conditions facilitated. (Rabo India Finance Pvt. Ldt, 2005).

2.6.3 Prior case study of KOMUL

A case study of KOMUL shows the achieved benefits due to implementation of new technology in terms of bulk milk coolers and bucket milking units in Kolar district. The investments include bulk coolers, milking machines, hygiene equipment and training.

Table 2.1: KOMUL Dairy Development Project

Investment made in procurement infrastructure

- Bucket Milking machines
- Feed racks, water bowls and partitions
- Supply of Automatic milk collection units
- Supply of Bulk Milk Coolers
- 10 sets of 1000 LPD
- 10 sets of 2000 LPD
- Supply of Hygiene Kits
- Training -Union and DCS staff

Outcomes (within six months of investment)

- Milk producers received premium of INR 0.10/Lit of milk as compared to earlier
- Milk yield increased by 10% at Community Milking Parlours
- MBRT values improved from 0.45-2 hrs to 5.45-6.30 hrs
- Bacterial count declined from 1.5-7 mn to 0.15-0.4 mn cfu/ml
- Loss due to spillage reduced at DCS
- Lowering of transportation costs - once a day trip of tanker
- Improved capacity utilization of milk and dahi manufacturing units -Higher returns to the union

(Rabo India Finance Pvt. Ldt, 2005:27)

The case study reveals some technical and economic benefits made from investments, which can be viewed as part of the CMC concept, in terms of the milking units and the bulk milk coolers placed out in the milk societies in Kolar district. However, the study does not investigate or state any social impacts for the individual milk producers and their societies, which is the main focus in this thesis study.

2.7 Summary of Literature Review

India has a unique pattern of production and processing milk, which is not comparable with any other large milk producing country. India face difficulties and great challenges in the dairy production concerning poor infrastructure, lack of new technology, low productivity, poor hygiene conditions at farm level, insufficient knowledge about dairy among farmers and poor extension of professional guidance.

India has around 75 millions of dairy farmers which depend on dairy income for their livelihood. In the perspective of both the great extent of the dairy sector in India and the present situation; it makes further improvements crucial for the future. A large share of the milk produced is still handled through the informal sector and only 15 percent is subject to industrial processing. Milk production, collection and processing through dairy cooperative societies established during the operation flood scheme, stands for a substantial part of the latter share.

The CMC concept includes implementing bucket milking units and chilling facilities on village level. The new technology facilitates and improves the milk handling process and reduces the numbers of stages in the milk chain between farmer and dairy processing plant.

Many of the obstacles facing India also face most other developing countries in the world. General issues for milk collection in developing countries include among other things: lack of access to training and education, lack of links and incentives between quality and payment and the lack of new technology. The CMC concept could become an efficient platform for solving several present obscurities.

A case study of KOMUL made by Rabo India Finance Pvt. Ldt in early 2005 reveals a number of benefits related to new investments including bulk coolers, milking units and training. However, the case study is fairly brief and has unlike this thesis study, its starting point in the perspective of the dairy processing plant. None has earlier studied the different relationship between the involved stakeholders in the milk production chain in a detailed and holistically manner and investigated social, technical and economic impacts of the new milk collection system implemented in Kolar district.

3 Theory

The following chapter describes the theoretical framework for the study. Agency theory and the principal – agent model facilitates an explanation of the relation between two parts involved in an economic activity but with different responsibilities or/and interests. The first part of the chapter includes a definition of the theoretical model and a review of the different problem, which may occur. In the latter part, the theory is applied to the relation between foremost CMC management and individual society members. Eventually, several hypotheses are presented which are associated with the four agency problems.

3.1 Principal - Agent Model

3.1.1 General fact

A relevant theory illustrating the problem of this study is the *principal-agent model*. The model is well suited for analyzing individual benefits for two parties that depend on each other's action and/or are involved in an agreement (Jensen and Meckling, 1976). The parties engaged in an agreement do both have to be provided attractive incentives in order to cooperate. Individual benefits will only be attained and sustained if transactions of products or services occur between two satisfied parts. Whenever one individual depends on the action on another, an agency relationship arises (Pratt and Zeckhauser, 1991). The individual taking the action is called the agent. The affected party is the principal. Jensen and Meckling define an agency relationship as:

> *"A contract under which one or more persons (principal(s)), engage another person (agent), to perform some service on their behalf which involves delegating some decisions making authority to the agent. If both parties of the relationship are utility maximizes there is a good reason to believe that the agent will not always act in the best interest of the principal"* (Jensen and Meckling, 1976:308).

The principal-agent relation arises in all firms and institutions when decision makers interact with the internal and external environment and affected stakeholders. The theory was originally developed for illustrating the relation between a company's management and its shareholders. The theory describes a situation where the agent is commissioned by the principal to accomplish a task as well as possible. The shareholders are principals and the company management the agent (Pratt and Zeckhauser, 1991). The theory of agents has gradually been expanded to cover further areas and today the model be applicable to both profit making firms and non profit institutions; e.g. universities, hospitals, mutual companies, cooperatives, governmental authorities and bureaus and unions (Jensen and Meckling, 1976). It can also be applied to the relationship between different actors *within* an organization/company but also the relation between the organization/company and *external* actors may be studied using the model. Two of the main elements which are combined in the principal-agent problem are firstly, risk sharing and secondly, differential information. (Pratt and Zeckhauser, 1991:44).

An agency relation occurs due to the divergence in perspectives and objectives between the agent and the principal (Laffort and Martimort, 2002). A case from the real

world can be visualized by an owner of a firm acting as the principal with different objectives compared to the agent, which can be various members such as workers, supervisors and managers.

The principal-agent theory is in the standard economic tradition and builds upon neoclassical economics assumptions (Pratt and Zeckhauser, 1991). Both the principal and the agent are assumed to make their decisions optimally in the view of their constraints and to maximize their own utility. Furthermore, limited rationality and information asymmetry are assumed to be part of the model (Nilsson and Björklund, 2003). Limited rationality for individuals involves limited knowledge and limited ability to manage information. In a situation where individuals strive for individual maximal utility at the same time as limited rationality exists, may create a substantial risk of fraudulent conduct. Limited knowledge and information is however likely to differ between the involved parties. The agent generally has an information advantage over the principal due to closer and more extensive contact with the core of the company.

A number of different problems are likely to occur in a principal-agent relation. Five of the most common problems are described below; horizon problem, portfolio problem, decision making problem, control problem and agency costs.

3.1.2 Horizon problem

The horizon problem takes into consideration the difference in time horizon facing the two actors in the principal-agent relation. The problem occurs when member's residual claim on the net income generated by an asset is associated with a shorter time span than the productive life of the asset. (Cobia and Anderson, 2000) In general the principal has less incentive to make expensive investments that demand a long repayment period. If the agent terminates the collaboration with the principal, there will no longer be any right to the returns from the investment for the principal. (Nilsson and Björklund, 2003). The horizon problem creates an undesirable investment environment where principals are provided weak incentives to contribute to growth opportunities (Cobia and Anderson, 2000). The time horizon is usually of shorter length for the principal in comparison to the agent. Differences in time perspectives among actors within a relation may underlie and cause problems that may complicate further expansion within the operation. (Nilsson and Björklund, 2003). To be aware of the difficulty and address obstacles associated with the horizon problem it is crucial to limit negative outcomes. Focusing on good communication between management and members has appeared to decrease the horizon problem and contribute towards a more entrepreneurial behaviour in cooperatives. (Cobia and Anderson, 2000)

3.1.3 Portfolio problem

The difficulties with disparities in objectives between agent and principal are strongly linked to the special and unique *incentives* the different parts face. A clear divergence between preferences and objectives of principals and agents is risk preferences (Anthony and Govindarajan, 1998). The portfolio problem considers how to handle risks.

The agent theory assumes that agents prefer more wealth to less but that the satisfaction, the marginal utility, decreases as more wealth is accumulated. (Anthony and Govindarajan, 1998). Wealth of the agents is measured both in terms of financial and human wealth – and to a large extent the wealth is typically tied up in the fortunes.

Principals are assumed to be risk averse[2], because of decreasing utility of wealth but also because of the fact that the principals return on capital assets depends on the actions of the agent. Principals cannot easily diversify away the risk in comparison to agents. Agents in opposite to the principal are assumed to be risk neutral[3].

A single principal may have many agents. Each takes an action and the output of the system is a random function of all the actions. It is impossible for the principal to observe all actions themselves, but he/she may be able to make several observations, for example on the output (Pratt and Zeckhauser, 1991:44).

3.1.4 Decision making problem

There is often a lack of clear decision-making rules when it comes to decisions taken by the agent (Anthony and Govindarajan, 1998). In a situation with several principals connected to one agent, it is difficult to combine the different wishes and wills from all principals. In general the agent takes a decision, which he/she believes is the best for the involved parties as a group. Establishment of a contract between agent and principal facilitates the decision-making process considerably.

3.1.5 Control problem

The control problem occurs due to the separation between ownership and control, which can lead to conflicts between the principal and the agent (Anthony and Govindarajan, 1998). Due to the divergence in incentives and information the challenge for the principal is how to motivate the agent to act for the principal's benefit rather than following his/her self-interest (Black, 2002). The principal may incur monitoring and bonding costs in an effort to limit the divergence in the interests of the agent and the principal (Jensen and Meckling, 1976). Hidden action is one problem that commonly arises within the control problem. The most typical hidden action is the effort of the agent. For the agent, effort implies disutility, but it has its value for the principal. Higher effort increases the likelihood of a favourable outcome for the principal. (Pratt and Zeckhauser, 1991:44)

Another dilemma within the principal-agent relation is imperfect information. The problem of information flow between the agent and the principal is a crucial part of the model (Laffort and Martimort, 2002). The hidden information problem can be illustrated when an agent has made some observation that the principal has not made. In terms of the agent, the observations serve as a basis for decision making – however, the problem remains for the principal. Delegating a task to an agent who has different objectives than the principal is problematic, especially when information about the agent is imperfect. The agent has generally a feature of specialized knowledge and the principal may never hope to completely check the agent's performance. The principal cannot check whether the agent uses the information in a way that best serves the principal's interest. An efficient control system is often the only way to ensure that the decisions made by the agent do not differ too much in relation to the principals.

3.1.6 Agency costs and control mechanisms

Problems originating in the principal-agent relation lead to agency costs of different kind, when there is an attempt to minimize these costs. Costs are undesired and by two major

[2] Preferring safer returns even if they are on average smaller (Black, 2002).
[3] Indifferent to the dispersion of expected outcomes (Black, 2002).

methods; *monitoring* and *incentives*, it is possible to deal with the problems of divergent objectives and information asymmetry. (Anthony and Govindarajan, 1998). The first control mechanism is monitoring. Through a control system designed by the principal, the actions of the agent can be monitored and the system makes it easier for the principal to ensure that the agent does what the parties have agreed upon. The monitoring system aims to eliminate actions by the agent that increase the agent's welfare at the expense of the principal's interest. (Anthony and Govindarajan, 1998). If the task performed by the agent is well defined, monitoring systems usually become more effective. In contrast, it may be impossible to define the agent's assignment well and in those situations a monitoring system bet looses in effectiveness or may not work at all. A signed contract or agreement between agent and principal is one way of monitoring, but contracting requires both time and resources for control, which is costly. A second way to lower agency costs, often a useful tool when monitoring is too expensive or/and difficult, is incentive contracting (Anthony and Govindarajan, 1998). Incentives may support the interests of the principal to coincide with those of the agent. By creating appropriate incentive contracts the principal limits the divergence in preferences usually observable between the two parties. A reward and punishment system is an example of incentive contracting and generally increases the agent's incentive to act, for the principal, in an advantageous way. The more an agent's reward depends on a performance measure, the more incentives there are for the agent to improve on that measure.

3.2 Applied Principal – Agent Model

In the following section, the principal-agent model is applied to the unique problem examined in this thesis. The model is used to illustrate two different principal-agent relations within the areas of the study; firstly the relation between the milk producers and the CMC management, secondly the relation between the CMC and the dairy processing firm.

In the relation between milk producers and the CMC, producers are viewed as principals and CMC management as the agent (figure 3.1). The secretary and the staff members are employed by the milk society to run the community-milking centre. CMC management performs services on the behalf of the farmers. Both parties are to some extent dependent on each other's activities and face individual benefits due to the partnership, which enables an agency relationship to arise.

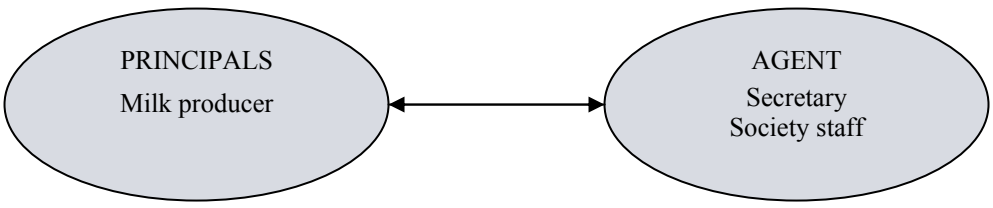


Figure 3.1: Principal-agent relationship between individual farmer and CMC staff

In the relation between the dairy processing plant and the CMCs (staff, committee and individual farmers) the dairy acts as principal and the CMCs act as agents (figure 3.2).

The relation is defined in that manner due to following reasons; the dairy processing plant is responsible for the investments associated with the CMC implementation. The farmers act as agents that produce the milk to the dairy processing plant through the CMC. The dairy processing plant has delegated the task to produce and deliver milk and simultaneously also signed away some authority through that task. KOMUL is interested in getting as much as possible out of the investment and depends on that the individual CMCs are performing well.

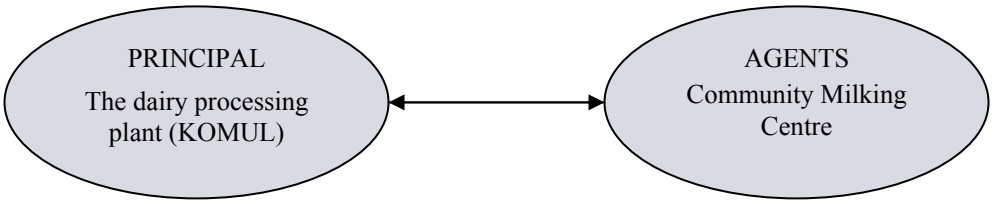


Figure 3.2: Principal-agent relationship between the dairy and Community milking cent

3.2.1 Horizon problem

Due to a divergence in time horizon first and foremost among the members and secondly between management and the dairy processing plant the horizon problem may occur. Members have difficulties to perceive the value of larger investments, if future returns on those are uncertain. In a situation of implementing a CMC, an investment requires a new shed and a sufficient room for a bulk cooler. The dairy-processing firm assumes the investment cost of equipment and bulk cooler. In a traditional cooperative like the M.P.C.S, most of the capital is unallocated equity, which means that the capital belongs to everybody but at the same time to nobody. It is not always the case that the total amount of money that individual members invest in the cooperative will earn a fair return, especially for an older member who is close to retirement. Simultaneously, new members do instantaneously get access to services provided and the associated unallocated equity in the cooperative although they have not been part of building up the cooperative. Features like age; size of farm and number of cows may be reasons for a divergence in time horizon for milk production and milk collection among farmers. Such heterogeneity could become harmful for the possibilities to develop the CMC concept further. The outcome of the CMC is highly contingent upon a stable member union of milk producer's, to enable efficient use of equipment and to provide other services at the CMC.

3.2.2 Portfolio problem

The portfolio problem is attributable to the issue of risk taking. The dairy farmers in the society may face difficulties in diversifying their assets. Generally, it do not exist a wide range of livelihood opportunities in rural areas in developing countries. Investment in a single cow often implies that all savings are used and the family becomes very dependent upon the income from that single cow, which sets the family in a vulnerable situation. Farmers may be assumed to be risk averse, in terms of preferring smaller, safer returns rather than higher, uncertain returns. This is just because of the vulnerability and dependence on one single income source. A common consequence of risk aversion is

carefulness in decision-making. Farmers that do have other income generating activities aside from the dairy business may be more interested in taking higher risks because they do not face the same difficulties if the investment turns into a failure.

Portfolio problems may also arise for the cooperatives. In general, there may be a desire from members that different services are provided. However, an increase in the diversity of activities at the centre often follows by a risk of increasing conflicts of interest among different member categories. With a narrow and concentrated business it is easier to satisfy all member expectations about the cooperative. However, if the services currently planned at the CMC are strictly associated with the dairy business and consequently of importance to a majority of the members, the problem of portfolio problem would not be a critical issue.

In the relation between the dairy processing plant (KOMUL) and CMC, KOMUL faces uncertainty regarding the returns on the large investments enacted at the centres. Returns from the investment would be less risky in milk societies that are run properly and where the cooperatives are stable and members are satisfied due a larger likelihood of proper management and maintenance of the milking equipment. The dairy would like the equipment to be used in an efficient manner to receive highest possible returns. When there are economic incentives to farmers, which take part of the CMC concept, the likelihood of more connected farmers' increases. Therefore the portfolio problem decreases for the dairy processing plant.

3.2.3 Decision making problem

There might be lack of rules that provide a straight and clear allocation of responsibility for different types of decisions. A clear contract signed between the two parties facilitates for both parts and reduces the risk of misunderstandings, obscurities and feeling of powerlessness. In cooperatives like M.P.C.S problems commonly occur in the relation between operating management and the committee, which is elected by the producers. The committee may interfere too much in the daily operation instead of delegating full responsibility to the secretary. The secretary best knows the daily routines and a limited power to act in the daily operational decisions may result in that necessary purchases of spare parts or other maintenance is not conducted in the most efficient manner.

3.2.4 Control problem, agency costs and control mechanisms

Because ownership and control is divided between producers and CMC management, control problems are likely to occur in this relation. Producers and the CMC face a divergence in terms of interest and objectives, which may be base for conflicts. Before the introduction of CMCs management had limited ability to control the operations at farm level and the actions taken by milk producers could be labelled "hidden actions". Through the introduction of community milking centre, more activities occur at the centre that monitor the process where both society staff and other members are able to supervise. The milk flows directly from the cow to the bulk cooler and there is no possibility for farmers to add any unknown substances to the milk or skim the cream of the milk. The introduction of CMCs facilitates for the secretary to obtain better knowledge and control on both members and dairy cows. Despite a deeper insight into the milk handling process, there will still be activities and actions taking place at farm level, which will be difficult for management to control, i.e. feeding and hygiene.

Hidden information is another common problem. As mentioned previously the agent, in this case the management group, have access to some kind of information, which the single farmer does not have. Simultaneously, farmers possess information advantages over the CMC management in other issues. The producer can decide how much information he/she wants to share with the CMC. For example, farmers will always know more about the cow's health and general background information and there might be several reasons why not all information will be shared with the CMC. Continuous documentation, information and communication between CMC staff and farmers facilitate the opportunities to control and supervise actions taken by the farmers.

Another issue, which may be connected to the control problem, is the daily/weekly activities of quality testing, measurements and payments going on at the CMC. With the introduction of the CMC there will be enhanced transparency. An increase in transparency decreases the costs and efforts connected to control problem.

For the dairy-processing firm the introduction of CMC could also be a way of reducing the risks of problems associated to control. KOMUL is dependent on an operation that takes place geographically far from the dairy. When milking at the CMC centre instead of at home, the production and collection moves closer to the dairy and control might be facilitated and the risk of fraudulent conduct from farmers reduced.

3.3 Hypothesis

On the basis on the theoretical framework and the applied circumstances, several hypotheses will serve as further help for the analysis of results. The hypotheses are linked to agency problems respectively and to the two different relationships. Some of the hypotheses are related to the milk producer-CMC management relation, whereas other are associated to the relation between CMC and the dairy processing plant.

3.3.1 Horizon problem

- *There is time horizon divergence among society members due to differences in age, size of farm and level of dependence on dairy incomes.*

Features like age, sex, size of farm and future outlook might create a heterogeneous member union with conflicts of interest as a result. Evaluating enumerated features towards different variables concerning the time perspective may reveal possible correlation, either providing support or deny information in favour of rejecting the hypothesis of a horizon problem. The variables may be; the attitude towards delivering milk through CMC in the future, the general current satisfaction level for the CMC and attitudes towards increasing the herd size.

3.3.2 Portfolio problem

- *The combination of a relatively specialized activity at the CMC and a homogenous member union that is geographically concentrated decreases the possibility of a serious portfolio problem.*
- *The dairy reduces risk taking through limiting investments in CMC to solely "stable" milk societies with good management.*

The income share from milk production in proportion to total income may differ among farmers. The question is then to what extent differences across farmers tend to or/and increase/decrease the portfolio problem? An additional question is if there are good reasons for making the assumption of homogeneous member unions and a concentrated activity portfolio? Furthermore, the issue is raised if KOMUL may handle the portfolio problem by only allocating CMC investment to villages they believe has a fair chance to operate a successful centre.

3.3.3 Decision making problem

- *Unclear routines and rules of distributing responsibilities between the secretary and the society committee cause misunderstandings, confusion and frustration in the daily operation of CMC and may contribute to conflicts.*

Ambiguous directives from above and/or interference by board of directors or the society committee with the work in conducted the everyday operation, may seriously affect the CMC routines and operation. The secretary acts as operation chairman and ought to have the responsibility to make independent decisions, concerning i.e. purchase of spares required, cleaning routines and necessary labour.

3.3.4 Control problem

- *Implementation of the Community Milking Centre decreases the control problem mainly due to the enhanced transparency the concept brings to the milk collection system.*
- *Control problems could decrease further by implementation of a reward system for CMC staff creating incentive for operating good routines and maintain high hygiene level.*
- *Risks of fraudulent conduct among milk producer's decreases through the CMC system and the control costs for the dairy processing firms are reduced.*

Transparency in the milk collection, the implementation of computerized measurement and payment systems yield advantages i.e. gain in member trust for staff and manager. Higher trust in the relations between society members and between members and staff increase the possibility of observing falling agency costs.

4 Research Methods

This chapter presents the different methods used during the phase of primary data collection. Data is assembled through a field study in Kolar district. First section explains and discusses the choice of research methods and follows by a section that explains and defines the issue of stakeholders. The subsequent section illustrates the qualitative and quantitative methods used i.e. observation, semi structured and structured interviews and quantitative measurement. Furthermore, comments on possible problems associated with the selected methods are mentioned. Last in the chapter, participatory methods are presented and applied to the empirical situation.

4.1 Choice of Research Methods

The data collection is done by the *survey method*. A survey method is an adequate method for collecting non-experimental data and it is commonly used in e.g. agricultural surveys, especially in developing countries (Olsson, September 14, 2005). The core area of study, so called *target population*, is viewed to be the CMC's. To be able to answer the key objective of the thesis, data collection is conducted from several groups and individuals viewed as beneficiaries of the CMC concept; from milk producers and secretaries at CMC level, to veterinary and MD at dairy level in Kolar.

The target population in the Kolar district consists of approximately 50 operating CMC's using 94 bucket milking machines and surrounding stakeholders including dairy employees, secretaries and veterinarians. The size of the target population precludes a survey of the total population and for that reason a sample is selected. The field study data is collected primarily through interviews with farmers and secretaries and observations made at 18 MPCS, of which 15 of the MPCS have implemented CMC and have milking machines. Additional three of the societies are operating traditional milk collection systems. The first three visited CMC's were used as pilot villages and permitted questionnaire testing and an observation checklist design. Data from the pilot study is not included in the final analysis. Interviews with responsible employees at KOMUL and participatory activities at three of the MPCS operating CMC have also contributed to information in the study. All together these groups and individuals form the *sampling frame* (figure 4.1). All data collection is made in Kolar district, Karnataka state, India between the 25. June and 25. July 2005 (appendix 1).

The study is mainly built on a combination of *qualitative and quantitative* evaluations, based on primarily *semi-structured* interviews. Semi-structured interviews facilitate and render possibilities for a deeper dialogue with each stakeholder involved in the project and enhance the prospects of a holistic view (Pole and Lampard, 2002). A selection of milk producers using CMC daily was interviewed at each plant, likewise responsible managers for different CMC's and people responsible for handling the milk for further processing at dairy level.

Participatory method is another part of the research methods used. The idea of participation is a general guiding philosophy in order to ensure that useful experiences from all stakeholders are taken into account (Pratt and Loizos, 1992). A participatory approach aims to value local people's knowledge and experiences. The influence of the professional staff from outside becomes mitigated and the role will be more of a

facilitator rather than an expert. People, groups and institutions directly affected by the project ought to be involved and consulted in the project evaluation. The level of participation has to be decided on the basis of each situation, not all circumstances are suitable for a high level of participation from locals.

Both qualitative methods and participatory approaches are principally based on close communication with local people. English is the official language in India but Hindi and other local languages are widespread, especially in rural areas. Therefore most of the interviews and other interacting social activities will be done in cooperation with a translator.

An element of quantitative research methods is used primarily for measuring the milk quality at the CMCs and at milk collection centres. Collecting information at CMC in terms of counting numbers of animals milked, output, and inventory of equipment and to observe and measure buildings will also be part of quantitative research methods.

