



Quality Based Milk Payment Study

Kenya Dairy Sector for SNV KDMP Project

Mission Report
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Outline

The introduction of a quality based milk payment (QBMP) system will be a tool to strengthen the dairy sector in Kenya. By improving the raw milk quality, possibilities for export will develop, there will be improvement in product shelf life, and production costs can be expected to go down. Food safety will improve, and general product quality will be enhanced. Stakeholders within the Kenyan dairy industry are aware of the potential benefits and the study concludes that the industry should proceed to implement a QBMP. To support the effort, the Dutch Government/SNV is willing to co-finance this initiative by providing knowledge support.

Introduction of a QBMP system will not change the price setting of milk, only the price structure. Bonuses for high-grade milk will be financed from penalties for sub-graded milk. There will be an investment in quality control and extension services, which will be paid back by the accruing benefits of value addition of the products.

Note: In the report, reference is made to raw milk bacteriological quality data which was derived from various studies conducted by organisations and NGOs from 3 to 5 years ago. From verbal reports with a variety of stakeholders met during this study, it was evident that the bacteriological quality of the raw milk supply remains much as it was and has not substantially improved. The consultants were unable to access the data from the most recent past collected by other organisations, but in our discussions with processors we were left in no doubt as to the average bacteriological quality of milk currently being delivered to the processing plants.

Executive Summary

Internationally, QBMP systems have repeatedly been shown to significantly improve milk quality at the farm level, which has a beneficial knock-on effect along the whole of the dairy chain. Examples are cited of improvements in milk solids, longer shelf life, and improved bacteriological quality. The impetus for change is the introduction of a financial incentive.

Only a tiny fraction of Kenya's milk production is exported. In recent years a number of trade conflicts arose, when regional importing countries (Zambia, Tanzania) rejected products, processed in Kenya on the grounds that Kenya's raw milk production was of insufficient quality. High total bacterial counts in the raw milk supply were cited as the cause for rejection of the products. Subsequently, in a response to address the problem Kenya revised the raw milk standard, and in 2007 the standard was harmonized with the EAC and COMESA standards. The current standard sets microbiological limits, which are more rigorous than the average bacterial quality of the milk produced in the country.

Under Component 1 of the Land O'Lakes KDSCP project (2007-2011), a number of initiatives were promoted to address the problem of the quality of the milk supply. The initiatives included, amongst others, writing new dairy regulations, training KDB regulatory dairy inspectors, delivery of a GMP training programme, and designing a QBMP system. The QBMP plan was not implemented.

Dairying in Kenya is a domestically focused activity with a very large informal sector and only 18% - 20% of the milk passing through formal market chains. Consumer demand is highly skewed towards low price raw milk that is generally boiled before consumption. Achievement of quality in the raw milk chain is extremely difficult due to long waiting times for collection in tropical temperatures and the lack of cooling infrastructure.

To ease implementation of a QBMP system, the design should be kept simple, understandable, and easily manageable. The proposed design in this study is a 'whole chain' approach, where the farmer, the bulk collection tank, and the processor are all participating players in the payment system. The proposed system aims to utilize the existing milk testing facilities at the collection centre and at the processing plant, with the provision of some additional testing equipment. Training of the operators and milk testers will be required.

To deal with quality issues as they arise, the processing plants in the programme will be required to provide farm extension workers to provide support and instruction to the farmers, cooling tank operators and transporters along the chain.

Before launching the programme a baseline study must be carried out in order to generate data on the current quality of the milk. The data will be used to determine and set the thresholds for each of the quality parameters to be tested.

The payment system will be two-tier, farmer to cooling tank, and cooling tank to processor. The test parameters for each tier will be selected to meet the specific local requirements and circumstances and are unlikely to be identical for each tier. The processor will pay the collection centre for quality, and the collection centre will pay the farmers for quality.

Total Plate Count is a priority choice parameter for the cooling tank to processor tier. The Resazurin or the Methylene blue tests will determine the bacterial quality of the farm milk arriving at the cooling tank indirectly. Freezing point determination to determine added water adulteration will be used in both tiers.

Acceptance thresholds will be chosen without reference to the raw milk standard. The thresholds for each band of milk quality will be selected to meet the capacity of the farmers to attain them.

Three quality bands are proposed:

- 1) Standard grade which will receive the standard milk price as it is at present.
- 2) Superior quality grade, which will receive a bonus payment.
- 3) Inferior quality grade, which will receive a deduction.

The deductions will pay for the bonuses so the pot of money remains the same as currently, and there will be no increase in the milk price. The QBMP system influences the price structure but does not affect price setting. The quality bands will be selected to ensure that 75% - 85% of the farmers will receive the standard price, 5% - 10% will receive the bonus, while 10% - 15% will receive the deducted price.

The system will provide advantages along the chain. The farmer will be encouraged to improve quality by the introduction of a monetary incentive. To receive the bonus payment from the processor, the cooling tank operator will be required to tighten the inspection of the farm milk being delivered, while the processor will be the ultimate beneficiary receiving milk that has been more carefully tested to eliminate quality faults along the chain. Operating a QBMP system, for the processor, the plant quality control system now extends to the farm level as everybody along the chain now has an interest in the quality of the product he passes along the chain. Previously, plant quality control started at the reception dock. With the active support of extension officers, quality problems can be identified at the farm level and rectified before they reach the dairy.

The intermediary has to ensure, that the milk quality from the moment it is purchased from the farmer until the moment it is delivered at the factory gate stays the same. If the handling of the milk is not performed properly during this period, the intermediary will lose money.

QBMP systems have been successfully introduced in countries with dairy economies similar to Kenya. Farmers and processors have benefitted, with improved incomes resulting in efficiencies in the processing plants and better quality products delivered to consumers.

The study presents a proposal for the design and operational methodology for a QBMP system, which is matched to the circumstances and conditions of Kenya's dairy industry. The necessary preliminary steps necessary for implementation are presented.

Statement of Work

The purpose of the assignment was to conduct an *assessment of the viability of a private sector-led graded raw milk payment system for Kenya. The assessment reviewed the dairy value chain with emphasis upon the challenges of transforming the quality of raw milk to a more competitive position within the dairy industry. The assessment concluded with a model for developing commercial motivation of the private processors and farmers to participate in a quality based milk payment programme.*

The farm gate milk price fluctuates for reasons of season, supply and demand, capriciousness of the traders and the dairy plants etc., all of which is out of the farmer's control. On a daily basis, the farmer cannot determine or be assured of the price he will receive for the milk he sells. Experience internationally, has clearly shown that financial reward drives farmers to improve the chemical and microbiological quality of milk produced. The milk quality targets adopted in a graded payment for quality scheme need to be chosen with an appreciation of what is realistically attainable by the majority of farmers.

Kenya has one of the most developed dairy industries in East and Central Africa, which has recorded significant growth in milk production and value addition since year 2003 despite a depressed performance in the 1990's following the liberalization of the industry. According to the Kenya National Bureau of statistics (2009) Economic Survey, the industry contributes about 4.0% to the GDP and is a major source of livelihood to poor rural households.

As a player in the export market, the industry is expected to comply with stringent food safety requirements and standards. However, existing data reveals low levels of compliance to these standards, particularly in terms of microbial load and adulteration, pointing to malpractices such as poor handling during storage and transportation and water adulteration, an aspect that has been linked to the current payment system which rewards volume with little consideration to the quality parameters.

The objectives of the study will be to establish whether farmers would improve the quality of their milk if a payment system based on quality was adopted, determine whether farmers would earn more if the milk quality was improved, establish specific changes in practice that the farmers would adopt to realize improved quality and whether the system would be a viable option for the Kenyan dairy industry.

Terms of Reference

To conduct a study to describe, analyse and advise upon:

- The policy framework and quality control mechanisms in place (and being developed) related to milk quality and product safety.
- The feasibility and modalities of a quality based milk payment system in Kenya.