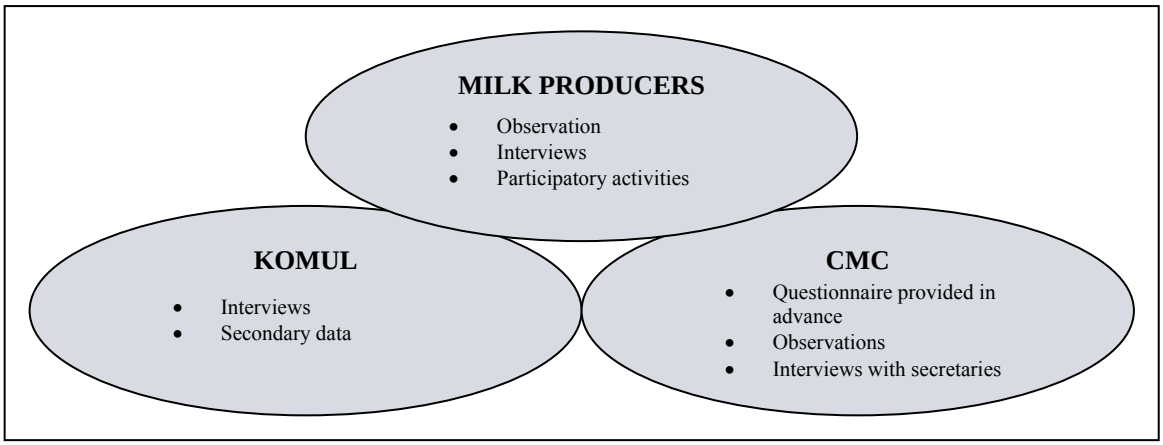


Figure 4.1: Sampling frame and sources of information during field study

4.2 Stakeholder Analysis

4.2.1 General fact

A stakeholder analysis is the identification of a project's key stakeholders, an assessment of their interests, and the way in which these interests affect project risks and possibilities (Qualman, 1997). Stakeholders may be persons, groups and/or institutions that are involved and interested in a project and/or may influence its outcome. Different stakeholders do have different interests, importance and influence on the project, which is illustrated in the stakeholder matrix (table 4.1). Group B, the key stakeholders, do have significant influence, importance and interest to the project. This group hold both the commitment to change and the authority required. Stakeholders in group A are distinguished by having a high interest in the project but a limited ability to put pressure on the decision making process. Group D may be a risk for the project implementation, monitoring and outcome. These stakeholders do have a strong influence but a weak interest in the project. Finally, with a low influence and low interest, group C plays a relatively small role in relation to the project outcome.

A stakeholder analysis may serve several purposes such as identifying stakeholder interests in relation to problems that the project is seeking to address, identifying conflicts

of interests between stakeholders and identifying positive relations between stakeholders. A stakeholder analysis also attempts to assess appropriate types of participation by different stakeholders, review the importance of each stockholder's importance to the project and evaluate the influence of each stakeholder over the project. Project success is particularly important for some stakeholders and this becomes most obvious when the stakeholders interests converge with the project objectives. The power over project decisions and control differs between stakeholders, which mean that some stakeholders have a larger influence in design, implementation and outcome of the project. It can be of interest to study the divergence in power.

The theoretical framework of stakeholder analysis may underlie following investigation of the situation concerning the stakeholders included in the CMC concept. The analysis will facilitate the understanding of each and every ones role in the concept and opportunity to influence the outcomes of the operation.

Table 4.1: Stakeholder matrix (Qualman, A 1997).

A High Interest/Importance Low Influence *These stakeholders will require special consideration if their interests are to be protected.*	**B** High Interest/ Importance High Influence *Stakeholders are the basis for an effective coalition that supports the project.*
C Low Interest/Importance Low Influence *These stakeholders are of least importance to the project.*	**D** High Influence Low Interest/Importance *These stakeholders may influence the outcome of the project, but their priorities are not consistent with the objectives of the project. They may be a risk or obstacle to the project.*

4.2.2 Stakeholders within the CMC concept

There are several groups and individuals who can be viewed as stakeholders in the development, implementation and operation of community milking centres. All stakeholders take different roles in the project depending on influence and interest. In figure 4.2, the key stakeholders are illustrated and coloured as a traffic light, to show to what extent they are involved. KOMUL and DeLaval both play a crucial role. They have a high interest in the implementation and development of community milking centres and to some extent also a great power of influence – with KOMUL having a little advantage in the final decision-making. DeLaval and KOMUL may serve as examples of the green light in the family of stakeholders, who are the ones who run the project forward. The yellow group consists of milk producers and their cooperative societies. Stakeholders in this group have a great interest in the project and furthermore also are of substantial importance to the outcome and final result of the project. Simultaneously, the group does not have the ability to influence in terms of decision-making etc due to a lack of authority, geographical distance to the decision-making process and financial reasons. Group D, the group of stakeholders who may be a risk for the outcome of the project is demonstrated in red in the figure. Milk consumers may be part of this group because they will influence the project outcome via their consumption patterns. CMC will hopefully

produce milk of higher quality, which will be sold to a higher price. Consumers are far from the actual project and may not have an interest in the project but still obtain influence, because the milk produced at the CMC has to find a market. The role of the consumers in relation to the CMCs is uncertain and will not be investigated in this paper.

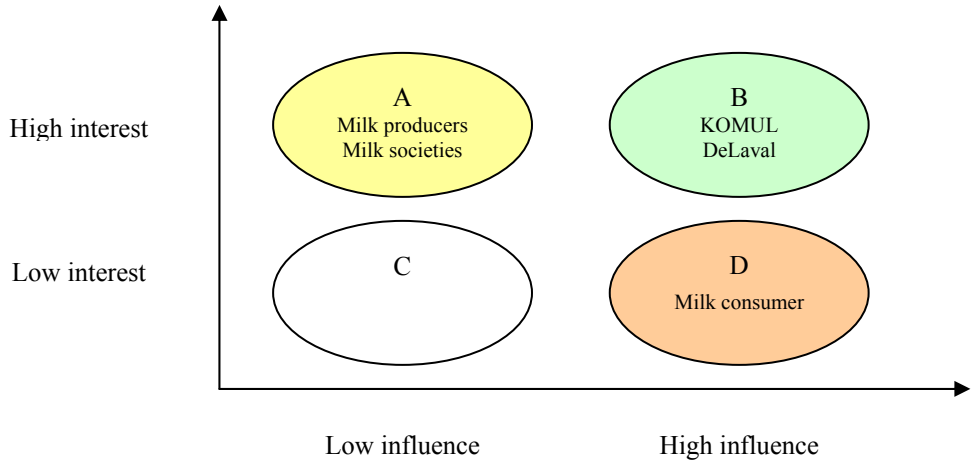


Figure 4.2: Stakeholder position in CMC project

4.3 Qualitative Methods

4.3.1 Interview techniques and design of questionnaires

An interview can be defined as *"a verbal exchange of information between two or more people for the principal purpose, of one gathering information from the other(s)."* (Pole and Lampard, 2002: 126). There are many ways of conducting an interview with a respondent. The approach can be conversational or programmed; the sequence can be wide open or strictly structured. The questions may be specific and closed or open minded and broad. In this study different interview techniques have been used for different groups. While the interview questions with managers and chairmen at the dairy processing level were moderately broad and open-minded by their character and a relatively light structured conversation, the questionnaires to farmers were more structured but still left room for open answers. (Casey and Lury, 2002). The questionnaires to farmers and secretaries represented a combination of some factual questions, which require a short, standardised or numerical response, while other questions required an extended response from the interviewee. Subsequent questions may sometimes be necessary to clarify some issues.

The method to create an appropriate questionnaire is described in three important steps. The first step includes enacting a background survey by collecting data from previously related studies or collecting other accessible information about the area of study. The data then serves as a platform in order to clarify the phenomenon to be examined. Step two includes extracting appropriate variables that are influencing the studied issue. It is of importance to eliminate variables, which are too difficult to measure, too detailed or simply irrelevant for the core research questions. The final step includes creating the questionnaire, which means developing questions and alternatives,

finding a natural structure and testing the questions before using them in the study. (Aster and Johansson, 2005).

Whatever the approaches for the interview and questions, there are three issues to be considered in the process of creating questions. (a) Does the respondent understand the question? (b) Will the respondent know the answer? (c) Will the respondent reveal the correct answer? Only if the answer is yes on all three questions above, a question in a questionnaire can be expected to succeed. Interviews in developing countries make these issues even more important because people face a whole different environment and different conditions. Furthermore, a common complication is that many questions are worded or expressed in such a way that the respondent consciously or subconsciously gets an impression that a certain answer is expected – these kinds of questions should be avoided. (Casey and Lury, 2002).

Accuracy of response generally declines with the length of the interview and the time of an interview should not extend beyond one hour. If an interview extends beyond that time limit, fatigue may cause that the concentration for both respondent and the interviewer falls dramatically. (Casey and Lury, 2002).

Two different examples of interview situations. To the left an interview with a CMC secretary and to the right an interview with a young female milk producer. Photograph: Santosh Thomas.

4.3.2 Avoiding pitfalls

A field study including observation, participatory activities and interviews with locals in a rural area in a developing country may be full of pitfalls, especially if the researcher is from a different background. Cultural and traditional differences can be hard to visualize and to understand if the data collection period is limited to a relative short time span. To avoid pitfalls to the very last there are several issues to consider. To start with – the translator should not be biased. The translator should be an objective person and should not have an interest in what the respondent is saying. If that is the case, there might be a risk that the respondent may feel insecure about revealing the truth or the translator may not translate accurately if he/she considers the information as 'wrong' due to individual interest. (Pratt and Loizos, 1992).

Gatekeepers are another pitfall. The definition of a gatekeeper in this context is someone who is a central person in the society. A gatekeeper is someone who knows almost everyone in the community and always is number one to take hold of new information including gossip within the village. The gatekeeper is usually a very social and conversational person and not seldom somewhat popular among society members.

The danger for the study associated with the gatekeeper is that this person often is the face outside and probably will show up when the research team visits the village. He or she might have a lot of information to share and also some interesting points to add. However the problem is that this person views himself/herself as someone who can answer for everybody that is not the case. It is not uncommon that the gatekeeper is the person who will guide the team around the village and decides who to talk to and not. The gatekeeper can be a hazard for the objective random sampling. (Scheyvens and Storey, 2003).

The gender issue has to be considered too, to avoid pitfalls. Women and men should be interviewed separately to avoid important information to be lost. In the rural areas in a country like India, men are traditionally the head of the family and women would not talk as freely in the presence of men. Local cultural pattern and rules should also be respected and followed by the research team to facilitate for cooperation and acceptance; this can for example imply appropriate dress code. (Pratt and Loizos, 1992).

4.4 Quantitative Methods

4.4.1 Measuring milk quality and composition

During the visits at the centres, milk samples were taken both from cooling tanks and individual farmers. The milk quality was tested for somatic cell count level through DeLaval cell counter (DCC). Two to three samples were taken from the tank and also milk samples from farmers were double-checked. By using DCC an almost exactly somatic cell count was possible to receive in less than a minute.

To the left, curious spectators when measuring cell count with DCC and to the right a staff member measuring fat content on milk. Photograph: Annegret Henriksson

Milk samples from all 15 visited CMCs were also taken to KOMUL and dairy technologists at the dairy made a more extended microbiological analysis report. The report includes fat, SNF, methylene blue reduction test time (MBRT), standard plate count (SPC) and coliform count (CC).

4.4.2 Statistical analysis through Chi-2 test

Some parts of the data collected during the field study have been examined by statistical methods, in the statistical programme Minitab. Data that has been statistical analysed include interviews with milk producers and CMC secretaries and data from the checklist.

The statistical tool chosen includes Chi-2 test (χ^2 test). Through Chi-2 test data can be analysed by cross tabulation and the test makes it possible to analyse any relation between two variables. Through the Chi-2 test, a null hypothesis is formulated, which implies that there is no relation between the two variables. Simultaneously, the alternative hypothesis is formulated, which stands in opposition to the null hypotheses and therefore states that there is a certain likelihood of a relation between the variables. The alternative hypothesis is accepted if the null hypothesis is rejected. A small value of χ^2 indicates a case of correspondence between observed and expected numbers, which renders support in favour of the null hypothesis. The null hypotheses can only be rejected if a fairly large χ 2 value is observed. The critical value is found in a χ^2 tables. (Körner and Wahlgren, 2000).

4.5 Participatory Method

4.5.1 General facts

Participatory evaluation is an approach that allows people on local level to participate in the process of project evaluation. It aims to create a forum where all stakeholders take part in the evaluation and where decisions are made cooperatively in how progress should be measured and results be acted upon. (Guijt and Geventa, 1998). Participatory evaluation differs from the conventional evaluation approach that only uses experts from outside to measure performance, using standardized procedures and tools. A participatory approach results in new ways of assessing and learning from changes that take into account the perspectives of local people. Including those most directly affected by the project initiates an empowering process where the views of the local people are considered. The process further aims to put the local people in focus and to value and develop local skills and knowledge. The core of the participatory approach is the conviction that the people directly affected by the project have the most valuable information and are experts on their lives. Additional, participatory approaches are based on four broad principles; participation, negotiation, learning and flexibility.

Chambers explain the main principles of participatory rural approach through 'the three pillars'. The pillars include *methods, sharing and behaviour/attitudes* (Chambers, 1997). The parts are of equal importance and only when all three pillars coexist, successful participation may be achieved. The *methods* include semi-structured interviews, mapping, observation, modelling etc. The pillar of *sharing* emphasizes the value of sharing knowledge, both among the local people and in the relation to evaluation staff. Sharing experiences of living, tradition, food etc also play a crucial function for successful participation. The people, groups and institutions affected by the project have useful information to share with the 'professionals' to the same extent as the professionals can inform the people of possibilities they may be unaware of. The third pillar considers the importance of having the right *behaviour/attitudes* in handling the project evaluation. With a lack of a suitable attitude towards the project beneficiaries', evaluation staff will face difficulties to collect useful information and experiences from the local community.

4.5.2 Applied participatory activities

Four villages were selected of the 15 already visited CMCs for conducting the participatory part of the field study, the villages were; Urigili, Chikkaankandahalli, Shettihalli and Kalvamanjali. The participatory method aims to involve the farmers in the study in a deeper dimension and in this case also facilitates crosschecking results from interviews. Advantageously, a participatory approach is used throughout the entire study and has a long time perspective. In that way, trust and confidence are built up both among the participants and between the participants and the researcher. In the way the method was used in this specific study, it had more of a pilot study feature – a *participatory method light version*.

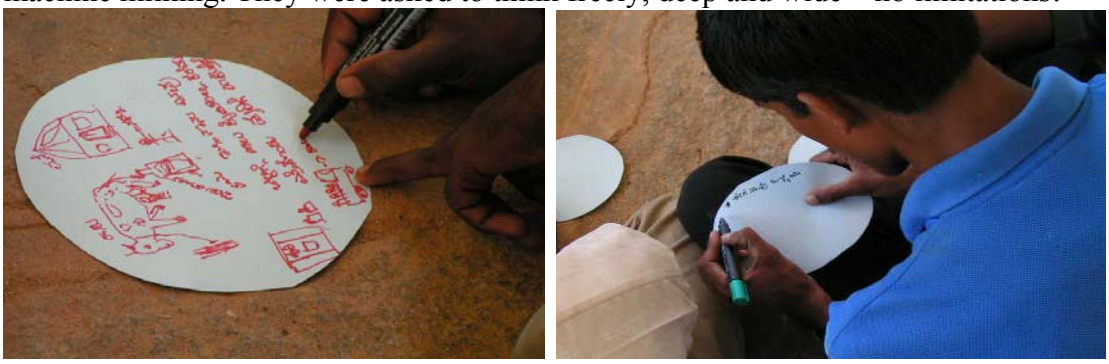
Group discussions were chosen as the participatory tool, which suited well to the time and resource limits facing the field study. The aim was to assemble a heterogenic group, in terms of age, household responsibility, and income level and farm activities. All these features are important to assure that all interests and perspectives are accounted for. Men and women were divided into different groups, because women otherwise have a tendency to not speak out freely and express their views and opinions. The size of the groups was all from eight to twenty people. Because women are busier doing household activities in the morning, the men's group discussion was held in the morning and the ladies in the afternoon. All together an entire day was spent in each village conducting the participatory activities. The secretaries were informed in advance and knew the purpose of the visit. Finding voluntary participants was by way of introduction not very easy. Farmers are busy doing fieldwork and household activities and in addition there was some scepticism towards the new way of gathering information from them. After all when the group eventually was created, a majority of the participants were deeply participating, very open-minded and happily shared their experiences with not only each other, but also with the research team.

A simple, physical and fun game initiated the participatory activity. The reason for that is to try to make sure that all participants participate, feel relaxed and secure and to furthermore strengthen the group feeling. A game also gives the local people some time and opportunity to get to know the researcher (me) in a relaxed manner.

Playing a game and sharing fun in the group of the participating society members before starting the group activity and discussion. Photograph: Santosh Thomas

After a personal introduction of everybody in the group the participants were asked to imagine themselves in the life before the introduction of CMC. On coloured, circular paper notes each and everyone wrote down or drew a picture, which illustrated

characteristics from the past. Persons, who could not write, were assisted by our translator to get their thoughts down on paper. On a new piece of paper they were then asked to mark something that symbolised their life today and which was associated with machine milking. They were asked to think freely, deep and wide – no limitations!



Participants are drawing and writing down personal experiences from the CMC system. Photograph: Santosh Thomas

Afterwards, a discussion followed including what all participants had displayed on their paper notes and why. During some of the group discussions we also categorised the opinions and thoughts and listed them of importance. Finally all the ideas and thoughts were set up on a wall at the CMC and the quotations were documented by digital camera to be translated later.

Examples of the participatory activities used, including brainstorming and group discussions with men and women groups respective. Photograph: Santosh Thomas and Annegret Henriksson

5 Empirical Findings

In the following chapter empirical findings from the field study are presented, including data from the dairy processing plant, CMC and individual farmers. The first part describes the Community Milking Centre on the basis of forms in advance and an observation checklist, followed by a compilation of the interviews from milk producers and the results from participatory activities with the farmers. Findings from the secretaries of the CMCs and from employees at the dairy plant are presented next. Last in the chapter the most interesting issues that came up during interviews and additional data collection are pointed up and relationship between empirical facts and the theoretical arguments are summarized.

5.1 Description, Observation and Milk Quality of the CMCs

5.1.1 Description of CMC

Information and results presented in this section originate from forms that in advance (appendix 2) were sent out to the selected CMCs before the actual field study took place. Secretaries, assisted by Mr Manjunath Reddi from DeLaval, filled them out. The form consists of a wide range of descriptive questions and covers among other things the size of the CMC in terms of total numbers of society members, cattle, milking machines, building etc. In addition questions regarding the year of establishment and form of ownership are posed. The form also includes questions about the services provided, milk production including seasonal differences and washing-, cooling-, power- and water facilities at the centre. The two last sections of the survey involve; firstly questions concerning occurrences or discoveries of cases of different animal health problems and secondly, questions regarding investment costs and annual operating costs of the community-milking centre. Of the 15 centres selected, 13 forms were received in advance and data was analyzed.

All centres in the study function as cooperatives denoted milk producers cooperative society MPCS and the implementation of CMC has not led to any change in ownership or organisation. The CMC concept has been implemented in the selected villages from June 2002 until March 2005. All MPCS deliver the milk to the district dairy in Kolar, KOMUL. Delivery and receiving duties are applicable for members and KOMUL, respectively. The milk is collected by KOMUL once a day for all centres with bulk coolers. Only one of the CMCs in the study does not have cooling facilities, which means the milk has to be collected twice a day. An absolute majority of all centres with bulk coolers also has a computerized measuring and payment system. The CMCs open hours for milking and the time when KOMUL collects the milk differs slightly between centres depending on size of the CMC, milk routes and distance to the dairy. Open hours range from one hour fifteen minutes to two hours. At earliest centres open at 5.30 am/pm and at latest it closes at 8.30 am/pm.

On average the cooperative societies have around a hundred members. The number of society members is not equivalent with numbers of milk producers in the village, because it is fairly common that one household hold more than one membership in the cooperative. Around 60 dairy cows were on average linked to CMC at each centre but there was a wide range from a total herd size of 10 up to 140 animals (table 5.1).

Around 90 percent of the households hold between 1-3 cows, which indicate that larger herd sizes are rare. Milk production per centre varies from 550 litres up to 2200 litres with large individual differences between the centres. Climate conditions in Kolar district creates a flush season between the months of August and November with its peak in October according to the secretaries and a lean season between February and April. Because of the differences in production among the societies and neighbouring villages connected to the BMC, three different types/sizes of DeLaval bulk cooler were found at the selected centres - 1000, 2000 and 3000 litres tanks. A majority of them hold 2000 litres. The ratio between maximum milk production and size of bulk cooler indicates both the current capacity used and possible future limitations. Currently, about 70 percent of the bulk capacity is used. However, noticeable is that two of the centres having the smallest bulk coolers do not have cooling capacity enough during flush season. All centres use DeLaval bucket milking units. Most centres operate four clusters but there are also centres that have three and six clusters.

Table 5.1: Membership characteristics and milk production at CMC

	No of society members	Total cows	Total cows milked	Bulk capacity (l)	Max prod/ day (l)	Min prod/ day (l)	Max bulk cap used (%)	No of units
Mean Value	101	61	54	1 923	1280	949	69	4,4
Min	60	10	8	0	700	550	35	3
Max	155	140	138	3000	2200	1600	105	6
Median	93	55	55	2000	1200	850	73	4

Regarding the services provided at the CMCs, all centres affirmed they offer veterinary services, animal medical supply and artificial insemination (AI). All centres except one also provide feed supply and all but two centres have telephone facilities. Professional herd management does not currently exist at any of the centres.

Additional half of the CMCs offer their members a service called human health care. Through the health care scheme members of the society and their family members can get medical consultation and surgeries guaranteed for free if paying a fee of 100 INR per year and person. Micro finance schemes are another service provided at some of the centres. At the time of completion of the forms no additional services were planned at any of the centres with two exceptions for the establishment of a veterinary hospital and bulk milk cooler in one village and introduction of public telephone in another. Neither did anyone of the secretaries' express a particular demand from farmers for any additional services than the ones already provided except from two of the secretaries. One expressed a desire for a washing unit and a new shed and another for a public phone facility.

None of the CMCs do currently have washing units. Both power network and generators supply power and power cuts occur frequently several times a week and last for an uncertain period of time. All centres receive their water supply from a drilled well.

The discovery and/or occurrence of different health problem vary widely among CMCs (table 5.2). Mastitis represent the most common health problem according to the poll but there is a substantial variation in the absolute number of treated and untreated cases between centres, with a mean value of 130 cases but a median value of 40 cases.

Injured udders and digestion problems are less common but also vary considerably between centres. Few cases of leg and hoof problems and worms have been discovered and treated. According to the secretaries no cases of lice, fleas or ticks do occur at all. Worth mention, result comes from the form in advance that has been filled in by the secretaries. The secretaries do not keep track of the incidence of disease frequency within the herd, which complicate the opportunity for them to answer trustworthy.

Table 5.2: Discovered annual cases of health problem at the CMCs

	Absolute numbers of annual cases (treated and untreated)						
	Mastitis	**Injured udder**	**Digestion problem**	**Leg/Hoof problem**	**Worms**	**Lice, Fleas**	**Ticks**
Mean Value	130	35	25	5	9	0	0
Min	6	0	0	0	0	0	0
Max	1000	250	100	20	30	0	0
Median	40	8	20	4	7	0	0

If using the median value of 40 annual discovered cases of mastitis and dividing it with 55, which is the median value of total cows at the CMCs, the mastitis incidence[4] frequency is estimated to 72 percent among the dairy herds at the CMCs (table 5.3). Using the mean value the same, frequency appears to be 213 percent, which would imply that each cow suffers mastitis 2.13 times per year. In Sweden the incidence frequency of mastitis is 70 percent (kunskapsbonden.se 2005-11-16). The value used for the estimation of the incidence frequency at the CMCs rest on the secretaries' estimation of treated and untreated cases of mastitis. There is an ambiguity whether these cases are clinical or sub clinical mastitis. The incidence frequencies for the other common health problem are also being viewed in table 5.3.

Table 5.3: Incidence frequency of different health problem among dairy herd linked to the CMCs. From forms in advance answers from secretaries.

	Mastitis	**Injured udder**	**Digestion problem**	**Leg/Hoof problem**	**Worms**	**Lice, Fleas, Ticks**
Incidence frequency (using median value)	0.72	0.13	0.33	0.07	0.11	0
Incidence frequency (using mean value)	2.13	0.57	0.41	0.08	0.15	0

Investment costs for building an appropriate shed and/or to rebuild the society building to provide room for a bulk cooler are costs that are allocated to the cooperative. Depending on the condition of the original society buildings and its environment the costs differ, with a range from 20 000 to 170 000 INR. On average around 70 000 INR is spent (table 5.4). The investment costs of the DeLaval equipment, including bulk cooler, bucket milking system and vacuum pump are financed by KOMUL. The costs viewed in the table below come from the forms answered in advanced by the secretaries. The reason for

[4] Incidence definition: the number of animals who have got a specific disease during a definite time period, (usually a year) in a certain population. (kunskapsbonden.se 2005-11-16).

the wide range in the estimation of investment cost of equipment is partly due to that the CMC secretaries are not involved with these costs at all, because the equipment is financed by KOMUL. This therefore to a certain extent explains the quite fictional costs shown in table 5.4. Furthermore, some respondents must have misunderstood the question considering annual costs for salaries. The intension of the question was to receive the total annual cost for salaries for all employees including the secretary. The minimum annual value of 1200 INR does fit well to a monthly salary for a secretary or staff member. The maximum value is probably the most veracious value. Costs for power, fuel and detergent do also vary considerably, perhaps due to misunderstanding or lack of knowledge.

An easy to grasp calculation of the production costs of milk at the centre reveal that the costs stand for approximately five percent of the production value – which is a reasonably share. However, the ambiguity in the answers from the forms in advance makes the result uncertain and a deeper investigation has to be made concerning operating costs to receive more reliable values.

Table 5.4: Investment and operating costs for CMC expressed in INR

	Investment costs		Costs that recur regularly (annual costs)					
	(A) Invest. building	(B) Invest. equipment (KOMUL)	(C) Salaries	(D) Power	(E) Fuel	(F) Detergent	(G) Add. operation costs	(H) Service fees
Mean Value	68 462	152 083	18 015	17 115	80 324	3 066	3 454	1 000
Min	20 000	125 000	1 200	2 400	11 000	0	0	1 000
Max	170 000	200 000	54 000	36 000	120 000	6 000	12 000	1 000
Median	70 000	150 000	15 600	18 000	86 400	3 550	2 400	1 000

5.1.2 Observations through checklist

The purpose of the checklist is to provide a routine to follow during observations of the CMC's. The aim of the observations is primarily to be able to get an overview of the every day activities and routines at the centre, see how members and staff divide duties among each other and to judge how well the building is suited for milking activities. Observation and completion of the checklist took approximately the first hour of each CMC visit. Nine different parameters are part of the checklist and the checklist also includes information in terms of routines, teat conditions and cell count from three individual farmers, which were interviewed. The checklist also includes the cell count from the milk tank (appendix 3).

The nine parameters in the checklist are following; *location, space, arrangement and design, efficiency, pre-milking routines, milking, post-milking routines, milk measuring and control and cleaning of equipment* (table 5.5).

Table 5.5: Description of checklist parameters

Location	Where in the village is the CMC located, centrally or in the corner of the village? Does the location affect the milking activity, close by neighbours or farmers in any particular good or bad way?
Space	Is there sufficient space for the milking activity? How well is the cow traffic functioning?
Arrangement & design	How clearly are the duties and responsibilities divided between staff and members? How well is the entire system working – from farmers and cows entering the centre until they exit? Are there any special routines making the arrangement better or worse off for cows and farmers?
Efficiency	How efficient is the staff doing their tasks?
Pre-milking routines	On average, how are the pre-milking routines fulfilled at the centre, in terms of washing and drying the udder, stimulation and pre milking?
Milking	Are the milking machines set in the right position and is the vacuum pressure level right?
Post-milking routines	On average, how are post-milking routines completed, in terms of teat dips and cluster dipping? (Cluster dipping could also be seen as a pre-milking routine).
Milk measuring & control	How well does the measuring- and control system work? Is a system with common cans use, do people have to queue, how is the hygiene of the equipment?
Cleaning of equipment	What do the cleaning routines look like? What is done on daily, weekly and monthly basis? How well is the equipment; buckets, tank, liners etc cleaned? What kind of detergent is used and how regularly?

A scale of three was used for the checklist, poor (1), average (2) and good (3). The scale was used regarding the nine parameters as well as for the parameters used for individual farmers, in terms of routines, teat conditions and cell counts. Routines included all actions taken by the farmer at the centre; teat conditions were controlled and assessed by the interpreter and cell counts measured by the DCC. According the cell counts, following scale was used;

(1) Mastitis	≥	*500 000 cells/ml*
(2) Suspect		*200000-500000 cells/ml*
(3) Safe milk	≤	*200 000 cells/ml*

It is difficult to achieve a totally objective assessment with this type of a scale – but a fair estimation has been conducted as far as possible.

Results from the checklist give a first indication of the condition of each of the centres but also give an idea about the outline of the 12 centres as a whole. All the average values of the checklist parameters, which were measured, are displayed in table 5.6. All of them show a number between one and three; apart from the two columns giving the exact somatic cell count (SCC). The first two columns show results at CMC level followed by five columns displaying results from the three individual farmers, which were interviewed at each centre. In the last column a mean value is viewed which is an average of the CMC checklist and the farmer checklist together.

Table 5.6: Checklist results

	CMC-level		Farm-level					Total
CMC	Average Checklist (1-3)	Average Cell count in tank (´000 cell /ml)	Average Routines (1-3)	Average Teats (1-3)	Average Cell count (1-3)	Average Cell count Exactly (´000 cell /ml)	Average Checklist (1-3)	Average Total Checklist (1-3)
4	2.44	797	3	2.67	2.67	117	2.78	2.61
5	2.44	**363**	2	2.33	2.33	281	2.22	2.33
6	2.22	792	2	2.33	2.33	323	2.22	2.22
7	**2.78**	830	3	3	3	58	**3**	**2.89**
8	2.33	679	1.33	2.67	3	86	2.33	2.33
9	*1.89*	648	1	2	1	1082	1.33	*1.61*
10	2.11	1043	1.33	1.33	1	1457	*1.22*	1.67
11	2.22	733	2	2	1.5	*1999*	1.83	2.03
12	2.11	618	1.67	2.33	3	**56**	2.33	2.22
13	2.56	596	2	2	1.67	646	1.89	2.22
14	*1.89*	781	1	2.33	2	352	1.78	1.83
15	**2.78**	*1074*	2.33	2	1.67	1447	2	2.39
Mean value	**2.31**	**746**	**1.89**	**2.25**	**2.10**	**659**	**2.08**	**2.20**

The first column, average checklist at CMC level, is an index of all checklist parameters mentioned above. The average stretched from 1.89 for the two lowest up to 2.78 for the two CMCs receiving best results. Best checklist results are received at CMC 7 and 15 and the poorest result is estimated at CMC 14.

The second column considers somatic cell count in the milk tank. Two to three milk samples were taken from the milk tank at each centre and SCC was controlled through DCC. The lowest SCC in tank was 363 000 cells/ml at CMC 5 and the highest 1074 000 cells/ml at CMC 15. On average the SCC in bulk cooler was 746 000 cells/ml. Worth to mention in this context is that milk in the sampling tanks originates from both machine- and hand milked cows – and the test results can therefore not directly be translated as a result of milk quality among cows connected to the CMC. The average SCC in tanks at farm level in Sweden is 175 000 cells/ml (kunskapsbonden.se 2005-11-16). Furthermore, Swedish farmers delivering milk to Arlafoods receive four percent price deduction of milk if cell counts in tank exceeds 400 000 cells/ml and ten percent price deduction if it exceeds 500 000 cells/ml (Arlafoods.se, 2005-11-16).

When it comes to routines, teat conditions and cell counts on individual cows connected to the centre, substantial differences can be observed between the centres. A few centres obtain good values in all three aspects while a few centres receive very unfavourable values. CMC 4 and 7 achieve good values while centres 9 and 10 have considerable lower values. Notice that the values represented an average of only three farmers at each centre. The individual cell counts reach from 56 000 cells/ml at CMC 12 up to 1999 000 cells/ml at CMC 11 – obviously there is a wide spectrum in milk quality in terms of cell count.

In figure 5.2 all cell count measurement both from tank and individual cows can be viewed (appendix 4). Mean value in tank is just about 800 000 cells/ml and the

different values are relatively concentrated around that value. Furthermore, mean value for the individual cow samples at each centre taken from three dairy cows, differ much more, from below 100 000 cells/ml up to more than 1 400 000 cells/ml. At seven of the twelve centres, individual farmers would pass international standards including cell counts below 400 000 cells/ml. The mean value by individual cows is below the tank value. This may indicate that cell counts among cows that are milked by machine are lower than from hand-milked cows, because milk is mixed in the tank.

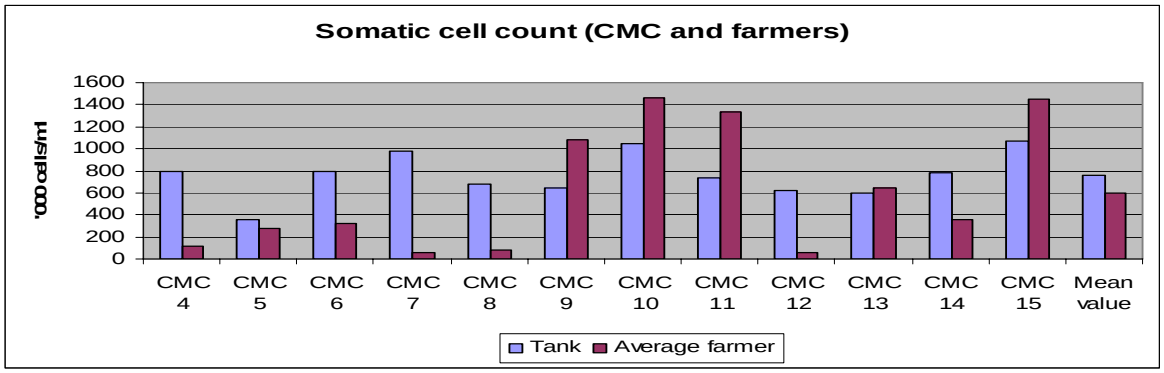


Figure 5.2: Cell counts from tank samples and individual cows

By utilizing the 34 individual cell counts measured by the DCC, the mastitis prevalence[5] frequency can be estimated in the CMC herds. The cell count values have been classified into three groups (see page 38), (1) below 200 000, (2) between 200-500 000 and (3) above 500 000 cells/ml (figure 5.3). The prevalence of mastitis is 49 percent, if counting all samples above 200 000 cells/ml as cases of mastitis. If counting only the group of dairy cows with cell counts above 500 000 cells/ ml the prevalence frequency falls to 40 percent. In Sweden the estimated average of infectious mastitis prevalence is 35 percent (kunskapsbonden.se 2005-11-16). The prevalence value is estimated through a sophisticated calculation method taking into account; the age, stage in lactation, the breed and number of lactations of each individual cow. The method is based on L. Brolunds research results. (Ekman, 2006-01-19).

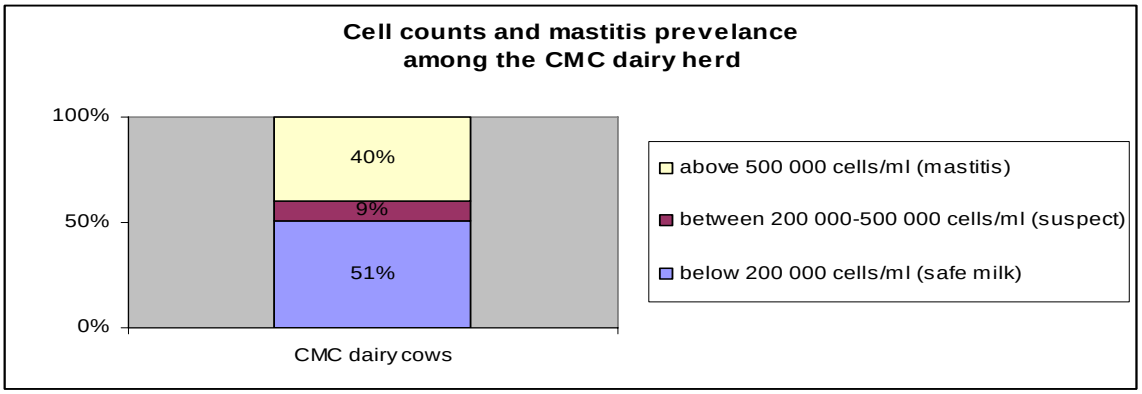


Figure 5.3: Cell counts for individual dairy cows at the CMCs and estimated prevalence frequencies.

[5] Prevelance definition: percentage or numbers of cases of a disease in a certain place at a certain time (kunskapsbonden.se 2005-11-16).

A Chi-2 test is conducted on the two variables; routines enacted by milk producers and the somatic cell count on their cows (appendix 5). The null hypothesis, which states that there is no relation between the two, cannot be rejected. Hence data from observing the farmers milking routines cannot affirm a correlation between good routines and low cell counts (table 5.7).

Table 5.7: Farmers' routines and somatic cell count in cells/ml

	Cell counts (cells/ml)			
	≥ 500 000	200 000-500 000	≤ 200 000	All
Poor Routine	7	1	3	11
Average Routine	6	1	8	15
Good Routine	1	1	6	8
All	14	3	17	34
Result	DF=4	$\chi^2 = 4{,}368$		
Critical level (5%)		$\chi^2 = 9{,}488$		

The last column, counting the results at CMC level and the individual results from farmer together, makes CMC 7 to a winner, attaining the best values at both CMC and farm level. Furthermore, the centre has among the lowest individual cell counts but a relatively high somatic cell count in tank. In the bottom of the same category, average total checklist, CMC 9 is found, closely followed by CMC 10. When ranking the five best centres at CMC level and the five best centres at individual farm level it is found that three out of five centres enter on both lists. Conducting the same procedure for the five worst centres at CMC and individual level, four centres are in common. Despite there is no statistically significance or difference in the relation between CMC routines and routines among farmers by the chi-2 test, the ranking indicates that it might be a connection between the two, although not revealed by the statistical test.

A closer examination of the CMC part of the checklist, some interesting information can be found. Out of the nine parameters, space and cow traffic received the highest average point with 2.67, while activities such as milking, post-milking and cleaning of equipment all obtained the lowest average with an average of 2.00 (photographs below). A mean value of 2.00 may be interpreted as an activity, which is working at an acceptable level and in some way sufficient. However, the quality of the activity could be further improved. The overall picture reveals that space, location, efficiency by staff and milk measurement and control obtain higher average points than the daily activities directly connected to the milking routines. An interpretation of following findings could be that more effort should be directed towards improving the latter group of activities rather than the former.


Examples of good and poor cleaning of milking equipment at two different community-milking centres. Photograph: Annegret Henriksson

5.1.3 Results from the microbiological analysis

During three mornings in July, milk samples were collected from all 15 CMCs and taken to the dairy in Kolar. The microbiological analysis of the milk shows both milk composition (fat and SNF) and quality hygiene parameters (MBRT, SPC and CC) (appendix 6). Fat content range from 3.90 up to 4.20 percent, which is similar to Swedish numbers (Andersson, 05-12-30), also the SNF measure indicates quite stable numbers around 8.50, which also are comparable to Swedish standards. The MBRT test shows a mean value of 4.8 hours. The SPC quality parameter ranges from 100 000 Cfu/ml up to 2000 000 Cfu/ml. In Sweden, milk which exceeds 50 000 Cfu/ml is subject to price reduction and most SPC measures fall below 30 000 Cfu/ml (Andersson, 05-12-30). There are three main reasons for high SPC in milk, (1) insufficient chilling (2) use of unclean milking equipment and (3) mastitis cases (Andersson, 05-12-30).

5.2 Milk Producers

5.2.1 Descriptive data of dairy farmers

The intention was to interview three farmers at each CMC. Three milk producers' times twelve centres makes 36 interviews with farmers. Three interviews were incomplete and had to be sorted out. The following findings from farmers rest on in total 33 interviews made at twelve different CMCs. A questionnaire guideline was prepared in advanced (appendix 7).

Personal information

The age of the respondents ranges from 17 up to 60 years, with a mean and median value of 35. Almost half of the sampled group were women, 47 percent and remaining 53 percent were men. Nine persons out of the 34 were unmarried and in the unmarried group everyone except for one individual was younger than 25.

Household composition

Questions concerning household composition show that the total number of people living in the household ranges from two persons up to 18, with an average of approximately six members per household. Two generations live together in the majority of the households, but it is not uncommon with three generation under the same roof. Two exceptions were

found, one living only with the same generation and one living in a household of four generations. The mean value of number of children in the household was 2.2, but up to 5 children was found in some families.

Educational background and work experience

Six out of ten respondents have attended school more than six years and 15 percent have studied at a pre university or university. Around 30 percent have not been to school at all or only attained school less than three years (figure 5.4). The illiteracy rate is just about 50 percent among the respondents. A majority in the survey has a long experience of animal husbandry and dairy cows. One third has had cattle for more than 20 years and only one tenth has had cows for less than 5 years.

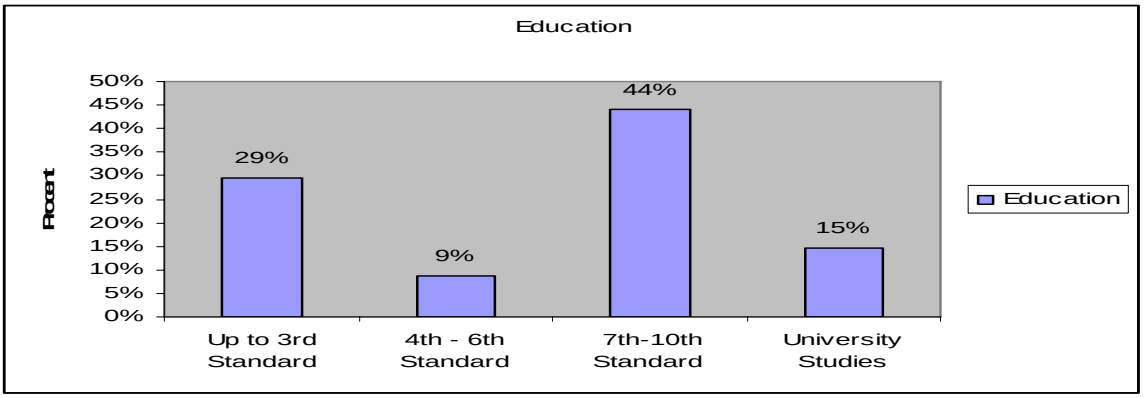


Figure 5.4: Level of education among interviewed milk producers

Farm composition

One quarter of the farmers do exclusively cultivate land for crop and forage production for self-consumption purpose aside of the dairy production – which implies this group is totally dependent on income from milk sales. Further, almost one third of the respondents carries out farming and/or operates a business connected to silk culture. This could involve everything from growing mulberry, producing and selling/renting out equipment for silk production or concentrating on the last stages of the silk production, when the silk worm produces the cocoon. Few mention animals as a specific farm activity. Twelve percent devote themselves to off-farm activities (figure 5.5).

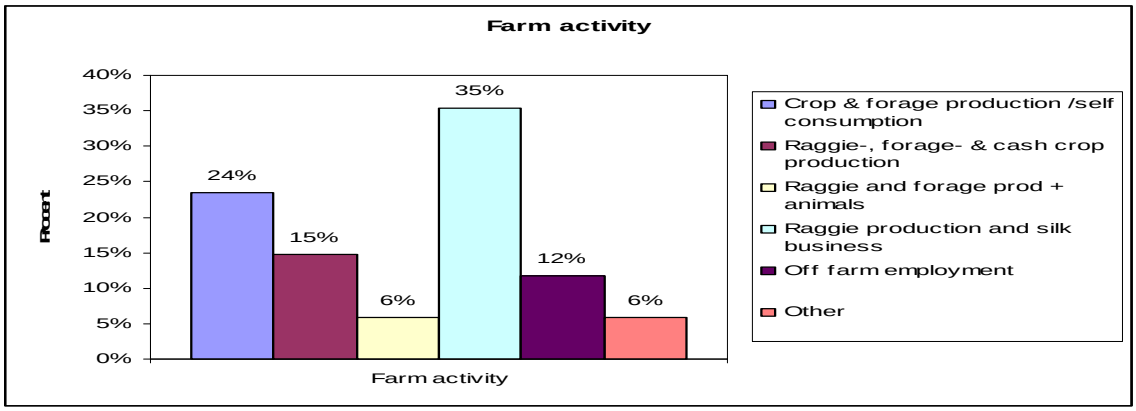


Figure 5.5: Kind of farm activity among interviewed milk producers

Almost 40 percent of the farmers cultivate one to three acres of land, one third of the farmers' own only one acre or less. Only one tenth own and farm more than 10 acres (figure 5.6). Land and cattle are exclusively family owned. Farmers do still hold relatively small herd sizes, one quarter of the respondents own and manage one single cow, 50 percent manage two cows. It is rare to own a herd size larger than three animals (figure 5.7). The daily time spent on activities associated with dairy production is most commonly seven to nine hours. Chi-2 test shows no significant relation between size of herd and time spent on dairy activities.

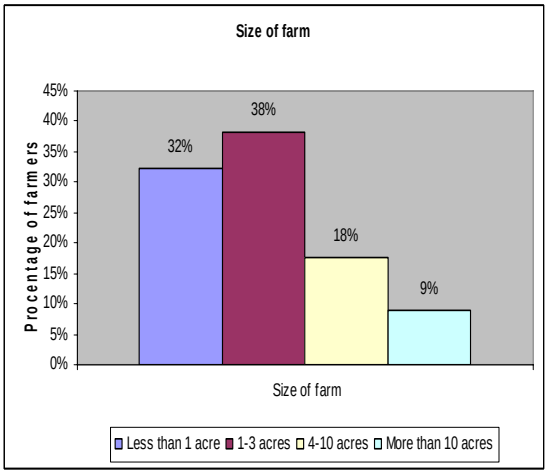


Figure 5.6: Size of farm

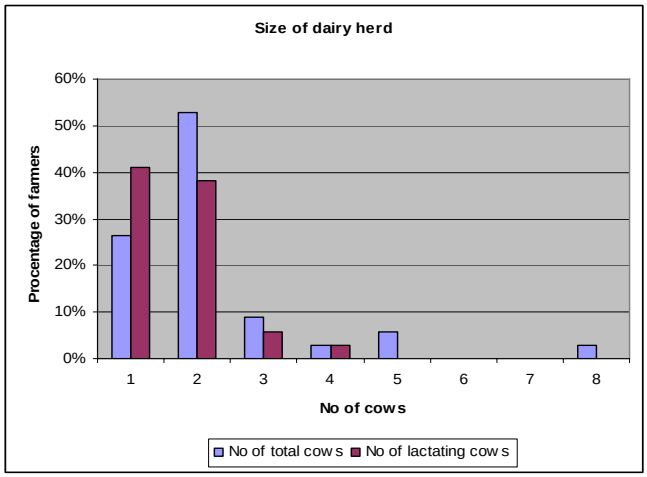


Figure 5.7: Size of dairy herd

Household income and milk production

Sixty percent mention the dairy business to be the main source of income and fifty percent state that the income share from dairy production exceeds fifty percent of total income. The remaining forty percent of the respondents state the milk production is the second most important income source. Beside milk production, it is primarily silk culture/business and off-farm employment, which contributes to the families' livelihood (figure 5.8).

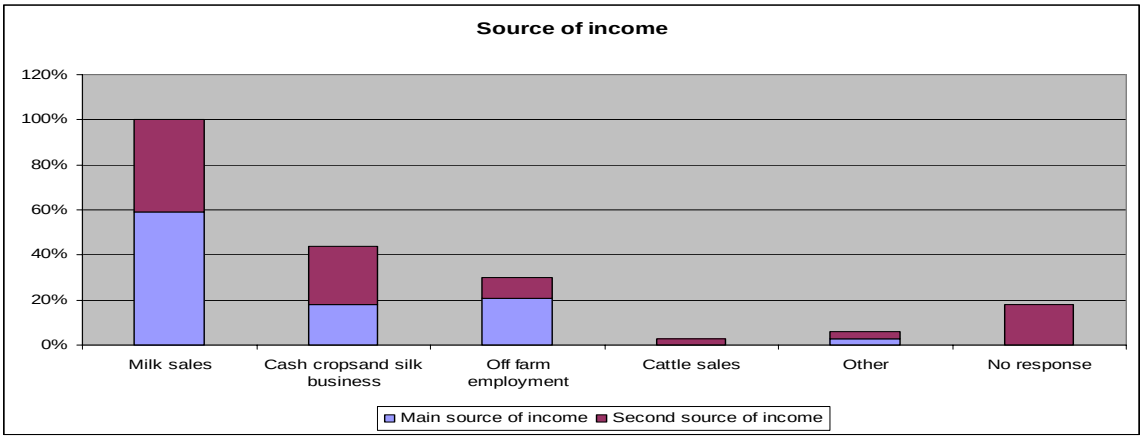


Figure 5.8: Stated activities, which contribute to the main source of income and the second most important source of income among the interviewed farmers.

Total monthly household income ranges from 800 INR up to 15 000 INR. Five out of ten households have an income less than 3000 INR/month, two of ten have an income below 1500 INR (figure 5.9) When dividing 3000 INR, the average total household income with average household size it is revealed that a large share of the dairy farmers and their families live below the poverty line[6].

Concerning the economic change due to the CMC implementation, 56 percent of the farmers perceive the new system has increased their household income. Furthermore, six percent mentioned a safer income since joining the CMC while one third of the respondents have not noticed any economic change at all. Around ten percent did not answer the question. In almost ninety percent of the cases (88 percent), the man acts as the head of the family and carries responsibility for distributing household income.