The consultant will be expected to link up with existing knowledgeable stakeholders such as KDB, KDPA and individual processors, Heifer International (EADD - Nestle, Tetra Pak, ABS TCM), Land O' Lakes, ANALABS, Kenya Bureau of Standards, Departments of Milk Production and Veterinary Services in the Ministry of Livestock Development, and the Ministry of Health. It is proposed for the works to be divided in 5 sections:

- a) An analysis of the policy environment, regulatory provisions and control mechanisms in place (and/or being developed), related to milk quality and product safety standards, and recommendations for improvements and support in KMDP's Inception Phase.
- b) A report/overview of a number of best practises in QBMP – systems. Particular emphasis should be put on cases/countries that can be used as benchmarks for the Kenyan dairy industry. This report should document:
 - Milk quality payment system objectives.
 - Milk quality parameters and price calculations, including penalties and bonuses.
 - Base price versus milk cost of production (Note: only in as far as reliable figures on cost price of milk can be derived from existing studies).
 - Production, milk collection, and cold chain structure. Consider groups of farmers, large-scale farmers, and small-scale farmers.
 - Regulatory mechanism, if any, in the implementation of the QBMP-system.
 - Other supportive structures, institutional or otherwise, to support the system(s).
- c) Collate information on QBMP - systems at work in Kenya, as in use by high-end producers of yoghurt, cheese and ice cream with a view to determine:
 - Milk quality payment objective.
Milk quality parameters analysed and relevance of current Kenyan milk quality standards.
 - Report on examples of pricing structure in existing QBMP systems currently being operated in Kenya.
 - Operations in terms of contracts, chain management including tracking and tracing, logistics, quality control and payment systems.
- d) Study on feasibility of large scale implementation of QBMP – system and sector preparedness, addressing:
 - Policy considerations.
 - Milk quality parameters to form basis of payment and best procedure for calculating payments.
 - Preferred protocols and structure for milk production, milk collection, cold chain, and transport to processors.
 - Milk testing and sampling schedule.
 - Contracting modalities between different actors.
 - Infrastructural considerations e.g. certified testing laboratories
 - Investment implications for processors, CBE's, and farmers.

- e) Develop a project proposal for consideration during the KMDP's Implementation, which shall include, but not be limited to:
- Context.
 - Problem statement.
 - Proposed solution.
 - Budget estimate or guideline.

Abbreviations and Acronyms

AI	Artificial Insemination
CBE	Collection and Bulking Enterprise
Cfu	Colony forming unit
DSA	Daily Subsistence Allowance
EAC	East Africa Community
EADD	East Africa Dairy Development Project
Fte	Full time employment
GoK	Government of Kenya
HACCP	Hazard Analysis and Critical Control Point (a quality assurance technique)
HTST	High Temperature Short Time (ref: milk pasteuriser)
KDB	Kenya Dairy Board
KDPA	Kenya Dairy Processors Association
KDSCP	Kenya Dairy Sector Competitiveness Program (Land O'Lakes Kenya dairy programme)
KEBS	Kenya Bureau of Standards
KENAS	Kenyan National Accreditation Service
Kgs	Kilograms
KSHs	Kenya Shilling
LOL	Land O'Lakes
MI	Millilitre
MoU	Memorandum of Understanding
MQC	Milk Quality Council
NGO	Non-Government Organisation
R1555	South Africa: Regulations Relating to Milk and Dairy Products
RATES	Regional Africa Trade Expansion Program (USAID-funded programme)
SNF	Solids-non-Fat
SNV	Netherlands Development Organisation
SOP	Standard Operating Procedure
TPC	Total Plate Count
TS	Total Solids

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3	Minutes of the pre-study QBMP workshop from November 2011
4	Kenya Dairy Board QBMP implementation paper
5	Parmalat Zambia Raw Milk Standard

1 Policy Environment Review



1.1. Analysis of the Policy Environment

In Kenya, the food safety control system is multi-sectoral in approach and is embodied in various statutes implemented by various Government ministries / departments and regulatory agencies. The coordination mechanism among these institutions is currently inadequate. This has created overlaps of mandates with ensuing inefficiencies in national food safety control. Food safety needs to be organized in a more co-coordinated and integrated way to deliver a high level of public health and consumer protection in accordance with both local and international requirements. There is need for the establishment and maintenance of a rational, integrated *farm-to-fork* food safety system that harmonizes inter-agency efforts, minimizes inter-agency conflict and overlaps, and ensures the protection of food safety in a manner consistent with the Sanitary and Phytosanitary Agreement of the World Trade Organization (WTO/SPS) and other international requirements.

Currently the population is approximated to be 36 million people with an annual growth rate of 4% and about a million visitors each year. It is important that the quality of Kenya's food supply meets the highest safety requirements to satisfy domestic and international demands. The Government of Kenya, therefore, prioritizes successful implementation of food safety policy. The policy complements several existing national policies in providing a framework for safe, sustainable, and ethical food production.

The national food safety system in Kenya is managed by various agencies under different ministries and laws. This is with an ultimate aim of promoting public health, protecting the consumer from health hazards and enhancing economic development.

Each agency operates independently to fulfil the function for which it was established. However, the activities at each level require integration into a coordinated system. This necessitated the formation of the National Food Safety Coordination Committee.

An elaborate food safety management system exists in the supply chain that targets the export market and the medium to high-income consumers. This may be attributed to consumer awareness and income levels.

Committees comprised of representative stakeholders drawn from regulatory bodies, academia, industry and consumers groups, collaborate to develop food quality and safety standards. The stakeholders provide the expertise and scientific information and build consensus required in national standards development. In developing standards, priority for reference is given to relevant codex and other international standards (texts) to provide the baseline information on which national standards may be adopted or adapted to suit the national food safety situation. Other reference materials include regional and other national standards, laws, and regulations.

The administration and implementation of food laws requires qualified food inspection services. The inspector is the key functionary who has day-to-day contact with the food industry, trade and often the public. The reputation and integrity of the food inspection system depend largely on the integrity and technical capacity of the inspector. The inspectors available are well trained but there is a limitation in terms of numbers and facilitation to adequately carry out their duties. There is need to update the skills of the food and dairy inspectors so as to keep abreast with the dynamics of the food and dairy industry.

Less than 1% of the EAC region's milk output is exported. Some observers have tended to link the poor trade performance with the existence of trade barriers. It is more likely that trade is not happening due to a general shortage of milk. Dairying in all the EAC member states is a domestically focused activity with very large informal sectors with perhaps only 10-20% of milk going through formal market chains. The reliance on the domestic market is the focus of the production and marketing challenges and opportunities faced by the sector. Consumer demand is highly skewed

towards low price raw milk that is generally boiled before consumption. Raw milk is not a readily tradable product due to tropical temperatures and the lack of a comprehensive cooling infrastructure. Trade primarily takes place in milk powder, UHT milk, and more high end products such as cheese and yoghurt.

Because of the preference of most consumers in East Africa for low cost raw milk, a major challenge for value chain projects has been to make formal sector dairying more attractive. Most dairy processors in Kenya have so far been unable, or perhaps unwilling, to pay a price premium for superior quality that would reward a farmer's investment in quality practices. Much NGO support given to farmers has been devoted to fodder and silage production training, the establishment of veterinary services, access to drugs and artificial insemination (AI) services. Much work has also been done with dairy producer groups to identify market outlets and negotiate reliable supply contracts with dairy processors.

Bulking centres have been the main focal point for this work with various NGO project investments in the rehabilitation and provision of milk cooling tanks, purchase of hygienic dairy equipment, provision of business management training, and other improvements needed to make formal sector marketing and business development more effective and attractive. The NGOs, with partners such as Tetra Pak have supported generic dairy promotions to build consumer demand, and the introduction of HACCP and GMP quality control systems.

In 2008, the Gates Foundation launched East Africa Dairy Development (EADD) Project, which is a 10-year initiative that started with a 4-year pilot worth USD 42 million that covers Kenya, Uganda, and Rwanda. The EADD strategy follows the "milk hub" approach, which uses milk-bulking centres as the focal points around which business development linkages are created between the hubs, the farmers, and inputs suppliers, so creating a web of market linkages. The milk hub development strategy focuses attention on bulking centres as a business enterprise and provider of services needed to support dairy production. The objective is to promote stable market linkages that act to attract farmers because of the services offered by the hub. This, in turn, allows the hub to create marketing relationships with dairy processors as purchasers of the milk, and so open the way to accessing other benefits including the ability to mobilize private finance for investments in cooling tanks and other infrastructure needed for the growth and development of the cooperatives.

1.2. Policy and Regulatory Mechanisms

Dairy industries are controlled by the use of several mechanisms, which may not all be present or in use in any specific national dairy industry. Regulation is conducted using a variety of mechanisms.

1. Product Standards and Analytical Standards
2. Voluntary standards
3. Dairy and Public Health legislation
4. Regulatory inspection
5. Courts to impose fines and punishments
6. Business licenses and permits

Government or parastatal agencies tasked with food safety commonly have a statutory objective to protect public health and consumers' other interests in relation to food. However, excessive or unclear regulations can place a burden on business and the public, and so hinder effective delivery of the intended benefits.

The regulation of the food industry impacts a wide range of products and industries, from the wheat in a farmer's field to the nutrition label on the yoghurt cup in the supermarket. The primary tasks of

food regulations are (1) protecting public health and safety (2) preventing consumer fraud and (3) suppressing unfair competition.

Licensing, labelling, and inspection of food products and food producers are the accepted means of regulating the food industry. Depending on the specific violation, both civil and criminal penalties can be utilized if food regulations are violated.

The regulation of the food industry often encompasses agricultural industry. Regulation of the agricultural and food industries is justified as a means of protecting public health and safety. Regulation of the food industry protects the food supply from the presence of unwholesome or harmful chemical, physical, or biological residues; from unsanitary manufacturing and handling conditions, and from false representation or mislabelling with regard to formulation and content.

To effectively carry out its regulatory duties, the agency responsible must be able to collect and analyse data from the field. Data collection has two sources:

1. Analytical results data generated from chemical and microbiological tests of samples taken from processes and products
2. Inspection observations, results, and reports derived from physical inspection of processes and operations within the food chain.

Successful technical inspection, data collection and analysis, requires a knowledgeable and competent technical staff within the regulatory agency responsible for these duties. The regulatory inspectors need to be able to perform their tasks with technical authority and competence.

1.3. The Rationale for a Quality Based Raw Milk Payment System

The basis of any quality based raw milk payment system is that there exists a market incentive for processors and end buyers of dairy products to provide incentive payments to farmers to stimulate the production of higher quality raw milk. Milk quality is generally defined by total bacterial counts (TBC), somatic cell counts (SCC), protein stability, higher than average butterfat and solids not fat, with no adulteration from added water, antibiotics, or chemicals, and free from the presence of any foreign material.

The quality parameter thresholds applied in a system may be set either below or above the national standard, but should be chosen to meet the needs of the processor. In some milk collection systems, the grades or quality standards implemented by the private sector may be in excess of regulatory requirements.

Regulatory requirements are established by government agencies as quality standards designed to protect public health. Private sector quality initiatives are designed to improve economic returns and increase market penetration through improved shelf life, higher milk to manufactured product ratios and yield, and improved sensory appeal such as flavour, odour, and product appearance.

Some of the potential economic returns and improvements that can lead to greater market penetration include:

1.3.1 Longer shelf life

The Kenya Raw Milk Standard, (Raw Milk Specification Kenya/EAS 67-2006) specifies three (3) grades of raw milk,

Table I.1: Kenya Standard Kenya/EAS 67-2006 Raw Milk, Raw Milk Specification

Grade	Cfu/ml
Grade I or A	<200,000
Grade II or B	>200,000 – 1,000,000
Grade III or C	>1,000,000 – 2,000,000

Cfu = colony forming unit

When operated at the legal minimum temperature/time combination, 73°Celsius for 15 seconds, a HTST (High Temperature Short Time) plate pasteurizer, can be expected to reduce the total number of bacteria present in the raw milk, by 2 logarithms. This means that if the raw milk has a bacterial load of 200,000/ml, then at the exit from the pasteurizer the bacterial count can be expected to be approximately 2,000/ml.

The resulting low count will ensure improved shelf life of the milk, provided the pipe system; pumps and filling machines in the plant are effectively cleaned and sanitized before the start of the daily operations. Additionally, the cold chain throughout the marketing process must be preserved and maintained at below 4°C. If these conditions are maintained then the expected shelf life of the packaged milk will be 10 to 12 days.

There is also a direct correlation between somatic cell counts (SCC) in raw milk and shelf life of pasteurized milk. Raw milk with a SCC of over 500,000 CFU/ml may begin to develop bitter and astringent off-flavours at 7 days. High SCC raw milk exhibits more lipolysis and proteolysis than low SCC raw milk. In high SCC milk, during refrigerated storage, the average rate of free fatty acids production and casein hydrolysis increases. The sensory defects, which develop during storage, are rancidity and bitterness, and are consistent with higher levels of lipolysis and proteolysis. Hence, mastitis adversely affects the quality of pasteurized fluid milk. It is generally recommended that the fluid milk industry should consider implementation of premium quality payment programs for low SCC milks.

The Kenya Raw Milk Standard specifies that the somatic cell count limit is to be not more than 300,000/ml.

1.3.2. Product Safety

High numbers of bacteria present in raw milk is indicative of poor handling practices and operations. A high bacterial load is always due to unsanitary operations, and inadequate maintenance of the cold chain. Unsanitary handling of milk increases the probability of contamination by pathogenic microorganisms, which can be of either animal or human origin. Milk, when obtained from a healthy udder, under clean conditions, is almost free of bacteria. Contaminating organisms gain entrance to the milk when the udder is not healthy as when mastitis is present, and when the teats have not been adequately cleaned prior to milking. The milker's hands, buckets, equipment and subsequent handling containers, pipes, pumps and storage-churns, and tanks all contribute to the bacterial load in the milk.

1.3.3. Antibiotic Residues

The presence of antibiotics in milk has been known to produce antibiotic allergies in people who are sensitive to certain antibiotics. Medical use of antibiotics in babies has been shown to fail because of

a resistance reaction in infants who have been continuously fed with milk containing antibiotic residues. The absence of antibiotics is imperative in milk, which is to be processed into cultured products and cheese.

1.3.4. Product Sensory Appeal

Invariably, dairy products suffer from sensory appeal defects when high TBC and SCC raw milk is used as the raw material. Pasteurized milk quickly sours. Cheese may have poor product appearance, poor in-process curd structure, and an undesirable texture in the final product, with probable production of gas holes caused by the presence of contaminating bacteria, and may be accompanied by bitter flavours. Yogurt and cultured milks may also have flavour and appearance defects. In-process fermentation times can increase, which is a cost to the processor.

1.3.5. Cheese yields

Cheese yield is usually expressed as the no. of kilograms of cheese produced from 100 kilograms of milk. Investigations have shown that high quality raw milk with low bacteria counts and low somatic cell counts can significantly improve the yield of cheese in a manufacturing process. In a cheese process, use of milk with a high somatic cell count may show a reduction of 1 – 2% in yield of final product. The losses/gains in cheese yield are so significant that it was cheese-makers in the 1970's who first implemented quality incentive payment programs for high quality milk.

1.3.6. Pasteurization costs

In the processing dairy, the usual way to deal with high-count raw milk is to raise the pasteurization temperature. In HTST plate pasteurisers it is not usually possible to conveniently increase the holding tube length to enable a longer residence time at pasteurization temperature, therefore processors simply raise the pasteurization temperature. As an example during this study we noted at one of the dairies we visited, 80°C - 82°C was used for routine pasteurisation. The legal minimum pasteurisation temperature is 73°C for 15 seconds.

When higher pasteurization temperatures are used to reduce the high bacterial load in low quality milk, the additional energy required to produce the higher temperature is an additional operational cost for the dairy. Pasteurization times and/or temperature will inevitably increase with poor quality milk. An increase in time and temperature will lead to increases in processing costs. These additional costs may range from 5% to 15%.

1.3.7. Deposits on Heat Exchanger Plates

When processing milk at high temperatures in a plate pasteurizer or sterilizer, milk mineral deposits build up on the plate surfaces. As the processing time increases, the deposits on the plates increase. The result is that the widths of the passages in the plate pack decrease, so leading to an increase in the internal pressure in the plate pack and a lower throughput of milk per unit of time. The only remedy is to stop processing and to circulate alkali and acid solutions to remove the deposits. This is a time consuming procedure, which has costs in processing downtime, labour, and materials.

1.3.8. Butterfat

Butterfat and protein in milk have a significant commercial value to processors. Consequently, many QBMP systems provide an incentive to pay for increasing these components of milk. For example butter is 82 - 84% butterfat, and cheese can range from 30% to 40% butterfat.

Butterfat and other solids are components, which are associated with component pricing and not necessarily with quality per se. At the moment, Kenya dairy processors are pricing milk purchased from farmers on volume, which may be acceptable in a fluid milk market. Processors who are manufacturing high fat content products, for example cream, are essentially receiving the components cheaply. As mentioned above, the market value of butterfat is significant, and farmers are not being compensated. Component pricing would certainly stimulate farm management practices to target higher yields, in kilograms, of butterfat and protein per cow. Protein production is a highly heritable trait, which is very difficult to influence through feeding and nutrition. Yields of butterfat are more easily influenced through selection of appropriate feedstuffs and nutritional management, and increased yields can be obtained relatively quickly.