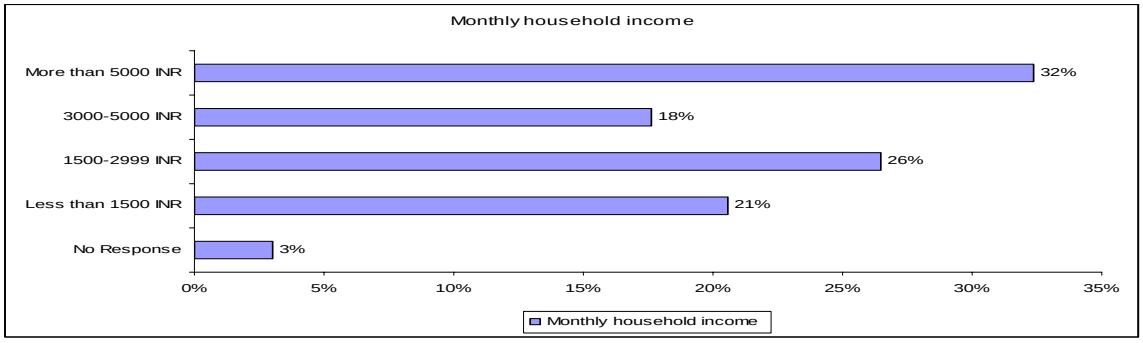


Figure 5.9: Different income brackets among farmers

Milk production per cow and day is on average ten litres, but the daily milk yield varies from a minimum of two litres a day up to 35 litres per day and cow (table 5.10). This result illustrates the wide variation in milk yield among farmers, which indirect also leads to a great difference in income from milk. There is obviously a higher genetic potential among many of the cows linked to the CMCs. This potential is not totally utilized at present, which could be linked to several reasons related to feeding, animal health and general herd management.

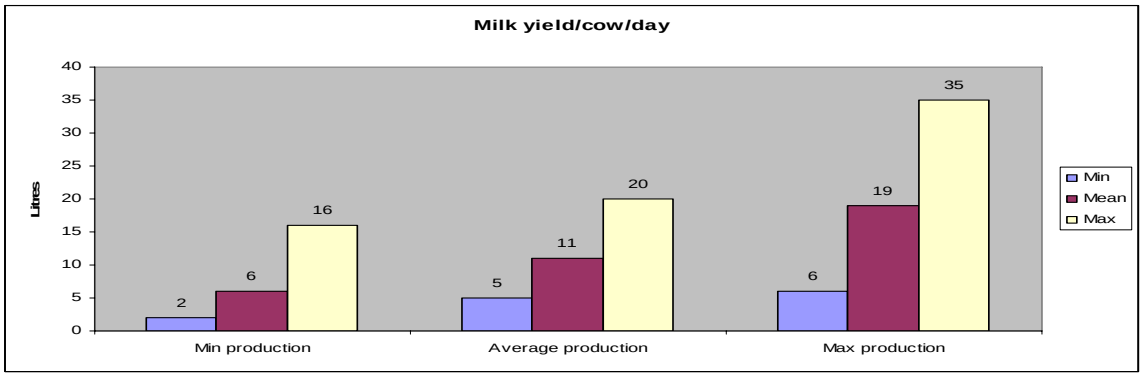


Figure 5.10: The figure estimates minimum, mean and maximum milk yield among CMC connected dairy cows during the entire lactation period – which implies a period of minimum, average and maximum production.

[6] The poverty line is set to be *a dollar a day* according to UN definition

One quarter of the respondents have noticed an increase in milk production since introduction of CMC but more than sixty percent believe there is no change in total production. However, no milk producer has experienced a decrease in production.

In order to examine possible explanations to the observed variation in milk yield among farmers, milk production/day/cow was analysed in relation to other variables. The relationship was tested by the Chi-2 tests. In several of the examined relations the null hypothesis could be rejected at what signifies the five percent level of statistical significance and consequently, a significant relation between the variables was found. These relations include i.e. milk yield and level of education. The higher the educational level of the farmer the higher milk yield (table 5.8).

Table 5.8: Relation between milk yield and education

	Level of education				
Milk yield/day /cow (l)	Up to 3rd standard	4th-6th standard	7th-10th standard	University studies	All
< 10	3	3	4	1	11
10-15	6	0	10	1	17
> 15	2	0	1	3	6
All	11	3	15	5	34
Result	DF=6	$\chi^2 = 14{,}634$			
Critical level (5%)		$\chi^2 = 12{,}592$			

A chi-2 test also revealed that a statistically significant relation between milk yield and size of farm was found. The chi-2 result of 15.855 is higher than the critical value of 12.592 and consequently the null hypothesis is rejected (table 5.9). None of the smallest farms, owning less then one acre of land was observed in the group of the highest milk yield i.e. more than 15 litres/day. Concurrently, the table shows that middle large farms with area of land between 7-10 acres appear to generate a higher yield/cow/day.

Table 5.9: Relation between milk yield and size of farm

	Tillable area of land				
Milk yield/ day/cow (l)	< 1 acre	1-3 acres	4-10 acres	> 10 acres	All
< 10	6	3	1	1	11
10-15	6	9	1	1	17
> 15	0	1	4	1	6
All	12	13	6	3	34
Result	DF=6	$\chi^2 = 15{,}855$			
Critical level (5%)		$\chi^2 = 12{,}592$			

Another significant relation was found between milk yield/day/cow and total income. This is not at all an unexpected relation because higher milk production logically generates a higher income (table 5.10). Milk producers in the lowest income bracket typically have low yields. With a slightly higher total income, a larger share of the

farmers is found in the middle yield bracket. Most farmers within the high yield group also belong to the highest income bracket.

Table 5.10: Relation between milk yield and total income

	Total income of household				
Milk yield/ day/cow (l)	< 1500 INR	1500-2999 INR	3000-5000 INR	> 5000 INR	All
< 10	5	3	0	3	11
10-15	1	6	5	4	16
> 15	0	1	1	4	6
All	6	10	6	11	33
Result	DF= 6	χ^2 = 13,484			
Critical level (5%)		χ^2 = 12,592			

The last relation found to be statistical significant is the milk yield and the quantity of concentrate fed to the dairy cow. Not surprisingly, low yields appear to be related to a low concentrate feed ration (table 5.11). Out of the cows milking more then 15 litres/day, none received less than 5 kilos concentrate per day. Depending on composition in the energy content concentrates will vary substantially, which implies that five kilos of concentrate at one farm may not necessary, be comparable to five kilos of concentrate at another farm.

Table 5.11: Relation between milk yield and quantity of concentrate feed ratio

	Concentrate feed ratio in kg/day			
Milk yield/day/cow	3-4 kg/day	5-7 kg/day	8-10 kg/day	All
< 10	7	2	2	11
10-15	2	14	0	16
> 15	0	2	4	6
All	9	18	6	33
Result	DF= 4	χ^2 = 25,264		
Critical level (5%)		χ^2 = 9,488		

In addition to statistically significant relationship between milk yield and education level, size of farm, total income and quantity of concentrate several other cross tabulations concerning milk yield did not reveal any evidence of a statistical relationship. These variables include age of farmer, income share from milk, type of concentrate and either type or quantity of forage.

The pattern of milk consumption at the household level has not changed at all since the CMC was implemented and unfortunately remained quite low. On average the consumption amounted to one litre/household, i.e. ~ 170 ml/person/day. According to the white challenge booklet the per capita consumption of milk in rural areas is estimated to 121 ml per day. (Waslekar and Futehally, 1999).

Half of the respondents, 56 percent, perceive that their economic situation has been improved since the CMC was implemented. One third does not perceive any change.

Only on quarter of the respondents mentioned an increase in milk production, which suggested that there are other positive elements associated with the CMC concept generating a higher income. Possible reasons will be discussed later. If an increase in income is experienced, the perceived change ranges between 50 INR to 1000 INR/month and most commonly around 250 INR. An income increase is mainly used for improving housing. Other prioritised areas are children's education and investment in additional dairy cows. All MPCS apply an every second week payment system, which is adequate and well liked among producers.

Relation to and impact of CMC

Almost everybody did join the concept of CMC as soon as it was introduced to the society – only two out of 34 interviewed persons did not. A majority of the farmers found out about the opportunity to join through the milk society and the main reason for joining seems to be associated with human effort. Very few mentioned economic incentives to be the main reason for giving up hand milking in exchange for milking machines.

The most important service provided through the cooperative, apart from marketing their milk, is the accessibility of feed. Veterinary services and AI are other services to be ranked highly. The MPCS's have an agreement with KOMUL, which provides the cooperatives with veterinary services. A coupon system is used and each coupon costs 30 INR. One coupon is valid for one veterinary consultation. Regarding services currently provided, a satisfaction scale of five, where five corresponds to total satisfaction, shows that 53 percent of the respondents are more than happy (4) and 44 percent are happy (3).

The question concerning to what extent expectations have been meet, reveals a similar pattern. A majority mentions that expectations have been almost totally fulfilled. Regarding services, which could be developed further, the answer, is first and foremost the veterinary services followed by issues concerning feed. Many farmers believe that the price for ready mix is too high compared to what they receive for the milk. In addition, a few farmers complain about poor feed quality.

In terms of veterinary services, farmers demand quicker service and do also ask for more frequent routine checks and visits by the veterinarian. Loan facilitates, more efficient operation and more clusters are other demand issues or services wanted.

The most frequently mentioned change due to the implementation of machine milking is undoubtedly the decrease in human effort, followed by the issue of fairer payment and improved milk quality (figure 5.11). Many respondents do also bring up issues like; "everybody can milk*",* less spoilage and less stress. These changes are accumulated to a group named *other*.

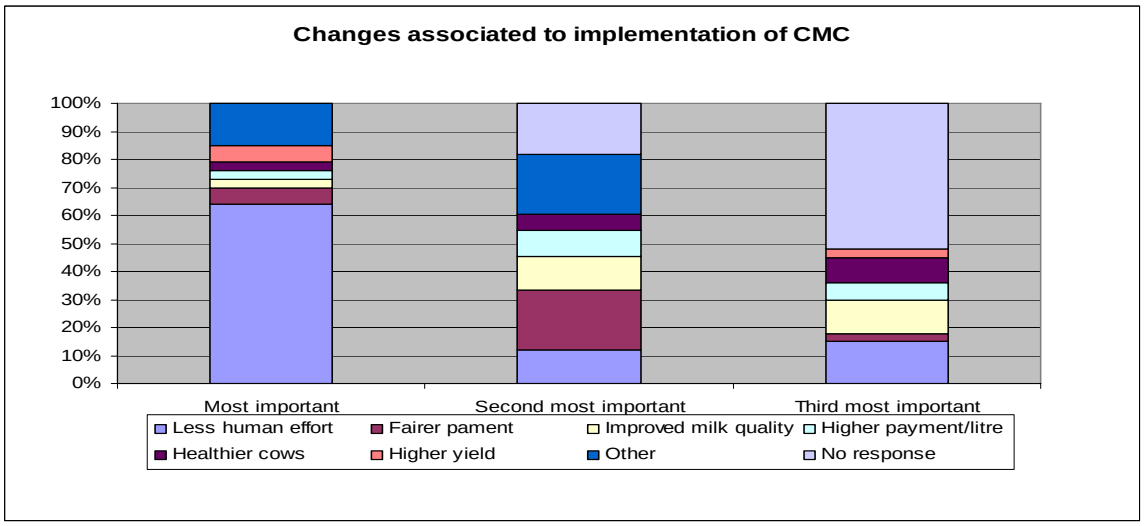


Figure 5.11: Farmers views of the impacts of the CMC implementation

The CMC concept also seems to generate, not only positive change on individual and household level, but on the society level as well. Eighty-five percent have experienced a change in the society to the better. Comments include a wide range of issues, i.e. increase in standard of living, less harassment and corruption problem associated with milk measuring and control, general increase in flexibility and freedom - especially for women, less stress when milking and a wider time span for collecting the milk, larger herd sizes. In addition, the fact that new technology has been implemented in the village enhances the self-esteem.

Only one tenth has in an organized manner participated in training at the centre, commonly including basic training in how to use the clusters. Everyone states, they would like to take part in a training programme if it is offered for free and 60 percent are still interested if they have to pay for the training.

No difficulties or obstacles seem to emerge concerning the contract signed between members and cooperative, which is based on the Indian National Cooperative Development Corporation Act. Farmers can at all time choose withdraw from the agreement. The committee has the authority to exclude members from the society but until today it has not yet happened among the sampled group. The farmers tend to be total in agreement with the contents of the contract. Most societies have a rule, which says that not more than two members in each household can become members of the cooperative. In 64 percent of the cases the man in the household holds the membership and in 15 percent of the cases the woman in the household the membership. In 20 percent of the cases both husband and wife are members of the society.

Feeding, breeding and health status of dairy cattle

The feed ration given to the dairy cows consist of roughage and concentrate. Concerning roughage, most farmers combine green fodder i.e. *Para grass*[7] with dry roughage mainly consisting of residues from crop production, i.e. raggie[8] or mulberry leaves (figure 5.12).

7 Para grass (Brachiaria mutica) is a straggling tropical perennial grass and is valuable for both pasturage and hay.

8 Raggie is the main crop for human consumption grown in this area of India.

Due to seasonal climatic differences in rainfall, the supply of green fodder varies. On average a lactating cow is fed around 40 kilos of roughage mix a day, with a variation between 20 and 100 kilos. Most cows have free access to roughage.

Regarding feed concentrate, 55 percent feed their dairy cows a concentrate combination of groundnut cake and wheat bran only. Around 40 percent combine groundnut cake and wheat bran with ready mix. No one of the farmers use only ready mix as concentrate. In addition, very few farmers purchase and give mineral mixture to their dairy cows on regular basis. On average the daily amount of concentrate a cow receives is six kilos, with a range from three to ten kilos. As mentioned in a prior section, there is a statistically significant correlation between quantity of concentrate and milk yield.

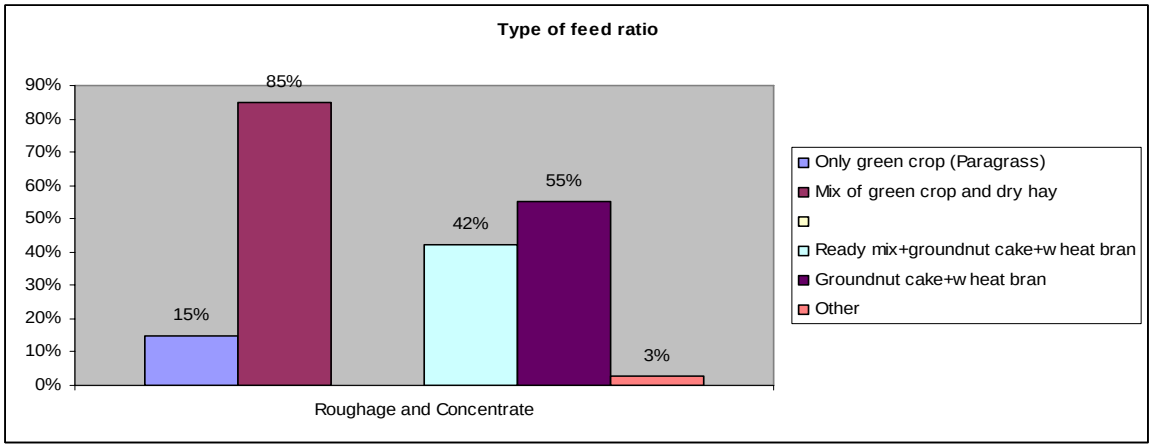


Figure 5.12: Type of roughage and concentrate given to dairy cows

Holstein breeds or cross breeds of Holstein are the most common breeds, with a share of 70 percent. Remaining part is mainly cross breeds of Jersey. Ages of cows range up to ten years. Most cows have had two calves and mortality rate among calves, i.e. calves that have died during its first year is estimated to nine percent, four cases out of 44 calf births. Most common cause of calf death is due to digestion problems as a result of incorrect feeding. Calving problems are quite common. Three quarters of the respondents mention some kind of problem i.e. milk fever, general weakness and/or complications associated with removing of the placenta.

According to the survey, the age at first calving falls below two and a half year for most heifers, namely 70 percent. One quarter of the respondents assess said first calving time to between two and a half year and four years. Not a single respondent allows the calf to suckle the cow due to difficulties associated with weaning. Almost 90 percent of the farmers milk their cows longer than eight months, 40 percent more than ten months. Simultaneously 91 percent respond that their cows become pregnant again within three to six months.

Mastitis is ranked as the most serious health problem, according to the milk producers. About 36 percent of the farmers rank it as the number one, closely followed by milk fever (33 percent). Diarrhoea, general stomach disturbances and the serious foot and mouth disease were mentioned as well. The question regarding the cost for the farmer, last time he/she treated a cow for mastitis, received very divergent answers. The result, which is not very surprising, depends on how serious the individual case is. Respondents have spent from 30 INR up to 7000 INR for a single case.

Improved animal health due to CMC has been experienced by 55 percent of the farmers (figure 5.13). A quarter of the farmers believe that there is no change and one-tenth express fear for a worse health status among dairy cows due to the centre. The last group is first and foremost worried about risk for spreading mastitis through the milking clusters.

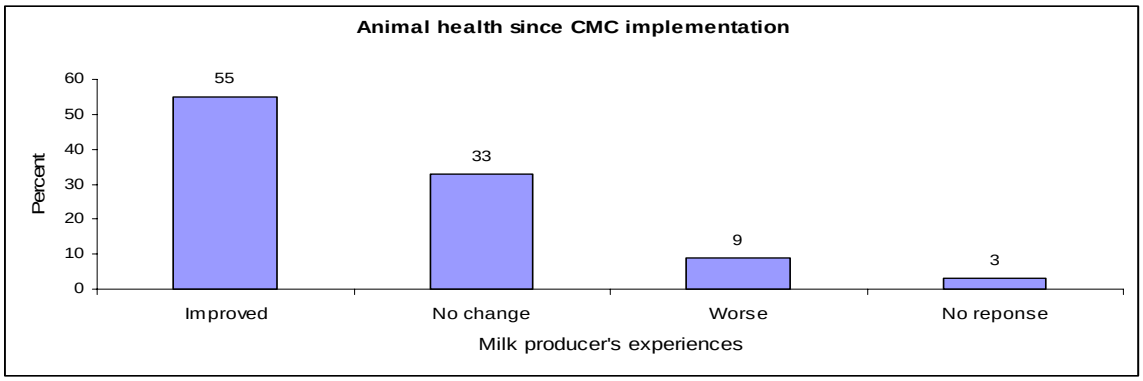


Figure 5.13: Experienced animal health changes since the CMC implementation

Future

Finally, some comments on the future outlook of these farmers. Nine out of ten would like to see their herd size to increase in the future and equally many believe they could achieve higher milk yields in the future first and foremost through improved feeding practices. All farmers except for two see themselves continue to deliver milk to the same society in a future span of 2-5 years. General, future farm developments plans include, aside from an increase in the dairy herd, increases in crop production. Only one out of ten mention other development opportunities for improved livelihood for the future, i.e. off-farm activity or other business activities.

5.3 Findings from Participatory Activities

The participatory activities included a total of 77 people in four villages. Out of the participants, 32 were women and 45 were men. Three group discussions were held with women and four with men. Each activity lasted for two to three hours. Most groups worked well together and had no problem in cooperating with each other or/and with the research team. The intention was to create an as heterogeneous group as possible in terms of age, income level, status etc – but it is difficult for a foreign researcher to be certain about total achievement in this point. People belonging to different casts had at one or two occasion's problems to work together. The mentioned behaviour was most commonly experienced in the groups of women.

5.3.1 Impact and changes for farmers due to CMC

All statements, opinions, improvements, issues and changes that emerged and were written down during the participatory activities, were documented by digital camera. Totally 210 quotations from men and women were expressed, concerning life before and after implementation of CMC.

The quotations were divided and classified into fourteen different categories. The categories are following; *less human effort, increased flexibility and freedom, fairer payment and increase in trust, improved milk quality, improved animal health, society development and enhanced self esteem, everyone can milk, improved dairy knowledge and higher commitment, demand for higher milk price, increase in herd size, higher incomes, increase in milk production, less spoilage and eventually, time saving* (appendix 8).

Less human effort was the most common mentioned issue associated with the implementation of CMC (figure 5.14). One fifth of the quotations touched that specific area. Secondly, a fair payment and enhanced trust in society staff and other members are important improvements. Latter impacts can both be classified as social impacts. Better milk quality, improvements in animal health and a more convenient work situation, which result in enhanced flexibility and freedom, are other issues frequently pointed out. Few of the participants mentioned economic change as a result of the CMC operation and even fewer stated an increase in milk production as an important outcome.

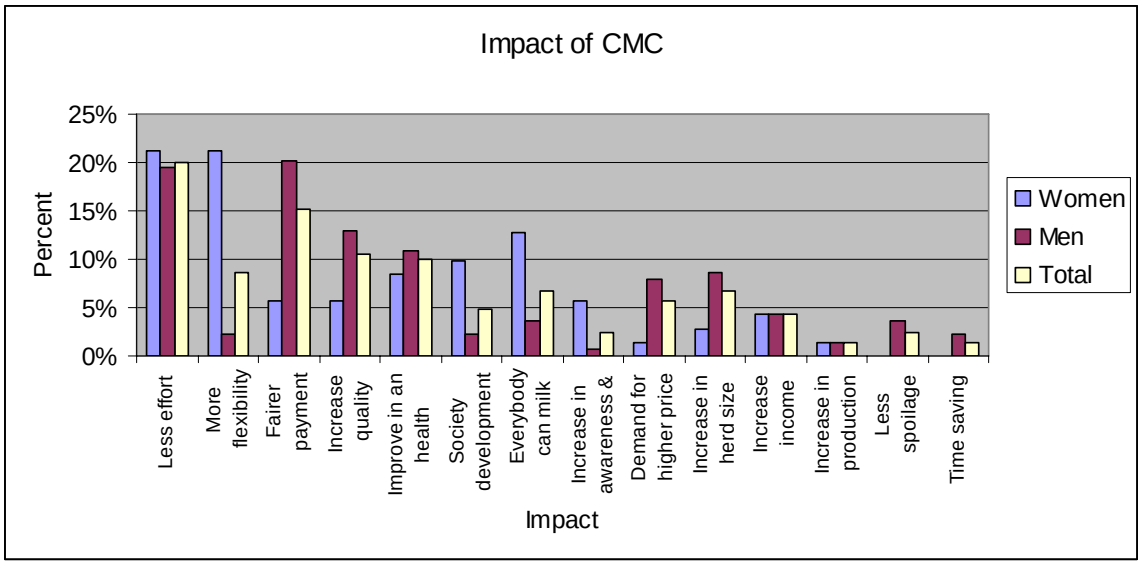


Figure 5.14: Empirical findings from participatory activities showing the experienced impact of CMCs.

5.3.2 Gender differences

The result from the group discussions reveals gender divergence (figure 7), at least in most of the categories. The issue of less work and human effort is one exception, where the results show that it is almost of equal importance to both men and women. Women rank the issue concerning time flexibility and increase in freedom to be the most important change. Prior to CMC, women were often the one holding the skill of hand milking in the household and therefore became solely responsible for milking. Milking routines morning and evening limited women's possibilities to be away from the village a longer time. With the implementation of CMC, both men and children to a greater extent can do the milking. The issue of flexibility is correlated to the issue whether everyone can milk, which also was mentioned more by women than by men. For men the issue of a fair payment and increase in trust play a crucial role in the change due to CMC.

5.3.3 Farmers links to principle-agent model

In the theory chapter, several hypotheses were formulated considering the link between theory and reality. The hypotheses were linked to the four main problems included in the principal-agent model. In the following section the problems linked to the milk producers according to results from interviews as well as from the participatory activities are discussed, and the hypotheses confirmed or rejected.

A. Horizon problem

- *There is a time horizon divergence among society members due to differences in age, size of farm and level of dependence on dairy income.*

As a result of the statistical analysis chi-2 tests, no significant relations were found between variables linked to the future and time horizon perspectives and socioeconomic variables such as sex, age and size of farm. The results imply that there is no divergence in time horizon among society members that more so indicate rather a homogenous member union. The analysis of collected data does not render support for the stated hypothesis. The concept of CMC does not appear to face particular problems associated with the horizon problem.

B. Portfolio problem

- *The combination of a relatively concentrated activity portfolio of the CMC and a homogenous member union, which is geographically concentrated, decreases the possibility of a serious portfolio problem.*

The milk societies in the study display a fairly homogenous picture of the member unions. Time perspectives, level of satisfaction, attitudes towards services provided and necessary improvements for further development of the CMC concept do not differ particularly in terms of differences in income, farm activity and size of farm. These results strengthen the overall picture that farmers linked to the CMC are a relatively homogenous group. In a homogenous group, the probability of emergence of a portfolio problem decreases.

D. Control Problem

- *Implementation of the Community Milking Centre decreases the control problem mainly due to the enhanced transparency the concept brings to the milk collection system.*
- *Risks of fraudulent conduct among milk producer's decreases through the CMC system and the control costs for the dairy processing firms are reduced.*

Out of the four main problems associated with the principal-agent relation, the problem regarding control shows to be particularly remedied by the CMC concept. Transparency in milking procedures becomes automatically a matter of fact when the milking activities take place at the centre. Secretaries and farmers gain additional insights into hygiene routines and animal health conditions of each individual cow. When the milk is collected directly at the centre, quality control such as measurements of lactose and density of the milk become unnecessary. The serious problem of adulteration of milk facing India would have great chances to be almost eliminated through this kind of collection system.

In figure 5.11 and 5.14 issues as fairer payment and improved milk quality reveal links to a reduction in the control problem. Farmers' do experience that the CMC system reduces the risks of poor milk quality and the problem of unfair payment.

5.4 Secretaries

5.4.1 Descriptive data of secretaries

Data from CMC managers were collected through interviews with secretaries at 12 CMCs. The interviews had a semi-structured character with prepared questions but opened up for discussion about issues not directly mentioned in the questionnaire (appendix 9).