In many QBMP systems, premium payments are made for the weight of fat, and sometimes protein, delivered, and not for the volume of milk delivered. By paying for the weight of the components, adulteration with water to increase volume is immediately discouraged, since the addition of water dilutes the weight of the components. This method is widely used in QBMP systems.

The incidence of water adulteration is quite significant in East and Central Africa. The perpetrators are encouraged to add water because milk payment is based on the volume delivered. The threshold for specific gravity used at milk collection centres is invariably 1.028. This value is low and indicates to the consultants a high probability of the presence of added water. Normal milk from healthy animals usually has a specific gravity in the range of 1.029 to 1.032. On the other hand, the EAC / Kenya / COMESA standard cites 1.028 as the minimum threshold value permitted. This indicates that there is a general acceptance of the reality of water adulteration. In previous consultancies, it has been noted that milk collectors and traders may even add water collected from roadside ditches, as they recognise that the dissolved solids (soil, dirt) will improve the specific gravity reading. In one case, it was reported to the consultant that urine may also be used for the same reason. Obviously, water carries a bacterial load, and the numbers will be a function of the source and cleanliness of the water. Consequently, the addition of water to milk inevitably increases the bacterial load in the raw milk, with subsequent reduction in its keeping quality.

The effects of added water are several. The prime problem for the processor and/or consumer is the resultant reduction in the total solids content of the milk. Processed products may not meet legal total solids content requirements, in which case the processor would be required to supplement the solids content by the addition of reconstituted skim milk powder, so increasing processing costs. For the consumer, lowered solids content due to added water, which essentially is protein, results in lower nutritional values in the products purchased and consumed.

In summary, it is clear that a milk quality payment program can be market driven, based upon delivering a product with greater appeal to consumers and decreasing processors' costs, and increasing revenues for both the farmer and the processor. A longer product shelf life could result in a reduction in distribution costs, as retailers would have to be serviced less frequently. Longer shelf life would also have convenience advantages to consumers who would be more likely to be able to purchase milk less frequently and cease the practice of boiling purchased milk. Increasing cheese yield will increase efficiencies and revenues. At no additional investment processors would be able to improve the yield of cheese per 100 kilograms of milk.

Experience of implemented QBMP systems has shown that with improved extension services to farmers, farm level productivity improves, and has been demonstrated in improved milk yields.

There seemed to be a consensus among processors that farmers would respond to a payment incentive of 1 Kshs per litre (3.5%) with the current price in the 28 KShs to 30 KShs per litre range. Farmers would have to make some management adjustments to produce high quality milk, although

the investment would be insignificant. Farmers most likely would have to upgrade their use of detergents and sanitizers, replace unsanitary milk buckets and containers, and replace them with acceptable metal containers, and they would have to attend to greater detail in milking practices. A more demanding management change would be to modify milk collection practices in order to deliver milk to the collection centre within a specified time to reduce bacterial growth during the gap between milking and chilling. Milk should be chilled to below 4°C within 3 hours of milking. However, the return on investment for all parties would be rewarding, which is the goal of a milk quality incentive payment.

It is a fair assumption that any incentive payment that exceeds the current price of milk paid to farmers would also drive more raw milk from the informal market channel into the formal market channel. Regarding the pilot program, caution must be exercised that if 1 Kshs or 2 Kshs is sufficient to serve as an incentive, a similar reduction in milk price serving as a penalty might drive farmers to a processor or informal trader not participating in the pilot program. One potential strategy to manage this scenario would be to contract with a cooperative as the milk supplier and bring the cooperative into a role of assisting in managing their member milk supply and quality. Additionally the cooperative may be able to exercise some element of peer pressure to maximize efforts to improve milk quality and minimize the loss of farmers to non-participating dairy processors or traders in the informal market channel.

There are two challenges for the milk quality incentive payment program. The program can be expected to have a secondary impact along the dairy value chain. For example, input suppliers will come to play a role by supplying better quality detergents, sanitizers, and equipment and providing technical advice on the use of the materials. The knowledge and competence of input suppliers will be challenged to improve.

Another critical area is the relationship between milk processor and milk producer or cooperative. The relationship between buyer and seller is characterized with a bundle of attributes; trust, financial flows, services, quality products, and others. These fall into a relationship of power/learning/benefit. The power relationship means the buyer and seller each have some control over the transactions and that there develops a win-win situation. Establishing quality standards that lead to reduced production costs, longer shelf life, increased cheese yield, etc. and rewarding farmers who meet that standards is desirable to both parties. With the milk quality incentive payment program the buyer is essentially the catalyst of change, and therefore a source of learning and capacity development for the farmers. In addition to input suppliers providing capacity development to farmers, the buyers whether it is the cooperative or processor, will have to adopt a teaching and extension role by working with and guiding the farmers, helping them to adopt farm management and milking practices that lead the farmers to improved quality and rewards from the incentive payment. The driver in the relationship is the financial incentive.

Training and supervision plus incentives should also be given to transporters and milk quality tester personnel. These participants in the chain also have interests and they should be attended to by creating a mechanism to ensure their cooperation and positive attitude.

The greatest challenge along the dairy value chain is the end buyer, the local consumer. This challenge is most likely to be with pasteurized milk. In 2008, the Land O'Lakes KDSCP programme conducted an assessment, "Consumer Milk Quality Perception/Preferences, An Assessment of Willingness to Pay for Quality".

The collected data showed that overall, consumers view dairy as the fluid milk market with 85% of consumers noting "top of the mind" dairy products as either processed milk or raw milk. This leads us to conclude that fluid milk significantly dominates the dairy market in Kenya. The assessment

concluded that consumers are not willing to pay more for improved quality. This is not surprising. The factors weighing upon a consumer's purchase choice is led by price, followed by quality. However, consumers may not have to pay more per unit of milk in order for the processor to increase profitability under a milk quality incentive payment program. As mentioned earlier, a longer milk shelf life can be expected to reduce distribution costs. Fewer stoppages in processing operations, caused by milk quality problems, will benefit processing efficiencies. Consumers who are satisfied with improved quality may purchase more units at the current price and the addition of new customers may expand sales further. Consumers rate the nutritional value of milk highly. Consumers also define quality associated with taste, smell, 'thickness' (milk solids), shelf life, and fat content, all of which would be improved under a milk quality incentive program.

If dairy processors were to seek to fund the incentive payment from the consumer milk price per unit, then the quality improvements and benefits would have to be effectively communicated to consumers. However, in the design of the payment system proposed in this study, the payment system will not entail a need to increase the price to the consumer. Instead, the pot of money used to pay the farmers will be distributed in such a way that the bonus payment for superior grade milk will be met by reductions made from the price paid to farmers who produce inferior grade milk. In this way the total fund of money used to pay the farmers remains constant and as it is under the present payment system. The difference will be in the way the money is distributed. A proportion of the farmers will gain and a proportion will face reduced prices. However, the incentive to improve quality and as a result to gain a bonus payment is integral to the proposed payment system.

In conclusion the team believes that a private sector-led milk quality incentive payment program will yield benefits to the entire dairy value chain. Farmers will increase income, processors will reduce costs and increase manufacturing efficiencies, and consumers will in the long run have their demands relative to quality attributes of milk satisfied.

1.4. Existing Regulation and Control Mechanisms

1.4.1 Legislation

There is inadequate coordination in the enforcement of various Acts of Parliament that covers the entire food chain. The mandates in the operations of the food control system at times tend to overlap resulting in ambiguity hence inadequate enforcement of regulations, and weaknesses in inspection and analysis. Some of the Acts have not been updated to keep abreast with the changing local and international trends. Attempts at piecemeal reviews have not resolved the food safety challenges that prevail. Street vended foods have not been formally recognized in the various legislative frameworks.

1.4.2. Institutional Framework

There is lack of formalized networking between institutions that deal with food safety. Linkages amongst research, regulatory and enforcement institutions are weak, leading to inefficiencies in ensuring food safety. This has led to an underdeveloped scientific data bank to support the development of science based food safety standards, risk analysis, regulations, practices, framework and capacity to effectively address emerging issues.