Personal information and work experience

All secretaries were men, and the age ranges from 30 up to 53 years, with an average of 42. All but one are married, i.e. 83 percent. All the respondents have grown up with dairy cows and almost everyone does still manage a dairy herd. The secretaries, have all had their positions for more than five years and eight out of ten had been managing the centre for more than ten years. Aside from education, more than half of the respondents have a history of farming or still run farm enterprise. Two of those asked had previous work experience from office management.

Education and training

In terms of education, all those asked have been to school at least up to 7th standard, 17 percent have been ten years in school. 42 percent have been studying pre university studies and equally many have studied at university level. Regarding the question if they have taken any training for managing the new technology, which is introduced with the community milking, everyone gives an affirmative answer. The training or exercise usually involved technical maintenance of the DeLaval equipment and were taught by DeLaval staff. As equipment and bulk cooler were installed by DeLaval, the servicemen simultaneously taught the society staff how to handle and maintain the machines and the tank. DeLaval staff stayed *"until the CMC staff could run it by themselves"*, which could be any time from two days to two weeks, but mostly common around four days. Many secretaries also have participated in courses concerning animal health. Six out of ten said they have been organizing training or/and courses for farmers at the CMC. It has been i.e. about basic use of the clusters and/or about clean milk production and animal health. One secretary took his society members to another village, which had already implemented CMC to show how it worked, before they introduced it. Due to the secretary, this was a much-appreciated visit.

Salaries and reward system

The society committee in each village sets the salaries to secretaries and society staff. The dairy has a recommendation for salaries in which the level of salary follows with the quantity of milk production. Running a big CMC should imply a higher salary than running a small one. However, many of the secretary's comment on that their society does not follow the recommendations given. Salaries range from 1000 INR up to 3000

INR, with a mean value around 1900 INR. In addition to the salary paid from the society, KOMUL pays a monthly payment to all centres holding bulk milk cooler (BMC). The fix amount is 1000, 1350 or 1500 INR depending on the size of tank and can be independently distributed among the employees at the CMC. In addition, the secretary has a fixed monthly salary, which depends on milk quantity. The salary is most often renegotiated with the committee each year. All respondents react positively to the issue of implementing a reward system linked to milk quality. Everybody believes such a system would increase incentives for working towards improved hygiene and routines. Individuals would put more effort into their duties, according to those asked. Several managers express dissatisfaction with the fact that their work and responsibilities are not linked to an appropriate salary.

Routines at the CMC

During the interview the secretary was asked to explain the procedures at the centre, in terms of milking routines. Everybody mention the routine of washing the udder and teats dip with use of Dipal[9]. A majority also mentioned cluster dipping as a regular practice, but two did not. A purple coloured potassium permanganate solution ($KMnO_4$) is used as a cluster disinfectant. Four out of twelve people mention drying the udder and further, two persons out of twelve mentions pre milking to be a daily routine. Three centres use common buckets held by the centre or supplementary DeLaval buckets instead of using individual vessels. The staff could this way more easily control the hygiene. The routine of common buckets eliminate the risk that the milk come in contact with individual farmer's vessels when transporting the milk from the bucket at the milking unit to the measuring point and finally to the milk tank at the CMC. Instead are buckets owned by the CMC used by all farmers.

Next question considers the share of men, women and children that enter the centre for milking. The majority seems to be men, with a share of 47 percent, followed by women, 33 percent and children 16 percent. However, a wide variation is observed among the centres; men's share varies from 20 to 75 percent and women's from 20 to 60, and children's from 0 to 45 percent. The interviews reveal that at three centres the share of women exceeds the share of men and at three centres the share of children exceeds the share of women.

Finance and milk prices paid

Monthly revenue varies a lot among the centres first and foremost due to size of society. CMC revenues range from 9000 to 30 000 INR a month. More milk produced and delivered from the CMC implies an increase in the unallocated capital. The milk payment to farmers is based on fat content only in the case of machine milking milk. With hand-milked milk, also density is measured and influences the payment. The standard fat content of 3.5 percent gives the farmer a price of 8.40 INR/litre. (Every 0.3 percent fat content deviation up or down implies a change in price by 0.3 INR.) The payments to the society from KOMUL depend on both fat content and solid none fat level (SNF). The prices vary from 8.56 up to 8.66 INR/litre.

[9] Dipal solution belongs to the family of post dips. Iodine, chlorhexidine and alcohol-based dips address a broad spectrum of mastitis-causing organisms (DeLaval.com, 05-12-30).

Membership agreement

To become a member of an MPCS all societies make use of an application form. Subsequently to the completion of an application, the society committee takes the final decision whether the person is accepted as a member or not. The requirements to become a member differ slightly between centres. However, several common requirements are found. The applicant has to be a member of the village and be an active milk producer i.e. own at least one dairy cow. More than half of the centres further require the candidate to deliver milk for a certain period of time (25, 90 or 180 days) before he/she is qualified to apply for a membership. Most centres also have a rule, which limits the number of membership holdings per household; most commonly there is a maximum of two persons. Further, some of the centres apply society specific requirements, i.e. a minimum age of 18, no illegal records, not allowed to be a government employee and stable mental and physical health. The cost of membership consists of two parts; membership fee and the cost of the shares. Membership fees vary from 1 to 10 INR and the price of shares range from 10 to 100 INR. All secretaries experience that the present agreement works well. Only one secretary speaks out about hazards and problems associated with members that simultaneously deliver milk to a private dealer. In one society there is a discussion about altering the contract and increase the price of the shares. Otherwise, there are no plans of changing the present agreement/contract in the milk societies. As mentioned earlier, members may withdraw membership and the committees have the authority to exclude members.

Half of the secretaries express content with KOMUL. The dairy processing plant provides the guidelines for the society and acquires the milk produced by farmers.

Services at CMC

According to the interviews with the secretaries, services provided at the CMCs are the following; veterinary services and AI are those two services provided at all centres. At all centres but one (different ones) society members are able to purchase feed and seed. Two thirds of the societies have telephone facilities for public use. Half of the CMCs have a micro finance scheme, which could be linked differently to the centre. The centre may both be responsible for the complete procedure and solely handle the contact with the bank or the centre just acts as a provider of collateral for society members who would like to receive a loan. Another service provided apart from the already mentioned is the human health care scheme, which is accessible approximately at half of the centres (figure 5.15).

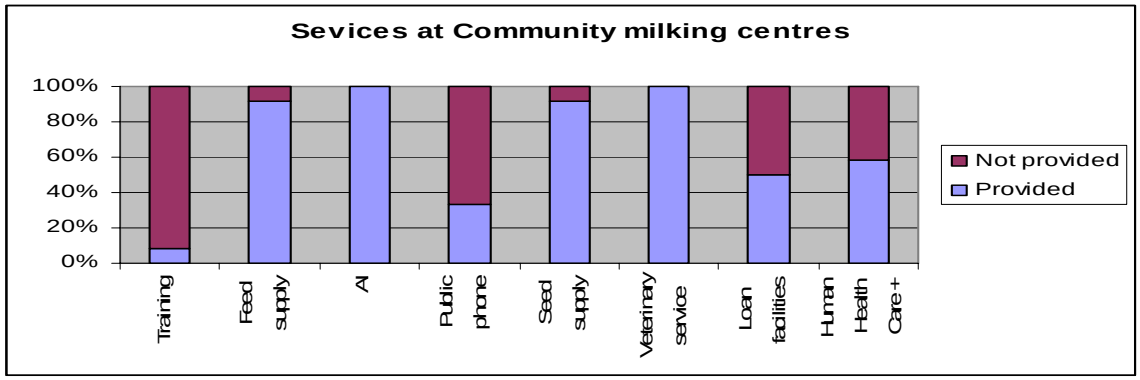


Figure 5.15: Services provided or not provided at visited CMCs

Additional services that the secretaries would like to be introduced or developed further, include several issues. The most wanted service is training to farmers; five of those asked expressed the need for better knowledge and more training to farmers. Many also mention the need for mote timely veterinary services and feed of good quality at a fair price. Two secretaries mention loan facilities, where one especially mentioned the need for the poorest farmer.

In terms of those services secretaries believe are associated with success for the CMC concept, three main issues appear, (1) education to society staff and training to farmers, (2) fair payments from KOMUL for the quality milk farmers deliver and (3) loan facilities to society members. Most commonly issues discussed among farmers and desired is a higher milk price. Milk prices have been falling the last year but feed expenses remain unchanged, which leave farmers worse off. Two respondents mention the need for veterinary service to be improved. All secretaries but one, experience that the demand for training exceeds the current supply.

The respondents ranked the three most important changes for society members due to the implementation of CMC. The most important change seems to be the improvement in workload and working conditions, which includes enhanced flexibility and freedom and less human effort. Following work conditions, the respondent group mentioned issues including increase in trust, fairer payment, less harassment, less spoilage, a higher price per litre milk and both higher commitment and awareness among milk producers. Improved milk quality is also highly ranked. No one mentioned improved animal health to be on the top three changes.

DeLaval equipment and spare parts

In the questionnaire to the secretaries several questions concerned issues associated with the DeLaval equipment and spare parts. Eleven out of twelve secretaries did answer these specific questions.

In general the secretaries were satisfied and happy regarding the function and quality of the DeLaval equipment. Nine out of eleven secretaries state good quality of the equipment. Furthermore, two secretaries express problems to come in contact with the DeLaval service team while another mentions the opposite and states good service. One secretary pointed to the high cost of DeLaval spare parts.

Regarding maintenances of DeLaval equipment, seven out of eleven secretaries confirm that the equipment is cleaned properly after each milking session and the cooling tank is cleaned once a day. Only a few of them make clear they use detergents and hot water when cleaning the equipment. Furthermore, five of those interviewed mention that some routines like checking the oil level, filters and lose connections are done every two weeks or on a monthly basis. Three secretaries have very little knowledge about the cleaning routines and say the staff members are responsible and trained to do the daily routines.

Concerning spare parts and hygiene articles like detergents, brushes, Dipal and $KMnO_{4\ are}$ in stock; only one centre had a full range of the items, including teat cups, brushes, short and long pulsation tubes and hygiene articles. Most centres have some stock, but usually they have spares or hygiene articles and/or brushes (figure 5.16). Brushes in stock are found at three centres. Seven centres out of eleven had no stock of detergents needed on daily basis at all. Furthermore, four centres had teat dips in terms of

Dipal and six centres had disinfectants, $KMnO_4$ in stock. Stock in some kind of spare parts was found at four CMCs.

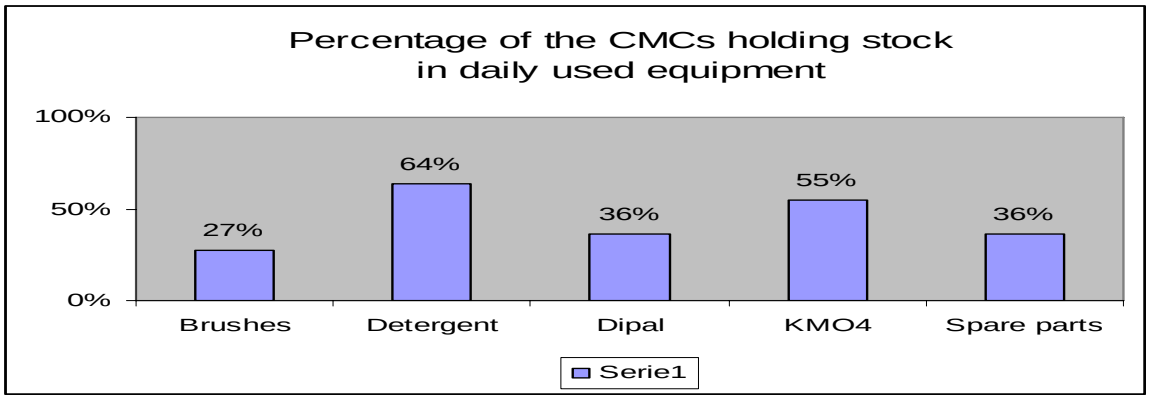


Figure 5.16: Share of the CMCs that holds stock in different products used at the centre daily

When spare parts and hygiene articles are required at the CMC, the most common procedure to acquire the items follows several steps. Most secretaries first have to get the requirement signed and confirmed by the society president before contacting KOMUL. The secretaries have to make a personal visit to KOMUL in Kolar in order to get the requirement list signed and confirmed by KOMUL before receiving the spare parts and hygiene articles from the dairy. If stock is available at KOMUL the spares are delivered directly, although many secretaries express common delays on spares and detergents.

A question regarding the financial responsibility for the costs of spares and hygiene articles was asked. Six out of eleven secretaries explained that the costs are shared equally between KOMUL and the society. Furthermore, three secretaries answer that the costs are entirely totally borne by the society. Two of those interviewed did not know. According to the general manager at KOMUL, costs of spares and brushes are equally shared by society and KOMUL, Dipal solution and $KMnO_4$ are for free and costs of detergent has to be totally borne by the society.

Half of the secretaries interviewed, expressed a desire for a simplification of the procedures regarding spares and hygiene articles needed at the centre. Furthermore, an improved stock at KOMUL is needed. Two secretaries would like to receive more frequent feedback and participation from KOMUL and desire regular visits from KOMUL. Two secretaries state enhanced decision-making authority for secretaries to be an important issue to improve the daily operation at the CMC.

Health problem and costs of mastitis treatment

A majority of the secretaries declare mastitis to be the most serious disease among the dairy herds; seven out of twelve states it as number one. Fever and milk fever are other common health problems that require assistance. Coughing and stomach disturbances can usually be treated at the centre without involvement of veterinarians. Cost of mastitis treatment can vary significantly, due to at what time and stage it gets noticed Secretaries answer everything from 30 INR up to 2000 INR.

Future for CMC

All respondents but one believes in a continuous, gradual development of the CMC concept both at village level and in Kolar district as a whole. It means introduction of new centres as well as capacity improvements in the already existing centres. One quarter of the secretaries mentions that an increase in herd size is an expected outcome of the development. One person regards the success of the concept to depend highly on KOMUL and their possibility to find new markets for the milk. One manager is sceptical to further development, as long as the expenses for CMC equipment remain high. Another secretary expresses the development as somewhat amazing for the rural milk producers and several points out the expansion of new technology as necessary and desirable when even more farmers become dependent on income from milk production.

Training and a fair price for milk with a higher quality – these two issues/improvements are the most important for a successful future for the CMC, according to the respondents. Three persons believe it is crucial to continuously improve milk quality, furthermore, one manager perceives communication and good relationships between member, staff and KOMUL as a key issue for future success.

5.4.2 Secretaries links to principle-agent model

The hypotheses linked to the secretaries' role in the CMC concept include two of the four principal-agent problems regard. Firstly, the decision making problem secondly the control problem.

C. Decision making problem

- *Unclear routines and rules of distributing responsibilities between the secretaries and the society committees cause misunderstandings, confusion and frustration in the daily operation of CMC and may contribute to conflicts.*

The questionnaire did not particular include questions regarding the specific problems associated with decision making authority, but during some of the interviews the issues emerged anyway. Two secretaries expressed difficulties linked to an unclear decision making system, which leaves the secretary with a limited power to act in the daily operation. A limited power of acting could be harmful in terms of maintaining hygiene and routine levels high. A complete operating responsibility by the secretary is desirable in order to reduce the decision-making problem at the CMC.

D. Control problem

- *Implementation of the Community Milking Centre decreases the control problem mainly due to the enhanced transparency the concept introduces in the milk collection system.*
- *Control problems could decrease further by implementation of a quality reward system for CMC staff creating incentives for operating good routines and maintain high hygiene level.*

With the implementation of CMC, secretaries have noticed a reduction in the need for control and a decrease in the problem of distrust and harassment linked to measuring and controlling milk. The secretaries may directly view the milking activity by farmers and the task of measuring is computerized. Fewer activities may be left out for imagination and ideas, which otherwise usually may be a subject for doubts and harassments.

To sum up, the CMC concept contributes to a more transparent collection system and decreases the numbers of necessary actions the secretary linked to control. All secretaries in the study have a positive attitude towards the implementation of a quality system including rewards. By introducing a quality payment system linked to the performance of CMC staff and the secretary; maintenance, education and control and routines at the centre, would be further improved.

5.5 KOMUL

5.5.1 Description of KOMUL

Kolar District Cooperative Milk Producers Union is registered under the Cooperative Societies Act since 1987. The area of operation is restricted to Kolar district only, including 2889 villages divided into 11 smaller areas called Taluks. The Kolar district union have at the end of May 2005, 1580 MPCS registered out of which 1486 are in function, including 90 exclusive women dairy cooperative societies. In total, 286 232 members are enrolled and associated to KOMUL out of which approximately 100 000 are small-scale farmers. 100 000 are marginal farmers and 50 000 are landless labourers, with a remaining part labelled "others". Women account around 24 percent of the memberships. The dairy does not collect any milk from private farms but exclusively from milk producer society cooperatives.

The dairy procured an average of 668000 kg milk/day during the month of May 2005, which is close to the maximum volume ever procured since the introduction of the union. Of the total milk procurement, more than 60 percent of the total volume was marketed as bulk sales of which half is delivered to the mother dairy plant in Bangalore. Around 16 percent of the retail sales are contained in polythene packets, five percent as UHT milk sales and the remainder part is sent away for conversion.

KOMUL operates 105 milk routes in total, out of which 17 are BMC milk routes. The total procurement per milk society and day is 444 kg. According to data from the KOMUL progress report, the amount paid per litre by KOMUL to the milk societies is 8.58 INR. The amount paid from the societies to producers is 8.40 INR/litre.

The total number of 286 232 members associated to KOMUL, is divided into 1580 societies where the average society size is around 180 members. Connecting households are probably less than 180 per village, because more than one family member per household can sign up for membership. Milk production is according to the data mentioned above estimated to 2.33 litre/day/member (668 000/286 232), which really points to the special structure and character of milk production in rural India.

The first bulk milk coolers were introduced in Kolar district in 2001 and today 91 coolers are in operation. The 91 coolers cover around 300 villages, because milk is transported from surrounding villages to the BMC. Milking machines were introduced to the area a year later, in 2002. In May 2005 the total number of units reached 94. Due to KOMUL statistics, the volume of milk procured subject to BMC routes is 162 000 litre i.e. around 25 percent of the total volume at KOMUL. The data indicates that 25 percent of the total milk quantity associated with KOMUL in the Kolar district is chilled prior to the arrival of the milk tanker.

According to data, seven times as many AIs are conducted than the number of calves born during the time period 2004-2005. That implies that only thirteen percent of

the inseminations are successful at the first time. In Sweden 1.7 inseminations are on average made for each calf born (Gustavsson, 2006-01-16).

KOMUL has an ongoing society staff training programmes including secretaries, milk testers, AI programme and president. The number of programmes has varied over the last five years but all are still in operation. In the year of 2002 a programme labelled clean milk production, CMP was introduced to the district. The programme aims to obtain a holistic view of clean milk production including all stakeholders in the milk production chain. The first step includes training for the managing director and procurement dairy staff. Second step includes field officers, secretaries and some of the society members that participate in the programme. The programme concerns how to ensure and improve clean milk production from farm level all the way to consumer. It intends to increase commitment and awareness among the concerned parties. Today nearly 70 percent of the societies are covered by the CMP programme.

Procurement transportation costs for KOMUL have been stable around 0,22-0,24 INR per kg over the last five years. No remarkable change ha occurred since introduction of BMCs. Total amount paid from KOMUL to producers was 2.22 billion INR in 2004-2005. The turnover during the same period amounted to 2,7 billion INR. KOMUL has had net profit that ranging from 2 million INR to 5, 5 million INR during the years of 2000-2004 but in 2004-2005 they suffered a net loss of around 3 million INR.

5.5.2 View from dairy employees

Data from dairy employees was collected through three semi-structured interviews. The three interviews included the general P&I (procurement and input) manager, the deputy manager, (quality control manager) and a route doctor; (a veterinary employed by KOMUL) (appendix 10 a-b-c).

The general manager at KOMUL has the responsibility for the overall supervision of the cooperative and organises and supervises the managing officers who work in the field. The general manager has a university degree in veterinary science and has previously worked for Karnataka Milk Federation, KMF in Bangalore. Since a year back he is employed by KOMUL. The deputy manager has a degree in dairy technology and works as quality control manager and has been working within the company for thirteen years. As a quality control manager he has the responsibility for all milk quality testing linked to the dairy, from producer to consumer. Raw milk is tested by different quality parameters throughout the procurement process. Quality tests are even done at the retail level. The interviewed veterinarian, works as assisting veterinary manager and has almost 20 years experience from working in the field. His is responsible for Kolar Taluk, the area around Kolar, which includes approximately 250 villages.

Production and quality

Flush season occurs from October to February and the lean season is between the months of March to August. Previously, the differences in procurement between flush and lean season could be as much as 25 percent. Today the difference is only five percent.

At the dairy processing level, milk quality is tested through different parameters. The smell and taste are checked as well as a visual examination. Furthermore, random samples are taken daily from individual farmers, BMCs and milk tanks and the samples are checked for fat content, SNF and adulteration; (such as sugar, salt, water, foreign

particles etc). In the event that a significant poor quality is noticed, the case has followed up at least a week to ensure that the quality is improved, although this does not always happening in practice. In addition, general quality tests such as SNF, fat and total bacteria count (TBC) are done for each bulk volume prior to processing.

At the dairy level, the respondents regard the quality testing as sufficient. Every 15 days all BMCs receive feedback from KOMUL in terms of quality parameters, the results should be displayed to the farmers to enable increased awareness and inspire towards incentives for further improvements in quality. The quality manager is also in favour of introducing a quality payment scheme. The issues pertaining to quality are crucial for all three interviewees. Both the P&I manager and the quality control manager confirm that the milk quality has been significantly improved due to the BMC implementation and milking machine units. However, obstacles and challenges still remain to further improve quality. Due to the structure of milk production in Kolar district (which is general for whole India), with many thousands producers geographically spread out, small herd sizes and low yields; it is difficult to reach out with appropriate and necessary educational and training programs, according to the respondents. The CMP scheme, which was introduced in 2002, has been KOMUL's attempt to improve milk production awareness among members. However, according to one of those interviewed, poor coordination and almost no directions from persons in charge currently characterize the programme. Therefore, the scheme is unfortunately not working and developing in the way it has the capacity to do.

Impact of CMC implementation

The implementation of BMCs and milking machines represent changes and advantages for both dairy and milk producers, according to all respondents. KOMUL receives milk of significantly better quality, especially in terms of lower level of bacteria count. Milk from normal collection routes, not including BMCs, normally have a TBC higher than 4 000 000 bacteria per ml, compared to TBC levels between 200 000 and 1500 000 per ml for milk collected during BMC routes. The dairy plant believes TBC to fall below 800 000 for BMC milk in the near future. Milk that solely originated from machines has showed TBC levels less than 200 000 bacteria per ml. In addition to the achievement at lowering TBC, BMCs also facilitate milk collection and lead to fewer and more efficient milk routes and milking machines. Furthermore, it increases transparency in milk collection to farmers, society staff and the dairy.

From the dairy point of view, the milk producers will through CMCs obtain; higher milk yield, better milk quality, a higher price, improvement in animal health, decrease in human effort and possibility to increase herd size. One interviewee mentions an increase in milk yield of ten percent and achievement of better milk quality follows naturally by quicker chilling. According to the general manager, the dairy also pays 0.1 INR extra per litre milk, which is milked by machines. The society’s receive the extra payment from KOMUL as a lump sum and have the responsibility to distribute it to the society members. The veterinarian also points out a significant decrease in the cases of mastitis in the societies connected to CMCs and cleaner animals in general. At some centres the mastitis frequency has been limited to 3-4 cases per month compared to previous frequencies of 3-4 cases per day. The veterinarian further states animal health awareness to be higher among milk producers at CMCs compared to MCCs. The

veterinarian especially perceive a difference in awareness in terms of feeding between the two groups, with a higher attentiveness among farmers at CMCs. Simultaneously, the veterinarian points out a general improvement in animal health awareness among the entire farm union in Kolar district during the last years.

Despite advantages and improvements following the development of CMC, the implementation and outcome is not entirely uncomplicated and the dairy has come across several problems. These problems include i.e. the general anxiety and sceptics from farmers towards implementing the new system. According to the general manager, a good way for milk producers to overcome their worries and view the advantages is to experience the new activity in reality. Visits to villages where a CMC has been introduced can be arranged for members and societies who still do not operate a CMC. Another pressing issue is related to the non-functioning CMCs. A few centres have implemented the concept but are not operating successfully. The issue, including solutions, will be discussed later on.

For the dairy processing plant, one of the greatest challenges currently facing the operation is related to the issue of finding markets for the entire volume procured, according to two of the respondents. Especially, the problem concerning almost 200 000 kg milk of higher quality which is daily procured at KOMUL. New markets and marketing channels have to be found, but also new and diversified products have to be developed.

Transition to CMC and financial issues

To be able to make the transition from a traditional MCP to a CMC, KOMUL has stated several criteria's, which the cooperative society has to fulfil. The society has to procure at least 500 litre milk/day and with a sufficient a number of crossbreed herds. Furthermore, the management of the society committee should have an interest in the concept. It is vital that the secretary and society staff attain sufficient knowledge and education to run the new operation. Literacy is a requirement. Field officers and supervisors from KOMUL, who select the societies from experience, also choose the villages.