1.4.3. Validation, Monitoring, and Evaluation

Food safety validation, monitoring and evaluation systems are underdeveloped and under-funded. This has impacted negatively on the compliance to recommended food safety practices along the food chains. The consumers and the general public are not well informed of the dangers posed by

poor food safety practices during production, processing, and consumption of food. This hampers information gathering and flow to enable effective monitoring.

1.4.4. Traceability

Most players along the food chain have not established traceability systems in their operations. The perception is that this is the responsibility of government agencies whereas it is the responsibility of all stakeholders along the food chain.

1.4.5. Laboratories Infrastructure

The laboratory services provided by the regulatory agencies have limitations in scope of analysis and equipment and in some cases are not up-to date with the new technologies. With the increasing trade and stringent trade requirements, demand for laboratory analysis from inspections, product certification, quality assurance, and surveillance overstretch current capacity.

With no local accreditation body in place, a few laboratories have engaged foreign accreditation organisations to accredit some of their analytical methods and services.

1.4.6. Kenya Dairy Board (KDB)

Kenya Dairy Board is a parastatal organisation, and was established by an act of Parliament in 1958. The Dairy Industry Act Cap 336 of the laws of Kenya governs the activities of KDB. The Board has the following functions:

- Organise, regulate, and develop the efficient production, distribution and supply and marketing of dairy produce, having regards to the various types of dairy produce required by different classes of consumers.
- In collaboration with the relevant institutions, make regulations governing appropriate quality standards for milk and dairy products.
- Advise the Government on aspects deemed to be in need of policy and legislative attention, and other measures for improved management of the dairy industry.
- Permit and promote private enterprise and efficiency in the Dairy Industry.

Additional legislation, which impacts on the dairy industry, is:

- The Food, Drugs, and Chemical Substances Act, which sets the requirements for food plants, dairy product definitions and permitted additives.
- The Public Health Act, which deals with pest control, sewage and employee health.
- The Animal Diseases Act

Dairy Board operates 15 field offices throughout the country. The field staffs manning the offices include a group of approximately 25-30 inspectors. The function of the inspectors is to act as extension officers to dairy businesses of all types. Due to financial limitations, they lack appropriate tools, such as adequate supplies of laboratory equipment and/or alternative ready access to third party owned laboratories, to enable them to effectively inspect processes and test milk and products.

1.5. Regulations and Control Mechanisms Being Developed

Together with quality assurance, public health protection is a major consideration in the compilation of dairy standards. Historically, milk and milk products have acted as major vectors in the transfer of disease from humans to humans, and animals to humans.

An investigation (2005), which studied the health risks of consuming Kenyan milk, demonstrated that the microbial quality was generally poor and exceeded the then newly set EAC standards by a large margin. The EAC / COMESA standard for raw milk sets three grades of raw milk, with class C/III milk being the lowest quality. The standard determines that for class C/III milk, the total bacterial count may not exceed 2,000,000 colony-forming units (cfu) per millilitre (ml) and the milk may not contain more than 50,000 cfu per ml of coliforms. Logically, this implies that milk having a total bacterial count in excess of 2,000,000 cfu/ml is not fit for processing and implies that its use for processing is illegal. The total bacterial count is mainly a function of sanitation, hygiene, storage temperature, and elapsed time before cooling and ultimate heat treatment, while the coliform count indicates the possible presence of microorganisms of faecal origin.

In the collection of data for this study, reported analytical data indicated that most analysed samples exceeded the limit set for total bacterial count by a large margin. This finding has been verified by subsequent studies of raw milk produced by farm cooperatives. The reasons for the high bacterial load are insufficient sanitation and hygiene practices along the raw milk chain, extended holding times during transportation in tropical temperatures, and lack of cooling facilities and equipment.

Evening milk invariably is not chilled before delivery to the bulking centres, but held overnight at ambient temperature. Holding milk overnight at ambient temperature results in substantial bacterial growth. By morning, after holding overnight at ambient temperature, the bacterial population in the evening milk will be in the log phase. Adding the evening milk to new morning milk causes the bacteria in lag phase in the morning milk, to quickly multiply and go into log phase. The bacterial lag phase is usually 3 – 4 hours, but in log phase the generation time may be only 20 to 30 minutes. This means that the bacterial population doubles in 20 – 30 minutes, depending on the bacterial species present. Milk fresh from the udder contains very low bacterial counts (less than 1000 cfu/ml), but the environment where milking is done, the equipment used, and often poor hygiene, significantly increases the numbers of bacteria present in the milk.

Under conditions where the distance between the farm and the cooling tank is extended, either in terms of distance or in elapsed hours between milking and delivery, bacterial numbers can be expected to be higher the further away from the farm production source, the milk is tested.

In general, in the Kenya milk supply, the total bacterial counts exceed the EAC raw milk standard by a wide margin.

Table 1.2.: Representative Average Bacterial Counts in Kenyan Milk Samples
(Data from surveys of 5 cooperatives, conducted in 2008)

Source	Total Bacterial Count (per ml)	Coliform Count (per ml)
Farmer group	7.0 to 9.0 x10 ⁶	10.0 to 20.0 x 10 ⁴

1.6. The New Dairy Regulations

A previous study of the bacteriological and chemical quality of raw milk and a representative selection of over 250 samples of raw and processed milk products in Kenya, conducted in 2008, reported that when compared to the requirements and limits of the relevant Kenya dairy product standards, nearly all the samples failed on at least one of the test parameters.

In total, 263 samples were tested. The processed products were purchased from retailers. Of the total number of samples, 40 were raw milk, and others included pasteurized milk, yoghurt, cheese, milk powder, lala, butter, ghee, cream, and ice cream. Bulk raw milk samples were taken from sales outlets, which had high capacities for handling raw milk produced in the area.

105 samples were tested for pesticide residues, including the most commonly used in Kenya, Deltamethrin, Amitraz, Cyhalothrin and Pirimiphos methyl. No residues were found in any of the samples.

In the processed dairy products the most common cause of failure to meet the requirements of the standards was the presence of coliform organisms. The significance of the presence coliforms in pasteurized milk and dairy products is that they are indicators of the possible presence of gastrointestinal pathogenic organisms. Pasteurisation destroys all coliforms; therefore their presence in pasteurized products indicates lack of hygiene and sanitation in the post-pasteurisation operations, handling and packaging.

No salmonella was detected, but *Staphylococcus aureus* was isolated from 37.5% of the raw milk samples and from 1 sample of lala. The presence of *Staphylococcus aureus* in raw milk is significant as the organism produces a heat-stable toxin, which can survive pasteurization temperatures. The pathogen *E. coli* was isolated from a significant number of samples across the range of pasteurized products.

Similar significant bacteriological problems causing non-compliance with the requirements of the standards were found across the range of other dairy products.

The results of the investigation clearly identified an inherent quality problem in the milk and dairy products sold in Kenya. A significant proportion of the products, and also the raw milk, did not conform to the relevant product standards. To address the problem, it was clear that the issue of insufficient regulatory control of hygiene and sanitation in the production, handling, transportation and processing of milk needed to be addressed. Kenya Dairy Board however stated that milk quality has improved since 2008 when this study was undertaken.

Under the USAID-funded Land O'Lakes Kenya Dairy Sector Competiveness Programme (KDSCP), a series of initiatives were launched.

Table I.3: Quality Initiatives Launched by Land O'Lakes KDSCP 2007-2011

Initiative	Completed / Not Completed
Write and compose a set of new dairy regulations for Kenya	95% Completed
Implement a programme of GMP training directed at those working in milk bulking centres and retail milk shops	Completed, approx. 2000 people trained
Publish an illustrated version of Kenya Standard: Code of Hygiene Practice for Production, Handling and	Completed

Distribution of Milk and Milk Products.

In cooperation with the Kenya Bureau of Standards dairy technical committee, write and issue 2 new standards, Dairy Code of Practice, and a Good Manufacturing Practice Standard	Completed and issued
Expansion of the range of Kenya dairy product standards	Completed. 16 new dairy product standards approved.
Introduce a differential quality based payment system for raw milk	Proposal and pilot trial design completed and passed to KDB for further action. Not implemented.
Standardize the Raw Milk quality tests on a national basis so that all raw milk purchased at all points in the country, is graded and paid for using an identical set of tests	Not implemented
Training of KDB regulatory inspectors	90% completed. 36 graduates.
Create analytical laboratory facilities and capacities for KDB	Not completed

For the purpose of this QBMP study, the text of the new dairy regulations has implications on the future regulatory environment and the quality of milk and milk products. The text of the regulations was written by the consultant (Foreman) in cooperation with KDB, represented by Ms. Joyce Kii (KDB Technical Officer), working with the support of a public committee under the chairmanship of Prof. P. Muliro from Egerton University. The committee membership included representatives from various GoK Ministries, veterinary, public health, livestock, and also included representatives from the processors and other industry organizations. The committee membership was elected by KDB.