Financially, KOMUL is responsible for a major share of the investment needed for CMC implementation. The investments include; bulk tanks, vacuum pumps, testing equipment and milking machines. Depending on the size of the tank, the total investment varies across centres. But for a 3000 litre bulk cooler including 4 milking machines, the final bill is around 1 000 000 INR, according to the general manager. The local society is responsible for the investment cost associated with the shed needed and possible supplementary building costs required to providing a space for the bulk tank. Due to the general manager, the main explanation for unsuccessful CMCs, societies where KOMUL have invested in CMC equipment but the operation is not currently in function, are financially linked. That means the society has not been able to build the shed. As a solution, KOMUL has therefore started to grant loans to facilitate for the concerned centres. A loan of up to 50 000 INR with an interest rate is now accessible. KOMUL hopes that the loan facility will decrease the problem of poor functioning centres.

Relation and agreement to CMCs and DeLaval

The MPCS including the community-milking centres, KOMUL and KMF in Bangalore are all parts of the cooperative organization structure. They are linked through the

cooperative act, which includes rules and regulations to be followed. Decisions made in the milk union in Kolar have to be followed by the milk societies. KOMUL has the authority to exclude cooperative societies who do not follow the regulations. Poor quality and/or delivering milk to private actors may result in exclusion of members and/or societies.

The relation between DeLaval and KOMUL concerning CMCs includes among other things, the negotiations of the price of equipment. The warrant period, two years and a contract including fix prices on spare parts are signed between the two parts. KOMUL holds a stock of spare parts. When spare parts are required at a CMC, the secretary has to visit KOMUL in Kolar to receive the spares. The dairy is in general satisfied with the business relationship with DeLaval and the services provided by the company. However, the general manager mentions a few desirable improvements. The delivery time of 3-6 months for brushes does sometimes result in a shortage for KOMUL and could indirectly lead to deterioration in hygiene at the centres. KOMUL also faces problem concerning dipsticks used for measuring the milk level in the cooling tank. The problem with the dipstick includes both in shortage of dipsticks at the centres and the calibration of the same. This complication may lead to considerable losses for the dairy. In addition, problems with generators occur relatively often and create serious problems because of the uncertainties in the power supply.

The society has to pay 50 percent of the cost when acquiring new spare parts including; brushes, teat cups, claws, tubes, buckets etc. Dipal solution is free of charge, according to the general manager. Previously, all spare parts were free of charge, but the scheme was exploited and resulted in an increasing stock at society level, which caused a shortage of stock at KOMUL.

Future development and challenges

All three respondents have an optimistic view and vision for the development of community milking in Kolar district and agree upon the importance of a continuing work on further implementation. However, different opinions were stated by those interviewed. The general manager would like to see a rapid development and hope the BMC centres to cover almost all societies in five years. 400 milking machines and equally many BMC centres would he like to see are implemented before 2010. At that time, procurement would have risen to 1000 000 litre/day. The deputy manager views the development in a different manner. He would rather see a slower development and first ensure that the already implemented centres are successfully operated. Furthermore, he proposes a pilot study, where all stakeholders including DeLaval, KOMUL and milk producers can learn from the experience. He also wishes and asks for a closer partnership with DeLaval on this issue.

5.5.3 KOMULS links to principal-agent model

In the second relationship, including the relation between CMCs and KOMUL, the portfolio problem and the control problem are the two main problems to be considered. The portfolio problem handles the issue of risk taking while the control problem includes among other things the matter of transparency in the system of milk collection from CMC to the dairy.

B. Portfolio problem

- *The dairy reduces risk taking through limiting investments in CMC to solely "stable" milk societies with good management.*

The general manager at KOMUL confirms this hypothesis. Representatives from KOMUL only select villages that have a sufficiently skilled staff, high interest, a commitment to the new system and a stable economy. Due selecting societies with suitable and stable conditions, KOMUL decreases the risk taking associated with the CMC investment.

D. Control problem

- *Implementation of the Community Milking Centre decreases the control problem mainly due to the enhanced transparency that the concept brings to the milk collection system.*
- *Control problems could decrease further by implementation of a reward system for CMC staff creating incentive for operating good routines and maintain high hygiene level.*

The increase in transparency linked to the new milk collection system will also benefit KOMUL and the dairy processing. Transparency increases the possibilities for insight in the milk production in a greater extent for KOMUL, which also increase the prospect of higher milk quality. By introducing a quality payment scheme including both CMC staff and individual farmers, KOMUL would probable experiences even less control problem in the early stages of the milk chain.

5.6 Experiences from Milk Collection Points

The experience from milk collection points, the milk societies working in the traditional way, includes visits to three villages. Observation of the milk collection and measuring activities at the centres were made as well as observation of the actual hand milking procedures at farm level. Interviews with farmers and secretaries were also part of the study at MCPs. Because of the limitation in the sampling group, the study of the MCPs more facilitate an understanding the researcher than contributing and prove an actual group of reference.

5.3.1 Observation at MCPs

The milking activity at farm level is characterised by several recurring routines observed. All observed farmers wash the udders of the cow before milking, although with different degrees of accuracy. Different kinds of vessels are used for milking, plastic, aluminium and steel vessels. Before the milking begins, all but one farmer use oil to make milking smoother. No one is pre milking. Spoilage of milk occurs occasionally during milking partly due to narrow vessels. The milking usually takes place just outside the house, right next to the cow shelter. There is a divergence in hygiene and cleanliness of the area where the animals are kept. A few notable incidences were observed – such as one cow stepped into the vessel during milking, after which milking just continued. No farmer is using teat dips and none of the producers has any knowledge in what it is or what it is good for.

The routines at the centre include checking the milk for lactose content and weighing the quantity of milk. Control of fat content is not done at any of the three visited centres. The milk goes into milk cans before being picked up by a small milk vehicle to be transported to the closest bulk milk cooler. The milk can be stored unchilled up to two hours at the centre excluding the time of transport. Little spoilage of milk is observed at the centre. Cell counts were measured by DCC at the MCPs. Samples were taken both from individual farmers and from the "tank". The "tank sample" is a sample of mixed milk from the cans at the centre, which has to represent the average milk quality of the MCP. In the figure below (figure: 5.17) the result is displayed, the exact values can be found in appendix 4.

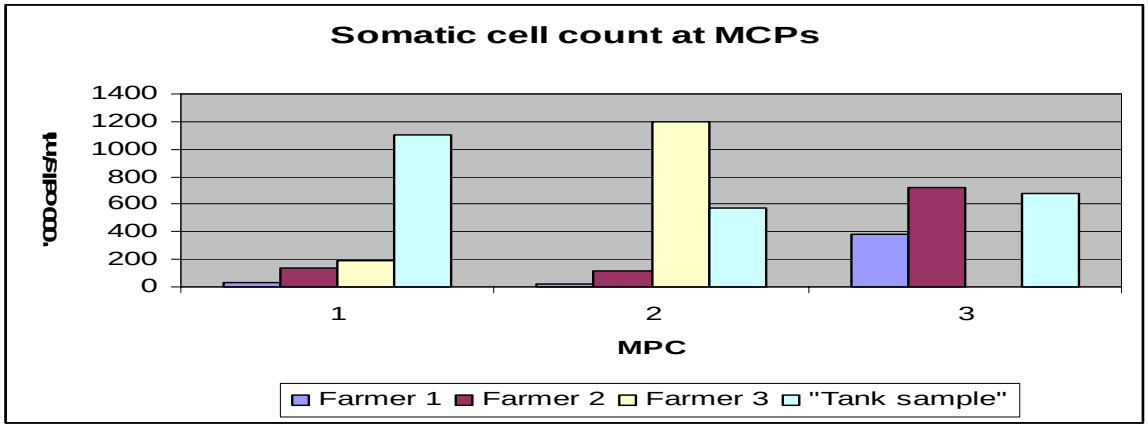


Figure 5.17: Somatic cell count at MCPs, both" tank samples" and samples from individual farmers

5.3.2 Milk producers at MCPs

A similar questionnaire was used for the MCP connected farmer as for the farmers joining the CMC, with some exceptions to suit the different specific conditions. The empirical findings are compared to the results from CMC farmers. The MCP farmers display a pattern of a fairly shorter experience of dairy husbandry and a lesser share of farmers with a higher education level. Furthermore, of those interviewed, no farmer owned more than three dairy cows, which is less than the numbers found among the CMC farmers.

Milk sales are the major source of income for this group of farmers, just like in the CMC sample group. However, a difference is noticed in terms of a lager share of the MCP connected farmers have off-farm income as a major source. The man and wife in the household equally share the responsible of delivering the milk to the centre, but women generally do the actual milking. In terms of milk yield, it seems like the average milk production per cow at the MCP, fall a few litres below those found among the CMC herd, with a mean value of nine litres in comparison to eleven. All farmers confirm that they deliver the milk to the centre directly after milking. Few of those interviewed express any specific common problems with the present system and the satisfaction level seems to be as high as at the CMCs. However, they would like to see improvements in feed supply and veterinary services.

Around 60 percent of the milk producers have heard of the CMC concept and all of them believe that if the system would be implemented in their village, it would cause

improvements in life for the farmer. Mentioned improvements supposed to be result of a CMC implementation are associated with less work and an improved standard of living.

In comparison to the CMC connected cows, the lactation period is on average longer for the MCP connected cows. All cows give milk at least 8 months. In terms of animal health, differences between CMCs and MCPs can be found especially in terms of calving problem and mastitis, viewed as the major health problem. Almost 90 percent of the MCP farmers answered affirmative on the question *"do your cows have any calving problems"* which is a ten-percentage point's increase in comparison to CMC farmers. Furthermore, a considerably larger share in the group of MCP farmers mention mastitis to be the main health problem, 57 percent compared to 36 percent among CMC farmers.

For the future, all but one believes in a change in the milking/collection system within two to five years.

5.3.3 Secretaries at MCPs

Like the secretaries at the CMCs, the managers at the MCP's have a long experience of both holding dairy cattle themselves and to managing the centre. All three secretaries are also relatively highly educated, with at least studies at the pre university level. The training and education occurrence at society level is similar to what was found at the CMCs. The payment system to secretaries works in the same manner as at the CMCs. Two out of three secretaries would like a quality payment scheme to be implemented. Routines in connection with milking at farm level should according to the secretaries include; washing the udder with clean water and hands before milking and delivering the milk immediately to the centre in a steel vessel with a covered lid. None of the secretaries mentioned anything about teat hygiene and teat dips. According to the issue of using oil, the opinion differs between the secretaries. Problems occurring in the system include both problems with low lactose levels, harassment when milk is rejected and some delays in milk transportation. The payment from society to farmers is based on milk density only.

In terms of services provided at the centre, there is no substantial difference in comparison to the CMCs. Furthermore, all three secretaries interviewed have both heard of and seen examples of CMCs. They believe that such a system would improve and facilitate life for farmers in terms of less work load, better milk quality and healthier cows. On the last question concerning the necessary future changes/improvements of milk production and collection they mention: increase in milk quality, importance of training to farmers, sufficient water facilities and higher milk price to farmers.

5.7 Summary of Empirical Findings

From the data collected throughout the field study; through observations, interviews, participatory activities, secondary data and quantitative quality methods, a number of key findings will be stated. Eight key findings will be pointed out to clarify and facilitate a general understanding of the current situation within the CMC system in Kolar district.

1. **Decrease in human effort for milk producers**

The most obvious impact of the CMC system from the farmer's point of view, up till today, is the decrease in human effort. The new system gives the farm family a better work situation. Men, women and children are nowadays able to share the responsibility

for the milking activities. Previously, the milking responsibility almost exclusively was borne by the women in the household. Hand milking demands both specific skills and hard work while machine milking simplifies the daily life in several aspects. In time required though, machine milking does not differ much in comparison to hand milking, at least not in the families holding only one or two cows.

2. Broad satisfaction level among CMC users

The interviews conducted with individual farmers and the participatory activities with the same kind of group, jointly confirm a picture of a generally very satisfied group of farmers which have to enrol in the community milking centre concept. The concept contributes not only to a decrease in human effort but also to an increase in self-esteem, partly related to the fact that new technology is implemented in their village. The sense of approval also emerges because of a more fair payment system, less spoilage, increase of freedom and flexibility and for some, also an increase in income.

3. Increase in transparency and control throughout the milk chain

The CMCs contribute to an increase in transparency in terms of both quality control and a more fair payment system. The fact that the milking activity has moved from farm level to the centre facilitates and increases the potential for enhanced control of milking routines. The risk of adulteration of milk and very poor hygiene decreases with this kind of system, which in benefit both the dairy processing plant and consumers. Furthermore, the milk producers and the milk societies gain from extended openness and transparency in terms of less harassment and increase in trust both in each other and in the CMC management.

4. Improvement in milk quality (TBC)

Through the CMCs, an almost unbroken chilling chain can be achieved for the milk – from the produce to the consumer. An unbroken chilling chain both keeps the milk fresh and prevents bacteria counts to increase. The increase in milk quality in terms of total bacteria count is until today only a benefit noticed specific by the dairy processing plant. Most farmers mentioned an increase in milk quality to be one impact of the system. However, it does not affect them substantially because they do not yet receive higher price for milk, which fulfils a higher quality standard. According to the quality manager at KOMUL, TBC for the bulk milk centres may fall below 800 000 per ml in the near future, in comparison to milk from MCP which attain TBC levels around 4 000 000 per ml. Milk which is exclusively collected from machine milked cows fall below 200 000 bacteria per ml.

5. Producers economy and animal health not yet significantly improved

While human effort has decreased because of CMC and other encouraging social impacts due to the CMC concept, the economic situation and animal health improvements have not yet been substantial. Around 50 percent of those interviewed have experienced an increase in income but one third of the respondents do not experience any change at all. Neither, on the question regarding the changes associated with the CMC implementation, nor during the participatory activities, have economic aspects attained top ranking.

Animal health has improved according to the interviewed veterinarian, first and foremost in terms of a decrease in observed cases of mastitis. Among milk producers, 55 percent experience an improvement in animal health. One quarter has not experienced any change and ten percent fear a deterioration of the animal health due to the CMC system.

6. A gap between the need for and the supply of management and training

Technical advice and professional herd management training for farmers linked to the CMCs are practically non-existent at the present. All stakeholders in the study point out education and training related to dairy management as an important and vital aspect of further development within the CMC concept. All milk producers are willing to attain training if it would be offered at the centre. Farmers possess a lack of sufficient knowledge regarding proper feed management, preventive animal health and the importance of appropriate milking routines. The links between good herd management, healthier herds, and increase in yield, enhanced milk quality and higher income have to be strengthened.

7. Lack of incentives for farmers and secretaries

Presently, there is a lack of strong incentives in the system, both for milk producers and secretaries at the CMC, to strive for improvements in hygiene, routines and milk quality. All secretaries are positive towards the development of a reward system linked to milk quality parameters. Presently, a price incentive of 0.1 INR/litre is to be given to farmers who use the milking machines, but the milk price is currently not related to any other milk quality factor than fat content.

8. A potential to contribution to rural development

The increase in transparency, which results in less harassment, fairer payment and enhanced trust in the relationship between milk society management and members, represents a vital contribution to rural development. Furthermore, the participatory methods revealed an increase in freedom and flexibility among users in the new system, which is also an element to notice in terms of rural development. The concept has a potential to include capacity building in terms of providing training of dairy farmers. Trough education an improvement in feeding, animal health and business management may be attained, which in the long run will contribute to a higher milk yield, an increase in income and an improved standard of living.

6 Analysis

This chapter aims to address the research questions stated in chapter one, utilizing the theoretical framework and the empirical findings. The first section states noticeable impacts, both benefits and obstacles, for the respective groups of stakeholders found though the empirical data. Furthermore, links to the principal-agent model are analyzed and last in the chapter the result are discussed in relation to previous studies dealing with similar problems.

6.1 Noticeable Impacts

The implementation of Community Milking Centres in Kolar district, Karnataka State has had observable, interesting and encouraging impacts on people, societies and the dairy industry. Data collected from the different stakeholders provide fairly unanimous opinions about improvement, challengers, current obstacles and further needs regarding the community milking system. There is clearly a general high level of satisfaction among all parties involved in the development. However, each group of actors face a unique situation with specific impacts.

6.1.1 Milk producers

From the milk producer's point of view the most obvious achievement of CMC until today is the decrease in human effort. Machine milking have facilitated daily life in more than one aspect. Milking by hand is hard work; time consuming and special skills are required. Previously, women were most often solely responsible for milking activities at farm level. The milk had to be delivered to the society at a more narrow time span than today, which automatically creates a stress situation. A second issue also mentioned by most of those farmers interviewed, concerns the enhancement in transparency. That specific impact also covers fairer payment, increase in trust among members and society staff and better control of quality and quantity produced by each member. Previously, most societies had troubles with farmers mixing foreign substances into the milk before delivering it. With bucket milking system, the problem of adulteration of milk has been eliminated substantially.

Through the participatory activities with farmers, several issues of importance were verified and crosschecked, i.e. the issue of human effort, fairer payment and increase in milk quality. An interesting observation and result from the group discussions with the women was the important issue of enhancement in flexibility and freedom the concept of community milking has promoted. Because the milking responsibility now can be shared more easily between women, men and even children, women do not always have to be around the village morning and evenings anymore.

Less clear are the impacts on income and milk yield related to the introduction of the community milking. Rather few people mentioned economic reasons as major incentive to join CMC and only just over 50 percent have experienced a higher income since joining. Increase in milk yield is experienced by only 25 percent. In general, a wide range in milk yields is observed, and average yield range from 5 to 20 litres. Education, size of farm, total income and the concentrate feed ration appeared to be variables that have a statistically significant effect on milk yield. Milk producers are generally very

satisfied with the services provided but do ask for an improvement in the veterinary services. The lack of suggestions regarding further development of services may be explained by a lack of knowledge of services related to new technology.

A majority has experienced an improvement in animal health since beginning of machine milking but it is concurrently noticeable that ten percent believe machines could harm the cows and are worried for the risk of spreading diseases.

The variety in answers concerning feeding indicate either farmers have a vague notion of the quantity they feed to their dairy cows or there is just such a wide divergence in feed ration between herds. Both scenarios imply a lack of awareness as well as knowledge of herd management. Training would be an effective tool to facilitate the process of knowledge enhancement. All those interviewed are positive to training and would like to attend if the opportunity will come up.

6.1.2 View of secretaries and impacts for the society

The typical secretary is a middle-aged man with a higher education than the average society member. He/she holds dairy cattle himself/herself and is married and has a family. The person is usually someone people look up to and has a key role in the society. All secretaries have been given some kind of training including animal health, CMP, AI etc. Specific training related to the DeLaval equipment and the management of the CMC is however usually exclusively limited to the days when the serviceman from DeLaval installed the equipment.

A large majority of the secretaries seem to have good knowledge in the daily routines which is of advantage in order to maintain a high level of animal health and hygiene and ensure good milk quality. Despite knowledge, many of the relatively straightforward routines are neglected at many centres. Pre milking is probably not practiced on a daily basis at any of the centres visited and many farmers also ignore routines such as cluster dipping and teat dips. The question is, why the secretary and staff members do not work harder to implement these necessary daily routines when it seems like they actually know they should be done? Many secretaries express that their work at the centre does not appear to be appreciated enough and they feel that they put more effort into the job than the actual rewards. That issue might be an explanation to why some society staff may somewhat lacks the required incentives managing the routines at the centre.

All secretaries are in favour of implementing a reward system, related to milk quality. The secretaries in the study assure that such a system would definitely give incentives to improvements both in routines and control.

The secretaries ask for more training opportunities both for themselves and for the farmers. A majority would like someone from outside train staff and producers. Given the knowledge and the background of most secretaries, there is definitely a possibility to train the secretaries to hold courses or training programs for the farmers. Secretaries also point out that providing credit services may be of interest, which should be provided at the centre.

Higher price for the milk is the most commonly demanded aspect by farmers and secretaries tend to agree that farmers should be paid a higher price if the quality of the milk meets a higher standard.

At a majority of the centres where good routines were observed the managerial

responsibilities were clearly divided among the staff members. In that way the work becomes efficient and accurate. For example, at those centres where cleaning of equipment got good marks during the observation period, there was usually one person responsible for the daily maintenance and cleaning of equipment.

Also the secretaries observe a decrease in human effort and workload as the primary impact of community milking. Less harassment, increase in trust and less spoilage are also ranked highly. An interesting observation is that none of the secretaries rank improvements of animal health among the three most important impacts.

6.1.3 KOMUL

The general manager at KOMUL would like to see a rapid development of the community milking. The system has improved the milk quality substantially and enhanced the possibility for the dairy processing plant to produce high quality products. The current challenge is to find a market segment and channels to distribute and market the high quality products. The problem currently facing some of the centres, (where operation is not running successfully or not at all), could according to the manager be mitigated by the credit facilities recently introduced by the dairy.

Unlike the general manager, the deputy manager believes a slow development would be better and enable the building of a more sustainable system. He would very much like to see a wide group of stakeholders, including the dairy and DeLaval to be part of a more extensive study.

6.2 Need of Training and a Holistic Approach

There is obviously a strong need and demand from both farmers and society staff for training in any field related to dairy management. And indeed, training and knowledge building concerning animal health, hygiene and clean milk production would improve milk quality and animal health. But improvements may be possible also by using simple means. Common buckets were used at some centres, i.e. milk cans owned by the society. That simple solution implies that the milk never comes in contact with an uncontrolled individual vessel. It also makes the operation more efficient and easy. A positive attitude among farmers and society staff is very important for a successful operation. Additional incentives related to improvements in milk quality, would probably facilitate the development of attitudes towards routines, both among farmers and society staff.

Several issues are of importance to achieve progress in milk production and only when all aspects are integrated and understood by the farmer, a desirable result may emerge, which indicate that a holistic approach is necessary. Implementation of milking machines and cooling tanks solely is a first step and a step in the right direction – but the study shows that it is not the entire solution to challenges facing the farmers and the stakeholders.

6.3 Links to Principle - Agent Theory

The results from interviews with farmers and the statistical analyse on the basis on the collected data display a relatively homogeneous group of farmers in terms of attitudes and mind set towards the community milking centres and its future. There was no statistically significant difference in time horizon depending on age, income level, farm size or dependence of milk sales. The horizon problem therefore does not appear to be a substantial problem for the development of the system.

Regarding the portfolio problem, the dairy processing plant attempts to reduce risks of unprofitable investments by choosing cooperative societies with stable finances and a large interest in the concept. At the village level, milk producers have reasonably similar needs and expectations towards services that should be provided and further developed at the centre. These needs are all strongly related to the dairy business. The conclusion is therefore that implementation and the operation of the community milking centres do not seem to increase the portfolio problem in any specific way, in comparison to the previous system.

Concerning the decision-making problem, rather few questions did touch the issue. However, interviews with some of the secretaries' revealed frustration regarding a lack of control and decision-making authority in terms of the daily operation. It is especially the topic pertaining to the purchasing of spare parts, which has to go through the committee to be accepted. The CMC system involves more decision making to be taken at the society level due to the operation and the activities including milking, that tend to expand the duties at the society centre. The change towards a CMC system therefore increases the importance of well functioning managerial system around the activities of milking and milk collection.

The control problem is probably the principle- agent problem that is mostly affected by the introduction of CMC. The CMCs automatically facilitate control by moving the milking activity from farm level to community level. Both society staff and other members are able to control the milking. The risk of adulteration is almost eliminated through community milking. This aspect is of great importance, because adulteration is a major problem in India.

Table 6.1: An overall picture on the agency problems linked to the two different relations studied

	Relation between Milk producers and CMC management	*Relation between CMC society and KOMUL*
Horizon problem	No statistically significant divergence in time perspective among society members, therefore little problem regarding the horizon problem.	Farmers linked to the CMCs reveal a homogenous long time perspective in terms of delivering milk to the centre. This perspective is also shared by KOMUL, which has to make a fairly large investment in the CMC equipment. Hence, no substantial horizon problem exists.
Portfolio problem	Not affected as a result of the CMC implementation. Dairy farmers face homogenous needs, requirements and interest, which decrease the obstacles linked of the portfolio problem.	The issue of handling risks is conducted by KOMUL through a careful selection of villages that obtain the opportunity to introduce a CMC system.
Decision making problem	More decisions will be taken at the society level in the CMC system, which enhances the importance of efficient decision-making process. Without a well functioning relation and clear responsibilities between management and committee, the decision making problem may increase compared to the former collection system	
Control problem	The control problem is likely to decrease substantially at the society level through the implementation of the CMCs. The openness and the increase in transparency during milking and measuring activities are key factors.	Through the CMCs and bulk milk coolers, it becomes easier for KOMUL to supervise the milking activities and to implement control activities that ensure milk of higher quality.

6.4 Links to Previous Research

The analysis of the empirical results concerning impacts and improvements reveal an interesting link to the recommendations at the conference for small scale milk collection and processing in developing countries (section 2.6). The CMC concept introduces and develops new and appropriate technologies at the village level. It also increases the control of milk quality and animal health awareness among producers. The extra premium paid by KOMUL of 0.1 INR/litre milk to those farmers who use milking machines creates an incentive for milk quality improvement. Furthermore, the payment scheme used at the CMCs is fair and transparent. The centres also have the potential to become a platform for further training, education and information. A holistic approach may be the next steps to further expand the CMC concept.