The regulations text as it was written and developed was reviewed at a series of public stakeholder meetings and changes made as required in response to criticisms and concerns. In 2010 the final text was submitted to the Attorney General's office for review, and then passed to a legal office for transformation of the text into legal format. The legally formatted text was completed in 2011, and transferred to KDB. KDB's stated intention was to legislate the document under the Kenya Dairy Act.

At this stage, the Land O'Lakes programme ceased to take an active part in promoting the implementation of the legalization process. The document is currently in the hands of KDB. A recent conversation with KDB has revealed that fresh comments have been raised by another GoK office, believed to be veterinary, and the issues will require resolution before the regulations are forwarded to be gazetted under the Dairy Act. To the best of the consultant's knowledge, the difficulty is over issues of zones of responsibility between government ministries. It was also reported to the consultant that there is interest in the EAC to review the text, with a view to possible adoption.

The New Dairy Regulations were written with the following objectives:

- To give effect to the provisions of the Dairy Industry Act, 1984
- To ensure quality and safety of milk products for human consumption in all of the following:
 - a. Raw milk
 - b. Locally processed milk and milk products
 - c. Imported milk and milk products
- Harmonize statutory regulatory requirements that will ensure consistent and harmonious performance of the inspectors in carrying out quality control, inspection and monitoring activities in the industry

In 2007, Kenya as a member state of COMESA, participated in the process of harmonization of COMESA dairy product standards. To access international markets, Kenya's dairy products must meet international standards, and to meet international Standards, industry sanitary and hygiene practices must be effectively regulated.

The New Milk Regulation is intended to be used as the sanitary regulation for milk and milk products throughout the national industry and expectedly will become the national standard for milk sanitation and hygiene.

The Dairy Regulations text contains 12 regulations, each pertaining to a specific segment of the dairy chain. The complete non-legalized text is attached to this report (Appendix 1).

Table I.4: The Content of the New Dairy Regulations*

Regulation No.	Regulation Subject / Title
1	TERMS, DEFINITIONS AND ABBREVIATIONS
2	DAIRY INDUSTRY REGULATORS
3	PERSONNEL IN MILK AND MILK PRODUCTS MANUFACTURE
4	STANDARDS FOR MILK AND MILK PRODUCTS
5	DAIRY FARMS
6	MILK COLLECTION CENTERS
7	MILK TRANSPORTATION
8	MILK BARS
9	DAIRY PROCESSING PLANTS
10	CALIBRATION OF EQUIPMENT AND APPARATUS
11	ENFORCEMENT
12	PENALTIES

Note *: The full text is attached as Annex 1

If and when the new dairy regulations are legislated and implemented, it will radically change the regulatory environment. The regulations describe how inspections of dairy businesses and testing of milk and milk products are to take place, by whom and with what frequency. A schedule for milk and products sampling and testing is described. The inspectors themselves are required to be examined for competency and ability to perform consistent inspections to ensure standard and repeatable inspection procedures. The regulations include sections on the issuance and revoking of permits to dairy businesses, labelling, misbranding, and the regulatory inspection of the operation of heat exchangers (pasteurisers and sterilizers).

Included are site-specific inspection forms to be used for the regulatory inspection of dairy farms, milk collection centres, milk transporters, and processing plants. The objective is to standardize inspection techniques by the inspectors themselves. Using the inspection forms results in a numerical score, which is awarded to the business that has been inspected. This enables a quantitative score result, while non-compliant issues detected in the course of the inspection are also recorded on the form. Non-compliant issues must be rectified and inspected again after a defined delay period, to confirm they have been rectified.

The regulations describe the sanitation and hygiene requirements for dairy farms, transporters, milk collection centres, milk shops/bars and dairy processing plants, with the aim of improving the sanitary and hygiene practices along the dairy chain. Expectedly, as in other regulated dairy

industries, active enforcement will require all who are engaged in the dairy industry to make the necessary changes in their work methods, which will be necessary to bring them into compliance with the regulations. The regulations will provide the legal authority and technical platform for the regulators.

KDB's inspectors participated in a training course delivered by the consultant (Foreman) under the Land O'Lakes KDSCP, designed by the consultant to specifically train regulatory inspectors. The training material relates directly to the sections of the new dairy regulations. The training course was almost completed before funding support was terminated. Within the regulations there is a section that deals with the operation of pasteurisers and sterilizers. The regulatory inspection procedures require the use of specific equipment and instruments, which were purchased from a supplier in the United States. The equipment was brought to Kenya in 2011, but has not yet been handed over to KDB. It yet remains to train the inspectors on the use of the equipment so that they will be competent to carry out regulatory inspection of milk pasteurisers.

The consultant wrote the texts of the operating procedures, for the inspection of heat exchangers, (Foreman). It was discussed between the consultant and KDB that the most effective way of giving the procedures legal authority, would be to prepare a Kenya standard for the inspection procedures. This had not been done when Land O'Lakes ceased its support.

1.7. Origin of EAC Standards

Standards are written and compiled by committees composed of sector stakeholders, who often act to serve and protect the interests of their own organizations or business sector. The resulting document text, though technically proficient, may set limitations and thresholds, which have been inserted to protect subjective motivations. Commercial considerations may take precedence over more objective considerations. Standards therefore may serve several functions. Dairy standards are set to safeguard public health and to provide a benchmark quality identity for the product.

Universally, processors and consumers recognise the need for dairy standards. The writing and compilation of national standards are the norm, and linkages to other frameworks, which also issue standards, notably the International Dairy Federation, usually expand these. The EAC, working with the donor community, chose to harmonize its standards with international ones. This choice was based on the desire to ease cross-border trade within the EAC / COMESA community. In this context, harmonization meant the setting of identical standards across the EAC Partner States, which were linked to product and analytical methods standards in use internationally.

The creation of the harmonized EAC standards has its roots in a policy paper (2004) issued by the USAID-funded Regional Agricultural Trade Expansion Program (RATES) in Nairobi. The paper identified the existence of trade barriers due to the divergence in the technical texts of the various dairy standards of EAC / COMESA member countries.

The policy paper recommended that that product standards and sanitary requirements should be harmonized, together with the analytical methods used for the examination of the dairy products.

The policy recommendations of the report were supported by the USAID-funded RATES program with the involvement of Land O'Lakes based in Nairobi. Land O'Lakes worked with the newly created Eastern and Southern Africa Dairy Association (ESADA), set up, and funded by RATES, to develop harmonized EAC standards based on international standards.

The EAC dairy standards committee met in October 2006 and recommended the adoption of 8 product standards, together with 42 analytical methods standards. The standards were later adopted

as common EAC standards and in 2007 national delegates to a COMESA conference met and discussed the EAC texts. The challenge to achieve unanimous approval for the texts was enormous since the level of dairy development and technical capacity of the various member countries was vast, ranging from the highly developed sophisticated dairy industries of Egypt and Zambia, to the poorly developed industries of countries such as Rwanda and Madagascar, and the almost non-existent milk production capacity of Mauritius. Consequently, the delegates represented national positions with reference to the varying technical and development capacities of their home countries. The negotiations over the texts led to compromises and instances of microbiological limits being set which did not meet the infrastructure and technical capacity of some countries to implement.

The harmonized EAC standards are largely based on international Codex Alimentarius standards. RATES supported the harmonization process with a trade specialist provided from within the programme itself, and a dairy technologist (Foreman) seconded from Land O'Lakes. In preparation for the final harmonization conference, RATES funded a round of regional and national workshops in each member country to discuss the standards and to determine national positions on the texts of the standards to be discussed.

1.8. Comments on the Raw Milk Standard EAS-2006 Raw Milk Specification

1.8.1 Background

In 2007, EAC dairy standards were upgraded very ambitiously and harmonized with international standards. This took place without a clearly defined demand from the private sector. The upgrading and harmonization process was donor and public agency-driven.