The case study of KOMUL, which was done for the Ministry of Food Processing Industries, Government of India, reveals some benefits that also were found in this thesis study. Enhanced milk quality in terms of total bacteria count, increase in total procurement volume, less spoilage, more efficient milk collection and lower transportation costs facing the dairy processor due to the new technology. The prior case

study also states benefits related to a premium received to farmers per litre milk. The extra amount of 0.1 INR/litre paid to society members who milk by machine is paid to most farmers, however, according to my study not to everybody. It is unclear if the missing link regarding the confusion the extra payment occurs between the dairy and the society or, if the omitted connection is to be found at society level. Higher returns to the milk societies thanks to CMC were not a main outcome due to this study, unlike statements included in the prior case study of KOMUL.

Despite correspondence in results between the prior case study at KOMUL and empirical findings in this report, this particular thesis takes the problem a step further. This thesis investigates wider aspects of implementation of new technologies in the milk societies in rural Kolar. A holistic approach has been taken and the different relationship between involved parties working with milk production has been studied in a way that has never been made before.

7 Discussion and Recommendations

Validity and reliability

The results show consensus among stakeholders regarding several issues pertaining to community milking. These include improvements in milk quality, decrease in human effort and a fairer and more transparent payment system that decreases the control problem at farm, society and dairy level. The unanimity concerning mentioned impacts verifies the validity and reliability in the result. The participatory method in the study gave an opportunity to cross check findings from individual interviews of a larger sample group. During the activities and group discussions, the importance of several previously mentioned issues were accentuated and a deeper understanding was obtained, i.e. the importance for women of becoming less fixed to the milking activity.

A variation in data from milk producers in terms of age, sex, farm size, total income, farm activity and herd size strengthen the possibility that all types of farmers actually are included in the sample frame, which is of great importance for reliability of results.

The interviews with dairy plant employees provided a fairly divergent view of the same problem. This is likely to occur due to the divergence in responsibilities and background of those interviewed. The validity in the answers may therefore not be rejected. Generally, results found in the study according to the dairy industry point of view, agree with those found at previous case studies of KOMUL. The correspondence in findings also confirms the validity of this study.

Some questions included in the questionnaires fall somewhat short and include insufficient wording. Milk producers had difficulties to answer questions concerning total income, total feed ration and issues concerning age of cattle and time span between pregnancies. An underlying reason might be a divergence in understanding of time and volume between the producers and the research team.

The fact that a interpreter assisted at all conversations at society level and also served during the interviews with milk producers while assisting at most interviews with secretaries, might be a source of ambiguity in the data collection process. However, only one interpreter participated during the field study, which reduce the variation in translations which otherwise might occur. The teamwork between the interpreter and me did work very well and I do not have any suspicions of fraudulent conduct from his side. However, it is difficult to remain entirely objective. The interpreter was an employee of DeLaval and also a native of the district of Kolar.

Relevance and importance for the research area

The study confirms positive impacts due to the implementation of community milking centre. The concept enables a decrease in workload in milking for the entire farming family and creates a more fair and transparent milk collection system. Only very few opinions concerning negative impacts did emerge. However, the study also indicates that economic and technical potentials in the CMC concept might be less noticeable until today. An installation of a milking machine may easily reduce human effort but does not necessary solve the complex problems associated with poor hygiene and feeding,

awareness of animal health and the issue of preventive actions to systematically map trends in diseases. The community-milking centres need a wider approach including some kind of herd management to enable further progress and sustainable development on sustainable basis. This study only scans the ground and points out areas to be on interest for further investigation.

Recommendations

After completion of the field study, documenting the material, analysing the empirical findings and drawing conclusions based on the theoretical framework – five recommendations for future development of the concept conclude this thesis project. The recommendations are pointed out based on relative importance, with the most important recommendation stated first. The recommendations are general and do not specifically point out who or which group is to be responsible for the implementation of the suggested recommendations.

I. Introduce a milk quality payment system to farmers and society staff based on TBC, SCC, fat
   → Increase incentives for improvement at several levels

II. Commit to provide more training to farmers primarily regarding feed management and preventive animal health
   → Increase necessary awareness by the farmers and create helpful links between input and output in dairy herd management and milk production

III. Use Benchmarking and allow the societies and farmers to review and compare each others results
   → Light version of competition, which could enable development of business thinking among society members

IV. To divide responsibilities more clearly among staff members and introduce extra milk buckets at the community milking centres
   → Improve the quality of the daily routines and in a straight forward manner decreases the risk for deteriorated milk quality as a consequence of unclean private vessels

V. Improve the system for spare parts and services needed on regular basis
   → Improve the status of CMC and the level of maintenance

Suggestions for future research within DeLaval and final personal conclusions

I believe in a development of the concept of community milking in Kolar district. I perceive a vast potential in the CMC model after my six weeks stay in the area, observing the operation and communicating with the people involved. This kind of dairy development in India is crucial both for milk production in general and for the milk producers in particular. It enables a better life situation and standard of living for the

people connected to the dairy business. The study shows that the way the concept works today yield several benefits in comparison with the traditional milk production and collection in India. Nevertheless, simultaneously the study also indicates still remaining issues to work with to reach even better results.

For a company with a mission of driving progress in milk production, these developments may suggest several favourable and challenging business opportunities. But to be part of building up a CMC model or a concept that is successfully sustainable, I would like to refer to the Swedish expression *"hasten slowly"*. In that way it is possible to adjust to an appropriate system, which suits the specific conditions of rural India.

There are actions that can be taken by DeLaval both in short and long term perspectives. These actions include both easy as well as complex measures. On a short term basis, DeLaval could propose a whole package to be sold, including firstly; the machines and the cooling tank, secondly; spares, brushes and detergents needed on regular business. DeLaval could also introduce a pre arranged time period for the serviceman installing the CMC and ensure he/she stays at minimum one week at the centre. Furthermore, DeLaval should make sure the serviceman is well educated in milking proceedings and routines, cleaning and maintenance of equipment and to obtain a general knowledge in herd management. The serviceman should have good communication skills and be a good trainer. Revisits to new centres should be a matter of course.

In the long-term perspective, other, more complex measures are desirable to be put up on the agenda. Below, three points are stated, which could be of interest to DeLaval to consider in the longer-term perspective.

1. Development of an appropriate small scale herd management system to benefit from the potentials and to improve achievements of community milking system

2. Initiate a pilot project including a few selected villages in Kolar district that involves milk producers and society staff from the very first phase

3. To build up an interdisciplinary research team that can serve on a more long term basis

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Appendix

Appendix 1: Entries over field study, Kolar

(2 pages)

Date	Place/Visit	Activity	Participants
20/06/05	Bangalore	Arrival at Bangalore airport, India	Vijay Kumar Uttam Kumar
21/06/05	Countryside of Bangalore	Visit to farmers who recently purchased or was about to purchase milking machines	Vijay Kumar
22/06/05	KMF Bangalore	Introduction of my project – purpose, duration and participating actors.	Dr. T.M. Lakshminarayana P & I Manager
23/06/05	DeLaval office Bangalore University of Agricultural Science Bangalore	Introduction of my thesis project Introduction of my project and a general dialogue about the dairy sector in India	Mr. Sudipta Bose Regional manager South Dr. N. Nagaraj and M.G Chandrakanth Professors in Agr. Economics MSc Agr. Students
24/06/05	Visiting friends - Bangalore		
25/06/05	KOMUL Kolar	Introduction of the project - purpose, approach and outlines of field study	Lakshmi Narayan (P & I) (MD) K. Gudiyappa (President)
26/06-25/07/05	CMCs, MCCs and KOMUL	Interviews, observation and participatory activities	Farmers, secretaries and Dairy employees
	CMC Shettihalli	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Urigilli	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Hanchala	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Chikkaankandahalli	Observation and interviews	Secretary M.P.C.S. 1 farmer
	CMC Kalvamanjali	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Siddnahalli	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Mallur	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Thippenahalli	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Nagamangala	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Hosapate	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Talagavara	Observation and interviews	Secretary M.P.C.S. 2 farmers
	CMC Manchanabele	Observation and interviews	Secretary M.P.C.S. 2 farmers
	Woody's Hotel	Planning & rest	

	CMC Hullibele	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Revisit Chikkaankandahalli	Observation and interviews	2 farmers
10-15/07/05	Delhi and Rajasthan		
	CMC Guttahalli	Observation and interviews	Secretary M.P.C.S. 3 farmers
	CMC Abrabi Kothanur	Observation and interviews	Secretary M.P.C.S. 2 farmers
	MCP Konganahally	Observation and interviews	Secretary M.P.C.S. 3 farmers
	KOMUL	Interviews	Lakshmi Narayan (P&I) G. Babu (Proc/CMP) S. Prahlad (Quality) (Veterinary)
	CMC Urigilli	Participatory activities	10 women 11 men
	CMC Chikkaankandahalli	Participatory activities	13 women 14 men
	CMC Shettihalli	Participatory activities	9 women 12 men
	MCP Gaddhe Kannur	Observation and interviews	Secretary M.P.C.S. 2 farmers
	MCP Chinnaapura	Observation and interviews	Secretary M.P.C.S. 2 farmers
	CMC Kalvamanjali	Participatory activities	8 men
26/07/05	Woody's Hotel	Summing up and completion of the field study - checking out and leaving Kolar	

Appendix 2: Forms sent in advance to the CMC planned to be visited

(3 pages)

CMC INFORMATION TO BE FILLED IN, IN ADVANCE

Survey
Question 1: General information
Question 2: CMC membership information
Question 3: Milk information
Question 4: Services and facilities at CMC
Question 5: Technical equipment at CMC
Question 6: Building
Question 7: Cow health
Question 8: Investment, Financing and Operation costs

1. GENERAL INFORMATION

1.1 Name of CMC
1.2 Address
1.3 Telephone no.
1.4 Name of manager
Address and phone no. to manager
1.5 Year of CMC establishment
1.6 Form of CMC ownership:
ڤ 1) Private investor
ڤ 2) Cooperative
ڤ 3) Dairy processor
ڤ 4) Other
ڤ 5) Combination of 1-4, please provide ownership shares

2. CMC MEMBERSHIP INFORMATION

2.1 Total no. of active members/producers/households
2.2 Total no. of milking dairy cows connected to the CMC
2.3 Average no. of dairy cows milked daily at CMC
2.4 No. of farmers with:
1-3 cows
4-6 cows
7-10 cows
≥10 cows
2.5 Average herd size

3. MILK INFORMATION

3.1 Max capacity of milk tank: _____ Litres
3.2 Collecting system:
Name of dairy that collects the milk
How often is the milk collected?
ڤ 1) Twice daily
ڤ 2) Once a day
ڤ 3) Every second day
ڤ 4) Other:
At what time is the milk collected at CMC
3.3 State seasonal variation:
How much is the maximum daily production of milk
How much is the minimum daily production of milk:
Which month/months do the cows milk most:
Which month/months do the cows milk least:
Other seasonal differences?

4. SERVICES AND FACILITIES AT CMC

4.1 Services provided at CMC:
ڤ Veterinary Services
ڤ Animal medical supply
ڤ Breed (AI/ training)
ڤ Feed (supply/ training)

- ☐ Herd Management
- ☐ Communication facilities (telephone/internet)
- ☐ Other

4.2 Services planned to be provided within the next year:

- ☐ Veterinary Services
- ☐ Animal medical supply
- ☐ Breed (AI/ training)
- ☐ Feed (supply/ training)
- ☐ Herd Management
- ☐ Communication facilities (telephone/internet)
- ☐ Other

4.3 Services not currently provided but asked for by farmers:

- ☐ Veterinary Services
- ☐ Animal medical supply
- ☐ Breed (AI/ training)
- ☐ Feed (supply/ training)
- ☐ Herd Management
- ☐ Communication facilities (telephone/internet)
- ☐ Other

5. TECHNICAL EQUIPMENT AT CMC

5.1 Type of milking machines
5.2 No. of clusters
5.3 Type of washing facilities
5.4 No. of washing units
5.5 Description of cooling system

Description of power supply

5.6 What kind of power supply is used at the CMC?

- ☐ Power network
- ☐ Generator
- ☐ Both power network and generator

5.7 If using power network, how often does a power cut occur?

- ☐ Several times every week
- ☐ Once a week
- ☐ Every second week
- ☐ Once a month
- ☐ Other

5.8 When power cuts occur – how long is the power usually away for?

Description of water supply

5.9 Water used for CMC activities comes from:

- ☐ Well
- ☐ Fresh water from surface
- ☐ Both well and fresh water from surface

5.10 Description of water heater and capacity

5.7 Computer available:

- ☐ 1) No
- ☐ 2) Yes

6. BUILDING

6.1 Size of building (m^2) (Please attach building plan)
6.2 Any addition or/and change of original building?

7. COW HEALTH

7.1 Please fill in treated and untreated number of cases of health problems
(Average number during the last year)

Health problem:	**No. of cases:**	**Proportion treated at CMC:**
Mastitis		
Injured udder		
Digestion problems		
Leg/hoof problem		
Worms		
Lice, fleas		
Ticks		

7.2 Possibility to treat with antibiotics without consulting a veterinary if needed?

ڤ 1) No

ڤ 2) Yes

8. INVESTMENT COSTS, FINANCING AND OPERATION COSTS (INR)

8.1 Approximate investment cost for CMC building

8.2 Approximate investment cost for equipment

8.3 Who has financed the building and equipment?

8.4 Have any loans been taken for financing CMC

 Yes

 No

Annual operation costs

8.6 Costs for salaries at CMC

8.7 Power costs

8.8 Costs for fuel

8.9 Costs for detergent

8.10 Other regular operation costs

8.11 What are the annual service fees for machinery service, spares and rubber?

Operation revenue

8.12 Average price paid per litre to farmer:

8.13 Average revenue per litre milk sold to the dairy processor:

Appendix 3: Checklist for observation, used at the visited CMCs
(2 pages)

CHECKLIST

Date: **Name of CMC:**

Poor	Ok	Good	
☐	☐	☐	LOCATION:
☐	☐	☐	SPACE:
☐	☐	☐	ARRANGMENT & DESIGN:
☐	☐	☐	ROUTINES & EFFICIENCY:
☐	☐	☐	Efficiency:
☐	☐	☐	Pre-milking routines:
☐	☐	☐	Milking:
☐	☐	☐	Post-milking routines:
☐	☐	☐	Milk measuring & control:
☐	☐	☐	Cleaning of equipment by staff after milking

	Poor	**Ok**	**Good**	ANIMAL EVALUATION
No:	☐	☐	☐	Routines:
	☐	☐	☐	Teats:
	☐	☐	☐	Sample: No of calves: Stage of lactation: Mastitis history: Litre/month and income: Feed expenses/month:
No:	☐	☐	☐	Routines:
	☐	☐	☐	Teats:
	☐	☐	☐	Sample: No of calves: Stage of lactation: Mastitis history: Litre/month and income: Feed expenses/month:
No:	☐	☐	☐	Routines:
	☐	☐	☐	Teats:
	☐	☐	☐	Sample: No of calves: Stage of lactation: Mastitis history: Litre/month and income: Feed expenses/month:

DCC sample from tank:

Sample: *Poor/Mastitis ≥ 500 000*
Ok/Suspect 200000-500000
Good/Safe ≤ 200 000

Appendix 4: Table somatic cell count

(1 page)

Somatic Cell Count (in '000 cells/ml)
Measured by DCC
Kolar District
July 2005

CMC	Farmer 1	Farmer 2	Farmer 3	Tank sample 1	Tank sample 2
	72	227	52	830	763
	522	167	153	337	388
	873	71	24	830	752
	51	92	30	989	959
	99	131	27	567	791
	932	1364	949	624	656
	768	1605	1999	1077	1008
	300	3698		731	735
	43	22	102	637	598
	35	1079	824	552	640
	222	745	89	829	733
	573	34	3734	1145	1003
MCC	**Farmer 1**	**Farmer 2**	**Farmer 3**	**Tank sample 1**	**Tank sample 2**
	29	138	193	1065	1132
	18	113	1203	572	577
	378	721	-	682	-

Appendix 5: Results from chi-2 test

(1 page)

No	Variable 1	Variable 2	DF	χ^2 result	Critical χ^2 (5%)	Significance
1	**Milk yield**	**Education**	**6**	**14,634**	**12,592**	**X**
2	**Milk yield**	**Size of farm**	**6**	**15,855**	**12,592**	**X**
3	Milk yield	Age	4	2,726	9,488	-
4	**Milk yield**	**Total income**	**6**	**13,484**	**12,592**	**X**
5	Milk yield	Income share milk	2	1,551	5,991	-
6	CMC routines	Cell count tank	4	4,368	9,488	-
7	CMC checklist	Farmers checklist	6	7,500	12,592	-
8	CMC checklist	Secretary education	4	2,860	9,488	-
9	CMC checklist	Farmers routine	6	6,571	12,592	-
10	CMC checklist	Size of tank	6	4,533	12,592	-
11	Age farmer	Deliver in future	2	1,100	5,991	-
12	**Age farmer**	**Increase herd size**	**2**	**4,263**	**5,991**	**Tendency (10%)**
13	Age farmer	Satisfaction level	4	4,301	9,488	-
14	Sex	Deliver in future	1	0,018	3,841	-
15	Sex	Increase herd size	1	0,196	3,841	-
16	Sex	Satisfaction level	2	2,821	5,991	-
17	Size of farm	Deliver in future	3	0,819	7,815	-
18	Size of farm	Increase herd size	3	2,764	7,815	-
19	Size of farm	Satisfaction level	6	5,724	12,592	-
20	Total income	Pay for training	9	6,086	16,919	-
21	Total income	Type of concentrate	6	8,234	12,592	-
22	Education	Type of concentrate	6	8,137	12,592	-
23	**Milk yield**	**Kg concentrate**	**4**	**25,264**	**9,488**	**X**
24	Milk yield	Type of concentrate	4	2,371	9,488	-
25	Milk yield	Kg roughage	4	2,605	9,488	-
26	Milk yield	Type of roughage	2	2,416	5,991	-
27	Time spend w cow	Total no of cows	6	6,451	12,592	-

Appendix 6: Microbiological analysis report of community milking centres

(1 page)

Done by Kolar Milk Union (KOMUL), Kolar.

CMC	Sampling Date/Time	Fat (%)	SNF	MBRT (Hrs)	SPC (Cfu/ml)	CC (Cfu/ml)	Grade
1	11/7 – 7.30am	4.10	8.55	6.00	1,00,000	7,000	VGood
2	11/7 – 1.00am	4.10	8.55	5.00	4,00,000	20,000	Good
3	11/7 – 7.30am	3.90	8.50	3.00	20,00,000	22,000	Fair
4	11/7 – 9.00am	4.10	8.55	5.00	8,00,000	20,000	Good
5	11/7 – 12.00am	4.20	8.58	5.45	2,00,000	5,000	Good
6	11/7 – 8.30am	4.10	8.43	4.35	7,00,000	30,000	Good
7	12/7 – 10.00am	4.10	8.55	4.00	7,00,000	10,000	Good
8	12/7 – 9.00am	4.00	8.53	4.05	10,00,000	4,000	Good
9	12/7 – 8.30am	4.00	8.53	4.20	6,00,000	15,000	Good
10	13/7 – 9.00am	4.00	8.50	6.15	1,00,000	1,000	VGood
11	13/7 – 10.00am	4.10	8.55	5.00	2,00,000	30,000	Good
12	12/7 – 11.00am	4.10	8.55	4.00	9,00,000	7,000	Good
13	11/7 – 10.00am	4.10	8.55	5.00	5,00,000	18,000	Good
14	11/7 – 11.30am	4.00	8.53	5.00	4,00,000	10,000	Good
15	13/7 – 11.30am	4.20	8.58	5.30	1,00,000	10,000	VGood
Mean Value		**4.07**	**8.54**	**4.80**	**5,80,000**	**13,933**	

SNF	Solids None Fat
SPC	Standard Plate Count
C.C	Coliform Count
MBRT	Methylene Blue Reduction Test time
Cfu	Colony forming unit

Appendix 7: Questionnaire milk producer

(6 pages)

CMC

Date:

Farmer's answers

NAME OF CMC:

1. PERSONAL INFORMATION

1.1 Age

1.2 Sex

1. Man
2. Women

1.3 Civil status

1. Married
2. Not married

2. HOUSEHOLD COMPOSITION

2.1 No. in household

2.2 No. of generation living in the household

2.3 No. of children living in the household

3. WORK EXPERIENCE

3.1 For how long time has your family had dairy cows?

1. Less than 5 years
2. 5-10 years
3. 11-20 years
4. More than 20 years

4. EDUCATIONAL BACKGROUND

4.1 Kind of education

1. Up to 3rd standard
2. Up to 6th standard
3. Up to 10th standard
4. Higher than 10th standard

4.2 Are you able to read and write?

1. Yes
2. No

5. FARM COMPOSITION

5.1 Farm activities beside dairy cows:

1. Crop and forage production for self consumption purpose
2. Raggie-, forage- and cash crop production
3. Raggie- and forage production + animals
4. Raggie production and silk business in some way
5. Off-farm employment
6. Other

5.2 Size of farm (acre)

1. Less than 1 acre
2. Between 1-3 acres
3. Between 4-10 acres
4. More than 10 acres

5.3 Who owns the land?

1. Family owned
2. Not family owned
3. Landless

5.4 Total no of cows

5.5 No. of lactating cows today

5.6 No. of young cattle and calves

5.6 How many hours do you spend on your dairy cow/cows a day?

1. Less than 3 hours
2. Between 4-6 hours
3. Between 7-9 hours
4. More than 9 hours

5.7 Who owns the cows?
1. Family owned
2. Not family owned

6. HOUSEHOLD INCOME

6.1 Major sources of income - rank the 3 most important
1. Milk production
2. Other animals
3. Cattle sales
4. Cash crop and silk production
5. Income from off farm employment
6. Other

6.2 What are your main tasks within the household – rank the 3 most important
1. Bring dairy cows to CMC
2. Animal care
3. Crop production
4. Child care
5. Cooking
6. Herd management
7. Other

6.3 Who in the family do usually bring the cows to the CMC for milking?
1. The man
2. The women
3. Children

6.4 Approximately monthly total income of household
1. Less than 1500 INR
2. 1500-2999 INR
3. 3000-5000 INR
4. More than 5000 INR

6.5 Income share from milk production
1. More than 50 percent
2. Less than 50 percent

6.6 Who in the household are responsible for taking care of the money?
1. The husband
2. The wife
3. Other

6.7 How many litres of milk do your dairy cows' produce in average a day?

6.8 How many litres of milk do your dairy cows' produce minimum a day?

6.9 How many litres of milk do your dairy cows' produce maximum a day?

6.10 Change in milk production since starting milking by machine,
1. Increase in production
2. Decrease in production
3. No change in production
4. No idea

6.11 How many litres of milk are consumed within the household per day?

6.12 Is there a difference in milk consumption before CMC and today?
1. Yes
2. No

6.13 Would you like another payment scheme?
1. Yes
2. No

6.14 How do you perceive CMC has changed your economical situation?
1. Higher income
2. A more safe income
3. More regular income
4. Other

5. No change

6.15 If a higher income – how much is the monthly increase?

6.16 What is the higher income to the household used for primarily?

1. Buying more dairy cows
2. Improving housing
3. Material consumption
4. Education
5. Other

7. RELATION TO CMC / IMPACTS FROM CMC

7.1 Did you join the CMC from the very beginning?

1. Yes
2. No

7.2 How did you found out about the opportunity of joining CMC?

1. From other farmers
2. From the dairy
3. From the community
4. From the CMC
5. Other

7.3 What was the main reason why you signed up for the CMC?

1. Less work
2. Economical
3. Improvement in milk quality and animal health
4. Other reasons

7.4 What kind of services at CMC do you use except for milking facilities - rank the 3 most important

1. Training/education
2. Feed (education, purchase)
3. Breeding (AI, education, etc.)
4. Communication (phone, internet)
5. Seed (for crop production)
6. Veterinarian
7. Human Health Care Scheme
8. Other

7.5 Is there a possibility to get credit/loans through the society in this village?

1. Yes
2. No

7.6 If there is a possibility – have you been taken loans for buying dairy cows?

1. Yes
2. No

7.7 How do you regard the services provided at CMC?

1. Unsatisfied
2. ↓
3.
4.
5. Very satisfied

7.8 Have your expectations of CMC been met?

1. Not at all
2. ↓
3.
4.
5. Totally

7.9 What service at CMC – if any - you would like to see be developed more - rank the 3 most important

1. Training/education
2. Feed (education, purchase, quality, price)
3. Breeding (AI, education, etc.)
4. Communication (phone, internet)
5. Seed (for crop production)
6. Veterinarian
7. Other

7.10 What kind of changes for you and your family has been achieved since joining CMC - rank the 3 most important

1. More money per litre of milk
2. More milk produced/cow
3. Healthier cows
4. Less work
5. Fair payment
6. Improved standard of living
7. Improved knowledge about dairy/management
8. Other
9. Improved milk quality
10. Increased herd size

7.11 Has the society gain in any sense since the milking machine came to the village?

1. Yes
2. No

7.12 Have you participated in any courses/training at CMC?

1. Yes
2. No

7.13 Do you want to participate in courses/training at the CMC if it was free of charge?

1. Yes
2. No

7.14 Would you be interested to participate in training if you had to pay yourself?

1. Yes
2. No
3. Depends on

7.15 Are you satisfied with your agreement/contract with the CMC?

1. Not at all
2.
3.
4.
5. Totally/Very

7.16 Who in family have signed for the membership in the society?

1. The husband
2. The wife
3. Both
4. Other

7.17 Do you have any opportunity to withdraw from the agreement?

1. Yes
2. No

8. FEED/FEEDING

8.1 What kind of roughage do you give your cow/cows?

1. Green grass or/and Para grass
2. Rest products from raggie or/and mulberry
3. Mix of green pasture and rest products from crop production
4. Other

8.2 What kind of concentrate do you give your cow/cows?

1. Only ready mix
2. Ready mix + groundnut cake + wheat bran
3. Groundnut cake + wheat bran
4. Other

8.3 Are there any seasonal differences in how the cows are fed?

1. Yes
2. No

8.4 How many kilos of roughage are your cows given in average a day?

8.5 How many kilos of concentrates are your cows given in average a day?

8.6 How many litres of water are your cows given in average a day?

8.7 How often are the cows fed and given water?
1. Free access
2. Twice a day
3. Three times a day
4. Other

9. BREED/BREEDING

9.1 What kind of breed are your cow/cows?
1. Holstein
2. Jersey
3. Holstein and Jersey
4. Other breed

9.2 How old are your cow/cows?

9.3 How many calves have your cow/cows had each?

9.4 How many calves were born last year?

9.5 How many of the calves died last year?

9.6 What is the most common cause of calf death?
1. Any kind of stomach problem
2. Fever
3. Other
4. No idea

9.7 Do you let the calf suckle the cow?
1. Yes
2. No

9.8 How old is usually the heifer at calving?
1. ≤ 2.5 years
2. 2.5-4 years
3. ≥ 4 years

9.9 For how long time does you milk your cow after her calving?
1. ≤ 6 months
2. 6-8 months
3. 8-10 months
4. ≥ 10 months

9.10 How many months after calving does the cow usually become pregnant again?
1. ≤ 3 months
2. 3-6 months
3. 6-12 months
4. ≥ 12 months

9.11 Do the cows have any calving problems?
1. Yes
2. No

10. COW HEALTH

10.1 Different kind of health problem/diseases - rank the 3 most important
1. Mastitis
2. Leg and hoof problem
3. Diarrhoea/stomach disturbances
4. Fever
5. Foot and mouth disease
6. Other problems

10.2 What was the cost of the treatment for your last mastitis case?

10.3 How do you believe the animal health has changed since joining CMC?
1. Improved animal health
2. No change in animal health
3. Worse animal health

11. FUTURE

11.1 Would you like to increase your number of dairy cows if possible?
1. Yes
2. No

11.2 Do you believe you can increase the yield per cow?

1. Yes
2. No

11.3 Do you think you will continue to deliver the milk to the CMC in 2-5 years?

1. Yes
2. No

11.4 How do you see your farm develop in 2-5 years?

1. Increase in herd size
2. Increase in land/crop production
3. Mix of alternative 1 and 2
4. Other development

Additional suggestions etc.