The microbiological limits requirements of the raw milk standard do not reflect the average microbiological quality of most of the raw milk currently produced in the region. The circumstances under which the limits were set are described elsewhere in this document (ref: Paragraph 1.7). The rationale and guiding principle for the choice of the ambitious microbiological limits was to enable the export of dairy products from the region. It was recognized by the participants in the standards preparation process, that the microbiological levels were set at a level which did not reflect the true average bacterial count levels being attained by most of the milk production sector. However, it was recognized that the improvement of raw milk quality would be a continuing process phased over a number of years.

By this rationale, it was perceived that the now internationally acceptable microbiological limits in the standard, would permit those processors already controlling the quality of their own milk collection networks and supply, and were already able to meet the thresholds set by the standard, to immediately consider export markets, as they now had the backing support of a national standard that would not be subject to criticism by purchasers of their products. It was recognized that to achieve compliance across the industry, the remainder of the industry would need to engage in the long-term task of upgrading the quality of the milk supply. The QBMP is the natural development of this strategy.

1.8.2. The Standard in Detail

In comparison to other international standards, the decision to provide for three grades of Total Plate Count microbiological limits is unusual. Usually, raw milk standards set a single upper limit. Milk, above that limit, does not comply with the standard and therefore is unfit for processing. Processors using above limit milk would risk the possibility of detection by regulators or clients, of using non-conforming raw material, and would therefore be unlikely to decide to process such milk.

By the same logic, at the moment in Kenya, much of the milk being processed does not comply with the standard and therefore in theory the processors could be prosecuted for use of non-conforming milk. Grade III milk, given an upper limit of 2.0×10^6 /ml, makes the use for processing of milk with higher bacterial counts non-conforming, and therefore technically illegal. Elsewhere, standards have sometimes required that high-count milk be used for industrial processing and been prohibited for use in the manufacture of fresh dairy products. The Kenya / EAC standard does not distinguish between permitted uses for each of the grades. It would have been an improvement if the standard had included a directive for each grade, stating for which products each grade may be used.

The inclusion of coliform counts in the standard is probably useful as it reflects the circumstance that a significant percentage of the total supply is sold as raw milk directly to consumers. Coliform counts are used in the food industry as indicator organisms. Their presence in high numbers indicates the possible presence of gastrointestinal pathogens, which have gained entry to the milk through inadequate sanitation and hygiene. The coliform group is not pathogenic, but being gastrointestinal organisms they may be accompanied by gut pathogens such as *Staphylococcus*, *Salmonella*, *Shigella*, etc. The use of two grades in the standard seems like a 'belt and braces' approach. Other national raw milk standards often do not include a requirement for enumeration of coliforms. All coliforms are destroyed in a correctly controlled pasteurization process. Their presence in pasteurized milk and products is prima facie evidence of inadequate post-pasteurization hygiene and sanitation procedures. In pasteurized fluid milk most international standards set an upper limit of 10/ml.

The somatic cell count requirement of not more than 300,000/ml is reasonable in the conditions of dairy management practices in East Africa. Significantly lower counts are routinely obtained in developed dairy industries, where somatic cell counts are invariably included as a parameter in milk quality payment systems. Mastitis is characterized by physical, chemical, and bacteriological changes in the milk and pathological changes in the glandular tissue of the udder and affects the quality and quantity of milk. The bacterial contamination of milk from affected cows render it unfit for human consumption and provides a mechanism for the spread of diseases including tuberculosis, sore-throat, Q-fever, brucellosis, leptospirosis and others of zoonotic importance. Somatic cell count (SCC) is a useful predictor of intramammary infection that includes leucocytes (75%) i.e. neutrophils, macrophages, lymphocytes, erythrocytes and epithelial cells (25%). Leucocytes increase in response to bacterial infection, tissue injury, and stress. Somatic cells are protective for the animal body and fight infectious organisms. An elevated SCC in milk has a negative influence on the quality of raw milk. Subclinical mastitis is always related to low milk production, changes to milk consistency (density), reduced possibility of adequate milk processing, low protein and high risk for milk hygiene since it may even contain pathogenic organisms.

Pesticides residues requirements are in line with Codex Alimentarius. In the 2008 milk quality survey cited in this report (Paragraph 1.6), pesticides were not detected in any of the samples.

Veterinary drug residues must comply with the maximum residue limits specified in CAC/MRL 2-2006. This requirement is essential in order to protect public health safety. Similarly to the requirement for heavy metals and contaminants, which must comply with the maximum limits as specified in CODEX STANDARD193-1995.

Under hygiene, the standard requires compliance with CAC/RCP 57, Code of Hygienic Practice for Milk and Milk Products. This is a comprehensive document, which applies to the milk and milk products obtained from all milking animals. Amongst other things, the document states; In order to effectively implement this Code, competent authorities should have in place legislative framework (e.g., acts, regulations, guidelines and requirements), an adequate infrastructure and properly trained inspectors and personnel. This relates directly to the necessity to implement the legislation of the New Dairy Regulations. Kenya has its own Code of Hygienic Practice for Milk and Milk Products.

In cooperation with KDB, a more reader friendly brochure version of the text was published in 2009. The intended purpose was to enable KDB to distribute the document throughout the industry, thus making the content of the standard more accessible to people working in the industry.

1.9. Regulatory Inspection

The growing and expanding sub-Saharan African dairy and food processing industry suffers from a lack of effective and competent regulation. Many small dairy and food processing operations and businesses currently conduct their operations in an environment of minimum regulatory inspection. Industry regulation is essential to ensure safe practices and safe food.

Where regulatory inspection of food processing and handling premises does exist, it is invariably carried out by personnel who lack the technical competence and experience required to enable them to conduct an effective inspection of the processes, equipment, food handling practices, premises and the actual control of the processes themselves. Large and medium processing plants enjoy a degree of freedom of action in the way they monitor and control their processes, when they should be under the watchful eye of a regulatory inspection service. Throughout the region, heat treatment processes are commonly not monitored effectively and safety devices installed on the equipment is largely ignored or non-functional. These conditions negatively impact on the safety of the food products sold into the market.

Stakeholders and government officials alike often state the export of food products out of the region as an aspiration. Without the development of a more effective regulatory environment, it is unlikely that many African dairy and food products will attain the chemical and microbiological standards demanded by more sophisticated consumer markets.

In those countries in the region where a regulatory body has been established, the regulation is invariably immature and ineffective. Commonly, regulation is based on a basic food industry ordinance accompanied by an incomplete set of undeveloped national food Standards. Many of the dairy and food Standards currently in use are technically insufficient and require improvement. To compound the problem, laboratories that are under-funded and in several countries lack the technical and material capacity to effectively carry out the analyses and tests required to support the regulatory authorities and control the industry for which they are responsible support them.

Competent and responsible food processing is essential to ensure the chemical and microbiological integrity of the food sold to the public. In an environment of weak industry regulation and high indigenous human and animal disease levels, food safety must be a primary concern to those responsible for public health safety.

Throughout Sub-Saharan Africa, in those countries where national dairy and food industry regulatory bodies and institutions have been established, the regulation of the food production and processing industries is usually provided by the Bureau of Standards and in some cases a specific para-governmental regulatory body. These institutions have been shown to be anxious to receive technical support to strengthen the technical capacity of their staff through training, compilation and writing of product Standards, instruction on laboratory methods to conduct chemical and microbiological analyses, and the standardization of inspection techniques to enable them to conduct effective in-plant inspections of dairy and food processing plants.

In the past, donors have largely ignored the regulatory and control aspects of the food chain, while considerable efforts and resources have been invested in the introduction and application of quality systems. In-plant quality systems are adopted voluntarily and their real effectiveness is never more than a function of the individual management's determination to apply the system. However, in a

mature food-processing environment, quality systems must be supported by adequate, competent product and analytical methods Standards, accompanied by effective regulatory inspection of the industry.

In 2007, the COMESA region dairy standards were harmonized with the objective of easing cross-border trade within the COMESA region. By themselves, the harmonized Standards are not sufficient to control the quality and safety of the dairy products that will flow across the region's borders. The equally essential complementary element that must be prepared to support the new Standards, is the training of a cadre of technically competent specialists who will be able to effectively inspect, instruct and direct the processors, warehouses, shippers and distributors on safe food processing and handling practices.

Food safety control systems as they exist today within the sub-Saharan region are incomplete. Recognizing that it would be beneficial to implement a project directed at training a cadre of regulation staff and personnel, in 2008 USAID-funded Land O'Lakes implemented a training programme for Kenya Dairy Board inspectors. The training work plan was not completed.