Appendix 8: Results from participatory activities

(1 page)

The quotations from the participatory activities were categorized into fourteen different groups – all illustrating a change or improvement since joining community milking. The numbers of opinions in respective group are divided into men and women and the result can be viewed below.

Change	Women	Men	Total
Less human effort	15	27	42
Fairer payment / gain in trust	4	28	32
Increase in milk quality	4	18	22
Increase in animal health	6	15	21
More flexibility / freedom	15	3	18
Everybody can milk	9	5	14
Possibility for larger herd size	2	12	14
Demand for higher milk price	1	11	12
Society development / gain in self esteem	7	3	10
Increase in income	3	6	9
Gain in milk production awareness & knowledge	4	1	5
Less spoilage	0	5	5
Increase in milk production	1	2	3
Time saving	0	3	3
Total	71	139	210

Appendix 9: Questionnaire secretaries

(3 pages)

QUESTIONNAIRE FOR MANAGER **Date:**

Survey
Question 1-3: Personal information
Question 4: CMC Information
Question 5: Economy
Question 6: Agreement
Question 7: Services at CMC
Question DeLaval equipment
Question 8: Cow health
Question 9: Future

NAME OF CMC:
NAME OF MANAGER:

1. PERSONAL INFORMATION

1.1 Birth year 19___

1.2 Sex
- ڤ 1) Man
- ڤ 2) Women

1.3 Civil status
- ڤ 1) Married
- ڤ 2) Not married

2. WORK EXPERIENCE

2.1 Did you grow up on a dairy farm?
- ڤ 1) No
- ڤ 2) Yes

2.2 Have you owned and managed dairy cows?
- ڤ 1) No
- ڤ 2) Yes
- ڤ 3) Still have own dairy cows

2.3 How long have you been working at the CMC?
- ڤ 1) Less than 1 year
- ڤ 2) 1-5 year
- ڤ 3) 5-10 year

2.4 Earlier work experience:

3. EDUCATIONAL BACKGROUND

3.1 Kind of education
- ڤ 1) No education
- ڤ 2) Compulsory school
- ڤ 3) Secondary school
- ڤ 4) University
- ڤ 5) Other

3.2 Have you taken any courses/training for managing the CMC?
- ڤ 1) No
- ڤ 2) Yes What was it about?
  - ڤ 1) Management
  - ڤ 2) Technical maintenance procedure for equipment
  - ڤ 3) Breeding
  - ڤ 4) Feeding
  - ڤ 5) Other

3.3 Do you organize courses/training at the CMC for the farmers?
- ڤ No
- ڤ Yes What are the course/courses about?
  - ڤ 1) Herd management
  - ڤ 2) Technical facilities
  - ڤ 3) Breeding
  - ڤ 4) Feeding
  - ڤ 5) Other

3.4 Under what conditions do you get paid?
- ڤ Depending on milk quality
- ڤ Depending on milk yield
- ڤ Independent

3.5 Would you like a bonus system to be implemented – which was depending on the quality of the milk produced at this CMC?

3.6 Do you believe such a system would increase your awareness and interest of the animal health within the dairy herd at this CMC and make you work harder for higher level of hygiene and proper and regular routines at your centre?

4. CMC INFORMATION

4.1 How many households are participating at the CMC?

4.2 Total number of dairy cattle at the centre?

4.3 Average number of cows milked every day?

4.4 Can you explain the proceedings/routines done at the CMC – from that the farmer comes with the cow to the centre till that the farmer leaves the centre?

4.5 Approximately – what is the share of women, men and children coming for milking to the centre?

5. ECONOMY

5.1 Profitability of CMC?

5.2 Prices paid per litre milk to farmer?

5.3 Does the CMC have any quality payment system to farmer?

- ڤ No
- ڤ Yes
  - ڤ 1) Quality payment that include bacteria and somatic cell count
  - ڤ 2) Payment based on milk density and acidity
  - ڤ 3) Payment based on fat content using simple fat testing equipment
  - ڤ 4) Payment based on fat, protein, lactose and total solids
  - ڤ 5) Other

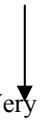
6. AGREEMENT

6.1 How do farmers sign up to be members today? (What does the process and agreement look like?)

6.2 How did the farmers sign up to be members to the CMC from the beginning? (How was the originally group created?)

6.3 How well do the present agreement work?

- ڤ 1 Not so well
- ڤ 2
- ڤ 3
- ڤ 4
- ڤ 5 Very well



6.4 What works well with the agreement/ problems associated with current agreement?

6.6 Does the CMC have any plans of altering/changing present agreement in the near future?

6.7 Are there any possibilities for farmers to sign off membership?

6.8 What are the possibilities for the CMC to exclude the farmer from delivering milk?

6.9 Explain the relation between the CMC and KOMUL?

7. SERVICES AT CMC

7.1 What services are currently provided at the CMC?

- ڤ 1) Training/education
- ڤ 2) Feed (education, purchase)
- ڤ 3) Breeding (AI, education, etc.)
- ڤ 4) Communication (phone, internet)
- ڤ 5) Seed (for animal, for crop production)
- ڤ 6) Veterinarian
- ڤ 7) Access to credit
- 8) Other

7.2 Any other services at the CMC you would like to introduce and/or be developed further?

- ڤ 1) Training/education
- ڤ 2) Feed (education, purchase)
- ڤ 3) Breeding (AI, education, etc.)
- ڤ 4) Communication (phone, internet)
- ڤ 5) Seed (for crop production)

ڤ 6) Veterinarian
ڤ 7) Other
8) Access to credit

7.3 What changes do you think have been the result for the farmer after they joined the CMC system? (Rank the three most important)
ڤ 1) More milk produced/cow
ڤ 2) Higher price per litre of milk
ڤ 3) Healthier cows
ڤ 4) Change in workload and working condition
ڤ 5) Safer and more regular income
ڤ 6) Better milk quality
ڤ 7) Improved standard of living
ڤ 8) Improved knowledge of dairy/management
ڤ 9) Other

7.4 What services do you believe being most importance for a successful development of CMC?

7.5 What services are mostly used/ asked for by farmers?

7.6 What services works excellent, good, satisfactory or not very well?

7.7 Do you think there is a reasonable balance between the need for training and the available training programs?
ڤ 1) No
ڤ 2) Yes

10. DELAVAL EQIPMENT

10.1 In general, how do you regard the quality and the function of the DeLaval equipment? Any complains?

10.2 Explain the routines of maintaining the equipment?

10.3 Do you have any spare parts to the milking units and additional equipment in stock here at the centre?

10.4 When spare parts are required – what is the process of getting them here? (Problems/time of delivering/service/cost)

10.5 Who pays for the spare parts?

10.6 Any suggestions to facilitate/improve the procedures of getting spare parts to the centre?

8. COW HEALTH

8.1 How do the routines look like when you notice different health problems in the dairy herd? (When is treatment used? When not?)

8.2 What are the most common health problem/disease farmers call veterinary services for?

8.3 What is the average cost of treatment for mastitis?

9. FUTURE

9.1 How do you perceive the development and long-term prospects of your CMC?
ڤ 1) Slow
ڤ 2) Unchanged
ڤ 3) Rapid

9.2 How do you perceive the development and long-term prospects of the CMC system as a concept?
ڤ 1) Slower
ڤ 2) Unchanged
ڤ 3) Faster

9.3 What kind of changes/improvements would you regard as desirable for a successful future for the CMC?
ڤ 1) Milk quality improvement
ڤ 2) Larger CMC
ڤ 3) A larger number of CMC's
ڤ 4) More dairy cows per centre
ڤ 5) More milk per cow
ڤ 6) Other

9.4 What is the largest challenge facing the future of your CMC?

Appendix 10: a-b-c: Questionnaire used at KOMUL / 3 interviews

(7pages)

QUESTIONNAIRE FOR P & I MANAGER - KOMUL **Date:**

NAME OF PERSON:

1. PERSONAL INFORMATION

1.1 Position in the Dairy:
1.2 Age_____ Year
1.3 Sex
ڤ1) Man
ڤ2) Women

2. WORK EXPERIENCE

2.1 Did you grow up on a dairy farm?
ڤ1) No
ڤ2) Yes
2.2 Have you owned and managed dairy cows?
ڤ1) No
ڤ2) Yes
ڤ3) Still have own dairy cows
2.3 How long have you been working at the Dairy?
ڤ1) Less than 1 year
ڤ2) 1-5 year
ڤ3) 5-10 year
ڤ4) ≥ 10 year
2.4 Can you explain your work at the dairy, your duties and responsibilities?
2.5 Earlier positions:

3. EDUCATIONAL BACKGROUND

3.1 Kind of education
ڤ1) No education
ڤ2) Compulsory school
ڤ3) Secondary school
ڤ4) University
ڤ5) Other

4. DAIRY INFORMATION

1 11 Taluks
2 2889 villages
3 1486 MPCS in function
4 90 exclusive women dairy society
5 286 232 members (70 291 women)
6 668 000 kg milk per day, average May 2005
7 738 000 kg milk per day – highest production since inception of union

4.1 How many MPCS have;
- BMC _____ covering _____ villages
- adopted the Community Milking Centre including milking machines _____

4.2 Milk Collecting Centre is still the main system – can you explain the key features of that system? (Advantages/obstacles from dairy point of view)
4.3 Are there any collections done directly from farms to dairy?
ڤ1) No
ڤ2) Yes. How many farms and how much milk is collected (litres)?
4.4 Approximately number of dairy cattle at all CMC together?
4.5 Average amount of milk collected every day?
Total for this Dairy:
From BMC/CMCs only:

4.6 Max capacity of milk collected from BMC/CMC: _____ Litres

4.7 State seasonal variation:

How much is the maximum daily collection of milk: _____

How much is the minimum daily collection of milk: _____

Which month/months do the Dairy collect most milk: _____

Which month/months do the Dairy collect least milk: _____

Other seasonal differences:

4.8 The seasonal differences facing the dairy are probable undesirable – are you in any way working for receiving a more steady level of milk production? How is that done? (Different payment system, training to farmers etc)

4.9 How is the CMC concept developed, introduced, implemented and maintained?

- Advantages/obstacles for KOMUL
- Advantages/obstacles for MPCS
- Advantages/obstacles for producers

4.10 In some villages CMC has been implemented but are not presently in operation – what do you believe is the main reason for that?

In what way does KOMUL try to make those centres work? Is there in your interest?

4.11 From KOMULs point of view, what is the expectation for development of CMC for the future?

5. ECONOMY/PAYMENT SCHEME

5.1 Ownership of Dairy?

ف1) Private

ف2) State

Cooperative

5.2

- How are the CMCs financed?
- What is the average cost of implementation?
- Who bear the costs?

5.3 Prices paid per litre milk to CMC/MPCS today, any extra bonus for using milking machines?

5.4 Prices paid per litre milk to CMC average over the year?

5.5 Max price paid per litre milk to CMC?

5.6 Min price paid per litre milk to CMC?

5.7 How large is the share of milk that has been cooled through BMC before collected by KOMUL?

5.8 Is there any difference in price paid for milked which is cooled/not cooled before delivery?

5.9 Any quality payment system to CMC?

ف1) No

ف2) Yes

ف 1) Quality payment that include bacteria, inhibitor and somatic cell count.

ف2) Payment based on milk density and acidity

ف3) Payment based on fat content using simple fat testing equipment

ف4) Payment based on fat, protein, lactose and total solids

ف5) Other:

6. AGREEMENT

6.1 What kind of agreement/contract is signed between KOMUL and the MPCS and CMCs today? What is included in that contract – obligations and responsibilities?

6.2 How did the CMC's sign up to be members to the Dairy from the beginning? (How was the originally group created?)

6.3 How well does the present agreement with the CMC work?

ف1 Not so well

ف2

ف3

ف4

ف5 Very well

6.4 What works well/less well with the agreement?

6.5 Does the Dairy have any plans of altering/changing present agreement in the near future?

6.7 What are the possibilities for the Dairy to exclude the CMC from delivering milk?
6.8 Under what conditions is it possible for the Dairy to refuse the delivered milk?
6.9 What kind of risks do you believe KOMUL face – when developing the CMC concept?
- How to cope with the risk and minimize them?

7. KOMUL AND CMC

7.1 Is the Dairy organising any courses for the manager at the CMC?
ف No
ف Yes What are the course/courses about?
ف 1) Herd management
ف 2) Technical facilities
ف 3) Milk quality
ف 4) Microbiology
ف 5) Other:

7.2 Is the Dairy organising any courses for the farmers at the CMC?
ف No
ف Yes What are the course/courses about?
ف 1) Herd management
ف 2) Technical facilities
ف 3) Milk quality
ف 4) Microbiology
ف 5) Other:

7.3 What kind of services / key features would you like to be part of the CMC?
7.4 What kind of changes have been the results since CMC started? (Rank all relevant)
ف 1) More milk collected
ف 2) Better milk quality collected
ف 3) Change in cost and work for collection
ف 4) Safer more regular deliveries
ف 5) Safer dairy products
ف 6) Improved knowledge about relation with milk producer
ف 7) Other
7.5 Is there a balance between supply and demand for milk?
ف 1) No. Does it depend on any seasonal differences?
ف 2) Yes
7.6 If there are any seasonal differences in the delivery of milk are there any plans for making the differences less noticeable?
ف 1) No
ف 2) Yes. How? (For example different payment system)

8. KOMUL AND DELAVAL

8.1 How does the relation between DeLaval and KOMUL look like today? Is there a contract signed – if – what is included in that?
8.2 What responsibilities bear KOMUL and DeLaval respectively according to equipment, service, spares and maintenances of DeLaval products at the CMC/BMC?
8.3 Is there any confusion/obstacles/problems today in information channels according to service and spare parts from DeLaval? Suggestion of solving the problems?
8.4 Does KOMUL have spare parts for milking units and additional equipment (hygiene articles) in stock? How are they distributed to CMCs if needed?
8.5 When spare parts are required – what is the process of getting them to the CMC? (Problems/time of delivering/service/cost)
8.6 Who bear the cost for spare parts and hygiene/cleaning articles?
8.7 Any suggestions to facilitate/improve the procedures of getting spare parts to the centre?

9. FUTURE

9.1 How do you estimate the development and long-term prospects of this Dairy?
ف 1) Slow
ف 2) Unchanged
ف 3) Rapid
9.2 How do you estimate the development and long-term prospects of the CMC system as a

concept?
ڤ1) Slower
ڤ2) Unchanged
ڤ3) Faster

9.3 What kind of changes/improvements in the CMC system would you regard as desirable for a successful future for milk producers and the Dairy?
ڤ1) Milk quality improvement
ڤ2) Larger CMC
ڤ3) A larger number of CMC's
ڤ4) More dairy cows per centre
ڤ5) More milk per cow
ڤ6) Other:

9.4 What is the largest challenge facing the Dairy today?
9.5 What is the largest challenge facing the future for the CMC's?
9.6 How much more milk will the Dairy process in 5 years?
9.7 How much of that increase will come from the CMC?
9.8 What can the Dairy do to speed up the milk production from the CMC's?

Additional Qs:
1 Definition of small/marginal/schedule caste farmers?
2 UHT milk sales?
3 Definition of DCS?
4 Possible to get map of Kolar district?

QUESTIONNAIRE FOR QUALITY CONTROL MANAGER - KOMUL **Date:**

NAME OF PERSON:

1. PERSONAL INFORMATION

1.1 Position in the Dairy:
1.2 Age_____ Year
1.3 Sex
ڤ1) Man
ڤ2) Women

2. WORK EXPERIENCE

2.1 Did you grow up on a dairy farm?
ڤ1) No
ڤ2) Yes

2.2 Have you owned and managed dairy cows?
ڤ1) No
ڤ2) Yes
ڤ3) Still have own dairy cows

2.3 How long have you been working at the Dairy?
ڤ1) Less than 1 year
ڤ2) 1-5 year
ڤ3) 5-10 year
ڤ4) ≥ 10 year

2.4 Can you explain your work at the dairy, your duties and responsibilities?
2.5 Earlier positions:

3. EDUCATIONAL BACKGROUND

3.1 Kind of education
ڤ1) No education
ڤ2) Compulsory school
ڤ3) Secondary school
ڤ4) University
ڤ5) Other

4. DAIRY INFORMATION

- 11 Taluks
- 2889 villages
- 1486 MPCS in function
- 90 exclusive women dairy society
- 286 232 members (70 291 women)
- 668 000 kg milk per day, average May 2005
- 738 000 kg milk per day – highest production since inception of union

4.1 What kind of milk quality tests is done at KOMUL?

- How frequently?
- What are the average levels of different measurements?
- Difference between MCC/CMC/others?
- Differences between the CMC?
- What is the most crucial obstacle facing milk quality at this dairy?

4.' CMP – clean milk production program – define, explain…

4.2 With the implementation of BMC/CMC in Kolar district – what kind of benefits/changes have been achieved in terms of milk quality from the dairy point of view?

- BMC
- CMC

4.3 What is the most important change/improvement in terms of milk quality that has faced KOMUL since implementing the CMC concept?

4.4 Has KOMUL in any way provided CMCs and BMCs with training or/and information about the importance of milk quality?

- Awareness among farmers for milk quality?
- If – in what way?
- If not – would that be of interest for KOMUL to provide in the future?

4.5 Do you believe the control and quality tests made today is satisfactory and enough? Or do you believe quality system has to be different in the future? In what way?

4.6 How do you believe incentives for farmers to produce milk of higher quality can be implemented? Is it necessary?

4.7 Do you know how the payment scheme to MPCS looks like today? Suggestions for development/changes?

4.8 If remarkable milk quality levels are noticed at a specific BMC/CMC – what are the routines/proceedings to handle that?

4.9 From KOMULs point of view, what is the expectation for development of CMC for the future?

8. KOMUL AND DELAVAL

8.1 How does the relation between DeLaval and quality department at KOMUL look like today? Any relation at all?

8.2 What responsibilities do you believe should KOMUL and DeLaval bear respectively according to milk quality and appropriate use of milking machines and additional products of DeLaval at the CMC/BMC?

Obstacles problems

9. FUTURE

9.1 How do you estimate the development and long-term prospects of this Dairy?

ڤ1) Slow
ڤ2) Unchanged
ڤ3) Rapid

9.2 How do you estimate the development and long-term prospects of the CMC system as a concept?

ڤ1) Slower
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9.3 What kind of changes/improvements in the CMC system would you regard as desirable for a successful future for milk producers and the Dairy?

ڤ1) Milk quality improvement
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ف4) More dairy cows per centre
ف5) More milk per cow
ف6) Other

9.4 What is the largest challenge facing the Dairy today?
9.5 What is the largest challenge facing the future for the CMC's?
9.6 How much more milk will the Dairy process in 5 years?
9.7 How much of that increase will come from the CMC?
9.8 What can the Dairy do to speed up the milk production from the CMC's?

QUESTIONNAIRE FOR KOMUL VETERINARY (Route doctor) Date:

NAME OF PERSON:

1. PERSONAL INFORMATION

1.1 Position in the Dairy:
1.2 Age_____ Year
1.3 Sex
ف1) Man
ف2) Women

2. WORK EXPERIENCE

2.1 Did you grow up on a dairy farm?
ف1) No
ف2) Yes
2.2 Have you owned and managed dairy cows?
ف1) No
ف2) Yes
ف3) Still have own dairy cows
2.3 How long have you been working at the Dairy?
ف1) Less than 1 year
ف2) 1-5 year
ف3) 5-10 year
ف4) ≥ 10 year
2.4 Can you briefly explain your work at the dairy, your duties and responsibilities?
2.5 Earlier positions:

3. EDUCATIONAL BACKGROUND

3.1 Kind of education
ف1) No education
ف2) Compulsory school
ف3) Secondary school
ف4) University
ف5) Other

CMC INFORMATION

What do you know about the CMC concept development, introduction, and implementation and maintenances?
- Advantages/obstacles for KOMUL
- Advantages/obstacles for MPCS
- Advantages/obstacles for producers

4. VETERINARY SERVICES

4.1 How does the veterinary service look like in general – within KOMUL and its milk producers?
- Covering/spreading
- Services provided
- Costs for consultation and treatment
- Need from farmers

4.2 Are the veterinary services provided today sufficient and in balance with the needs from farmers?
- How do you view the issue of Competition/access to private veterinaries –

because of time delays of services?

4.3 What is the most common health problem among dairy cows in Kolar?
- Other common health problem
- Difference in animal health between CMC and MCC
- What is done from KOMUL side to prevent health problem?

4.4 What are the most obviously pressing issue with the veterinary service system operating within KOMUL today?
- Complains and unfulfilled needs from farmers

4.5 How would you like to improve the services?

5. ANIMAL HEALTH and AWARENESS

5.1 How do you regard the animal health awareness in general among milk producers in Kolar district? Changes over time?

5.2 Do you face any difference between CMC associated farmers and other farmers in terms of animal health awareness?

1 What kind of difference – why?

5.3 Is there a difference in animal health problems facing CMC farmers and other farmers?

2 Less problems/other problems/improved health

5.4 Do you believe CMC has the potential to be a platform for enhancement and improvement according animal health – in what way?

6. TRAINING AND EDUCATION IN ANIMAL HEALTH

6.1 Is the Dairy organising any courses for secretaries at the CMC according animal health?

ف No

ف Yes What are the course/courses about?

1 What kind of training would you like to see/ would be necessary for the secretaries? Why?

2 Plans to introduce further training for secretaries? How and what issues?

6.2 Is the Dairy organising any courses for the farmers at the CMC according animal health?

ف No

ف Yes What are the course/courses about?

1 What kind of training would you like to see/ would be necessary for farmers? Why?

2 Plans to introduce further training for farmers? How and what issues?

6.3 In general, what kind of services / key features would you like to be part of the CMC?

6.4 From your experience, what kind of changes have been the results since CMC started? (Rank all relevant)

ف 1) More milk collected
ف 2) Better milk quality collected
ف 3) Change in cost and work for collection
ف 4) Safer more regular deliveries
ف 5) Safer dairy products
ف 6) Improved knowledge about relation with milk producer
ف 7) Other

7. FUTURE

7.1 How do you estimate the development and long-term prospects of this Dairy?

ف 1) Slow
ف 2) Unchanged
ف 3) Rapid

7.2 How do you estimate the development and long-term prospects of the CMC system as a concept?

ف 1) Slower
ف 2) Unchanged
ف 3) Faster

7.3 What kind of changes/improvements in the CMC system would you regard as desirable for a successful future for milk producers and the Dairy – for improvement in animal health?

7.4 What is the largest challenge facing the Dairy and CMC development today and for the future – according to animal health?

Pris: 80: - (exkl. moms)

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