1.10. Recommendations for Improvements and Support

The KDB regulatory inspection service would benefit from further support. The technical capacity of the inspectors should be reviewed to identify gaps in knowledge and technical proficiency. The equipment for the inspection of HTST pasteurisers will be passed to KDB in the coming months (source: private communication). A specialist on the use of the equipment should train the inspectors. In 2010/2011 when the consultant (Foreman) planned a training workshop for this purpose, there was resistance from several processors who were asked to allow the training to take place in their plants. The training requires access to a HTST pasteuriser for a period of 2-3 days. The reasons for the lack of cooperation were possibly the impracticality of allowing access and the consequent downtime to processing plant, or for reasons of not wishing KDB inspectors to acquire the expertise and capacity to carry out regulatory inspection of the pasteurisation equipment in the plants, some of which are known to be defective. The issue was not resolved.

Since 4 years have passed since the KDB inspectors received the training on the techniques and requirements of regulatory inspection, it would be beneficial to revise the training and to relate it directly to the specifics of the different sections of the new dairy regulations. The underlying principle of the inspection system is that the inspector uses the requirements in the regulations as the inspection reference. The inspection forms as they exist at the moment require revision, since changes were made to the regulations text.

The section in the regulations dealing with the requirements for pasteurisers and sterilizers is accompanied by a set of inspection operating procedures describing how to conduct each inspection test. Though originally these were included in the text of the regulations, on consultation with KDB a decision was made to issue them as a KEBS standard. This remains yet to be done.

The raw milk standard should be revised to correct some inconsistencies. Presumably this would necessitate a review under EAC and possibly COMESA, as the same standard is common to all. The issue requires discussion with KDB technical personnel.

2 QBMP Systems



2.1. Best Practices in QBMP systems

Designing and developing a QBMP system presents several options for selection. A QBMP system is a dynamic system, which will gradually change over time according to changing circumstances, achieved results, present local conditions and changing demands. It should be clear that there is not one single recipe, but there are several, all of which can lead to the desired milk quality improvements.

2.1.1. Kiss approach (Keep it Simple and Stupid)

Many parameters are included in QBMP systems in countries where QBMP systems have already been in place for many years. Milk suppliers have become familiar with the system and adjust easily when new parameters are included. This is a completely different situation to the one prevailing in Kenya at present, where there is none or only minor experience with QBMP systems.

Every change made in the selection of parameters can be expected to have a significant impact on the payment system and the farmers' reactions. Farmers and CBE's need time to familiarize themselves with the introduced parameter. For example, when a test parameter expressing the bacterial count of milk is introduced, it is of utmost importance that farmers understand the fundamentals of the sources and growth of bacteria, and what steps need to be taken to decrease the bacteria count in milk.

Farmers as well as CBE's will have to adapt and change their working procedures in order to supply milk of a higher grade. Collection times need to be shortened, cleaning procedures improved and, predictably additional investments will be required. This will require considerable efforts and CBE's and farmers will need support from the processor in order to improve and to implement these changes. Therefore, introducing the QBMP system parameters will have to be introduced gradually, step by step. A new parameter can only successfully be introduced when farmers and CBE's are familiar and comfortable with the system.

2.1.2. All inclusive

The whole chain from farm to factory has to be included for the successful introduction of a QBMP system. In Western Europe this is not an issue, because farmers deliver directly to the processors and the processor pays the milk money directly to the farmer. In Kenya, the payment system is structured differently.

Farmers deliver the milk to the co-operative or the dairy society (CBE) and these intermediaries then sell the milk to the processor. To introduce a QBMP system from intermediary to farmer will be only successful if there is a QBMP system implemented from the processor to the intermediary and vice versa. When an intermediary makes the effort to introduce a QBMP system to the farmer and the processor does not put in place a financial incentive for his efforts, then the objectives of the QBMP system will not be attained. Also, when processors introduce a QBMP to the intermediary and the intermediary does not take any action at the farm level, no progress will be made. Integral introduction along the complete chain is crucial.

2.1.3. Adequate milk testing facilities

The testing facilities must be adequate and reliable. For example, suitable incubators, trained staff and laboratory facilities have to be available if a processor is to decide to introduce the total plate count into its payment system. The capacity should be sufficient to do all the required tests. In general, this will be possible under Kenyan conditions. At present, it is not possible for the

intermediary to do total plate counts on milk from all its suppliers. Logistically it would be impossible to implement a large scale weekly testing regime e.g. to commit to running a thousand total plate counts a week, not to mention the high costs that would be involved. Therefore, the intermediary must choose a simpler but yet effective solution. The intermediary may decide to use the methylene blue reduction test for payment purposes or the results of the resazurin test in order to pay its farmers for microbiological quality.

Another example is the introduction of protein content into the payment system. Reliable milk analysers are required to test this parameter. The capacity of the analyser needs to be sufficient to be able to handle the number of samples. Milk analysers as currently used in Kenya are not regarded by the consultants as being suitable for use for a payment system. These instruments have inherent problems with maintenance of the instrumental calibrations. Any instrumental system that is to be considered suitable for payment purposes must be beyond reproach in terms of the stability of its calibration and the accuracy and repeatability of the compositional results it produces. Low cost instruments do not meet this requirement. Consequently, without access to more accurate instrumentation, the introduction of payment according to compositional analysis would not be a primary choice for the introductory phase of a QBMP system.

2.1.4. No payment for added water

The buyer should not pay for added water. By introducing payment for TS, SNF, weight of protein or fat into the payment system, the incentive to adulterate the milk with added water will be removed. This may not entirely stop adulteration with water, but adding water will at least no longer be an attractive incentive. It is usual to apply a 'financial penalty' when added water is detected. The severity of the penalty can be adjusted to suit local requirements.

2.1.5. Perform a baseline study

The local quality situation has to be investigated and understood before introducing a QBMP. At the moment of introduction of a QBMP system at least 10% of the farmers should be able to deliver first grade milk. The system will fail when this is not the case. For instance if it is decided to define first grade milk as milk with a TPC below 100,000 cfu/ml, while the majority of suppliers deliver milk with over 1,000,000 cfu/ml, the farmers will be discouraged as they struggle in an attempt to meet the target.

2.1.6. Carry out a secret test run before introduction

The QBMP system has to be run parallel to the existing payment system for at least 3-6 months before implementation. During this period the financial effects of the expected changes in the payment system should be compared with the existing system, in order to avoid undesirable financial outcomes. The system should be fine-tuned after analysing all the data from the test run. To become even more confident about the outcomes, the QBMP should be run parallel to the existing system, whilst the suppliers are kept informed about the payment they would receive in the changed system. By informing the suppliers of the financial outcomes of the compared systems, the implementers will be able to judge the willingness of the farmers to cooperate, or whether they are resistant to the proposed changes. It is of utmost importance to keep the loyalty of the farmer and his dairy society.

2.1.7. Good information dissemination

Integral to the system is the assurance of prompt and efficient flow of information. Test results have to be published, preferably not only to the individual supplier, but also in public. This will create awareness. Farmers will discuss test results with each other and become accustomed to the changes.

The farmers with less satisfying test results will be able to take steps to make changes in their work routines.

2.1.8. Individual payment

To achieve the optimum results, all farmers should be tested and paid individually. This will require substantial work and effort from the buyer of the milk. Nevertheless, when this is well organized it will pay off. Farmers can be paid per collection point or alternatively per payment group. This will create a common responsibility. Experience has shown that such systems work, but it requires cooperation and motivation on the part of the farmers. The motivation is financial improvement, and that induces the cooperation.

2.1.9. Extension service in place

This is the last item mentioned as a best practice, but probably the most important one. Farmers have to be trained and informed to create awareness and goodwill for the system. This strengthens the relationship between the supplier and the buyer. The buyer should not only be a buyer, but should also be a provider of technical information and support for the farmer. In this respect it is very important not to combine the functions of the extension worker with the milk tester. Under no circumstances should the extension worker become a policeman.

2.2. Milk Quality Payment Objectives

The general objective of a QBMP system is to improve milk quality and food safety. A QBMP can also be used as a tool to decrease adverse effects of seasonality. The definition of milk quality needs to be clear to all the participants, since for each participant in the dairy chain, milk quality may have a different meaning. In addition different players are likely to have different objectives and interests in the introduction of a QBMP-system.

2.2.1. The Government

For the Kenyan government, food safety will be the primary quality issue. The government has the obligation to protect its citizens from possible diseases. Contamination of milk with drugs, pesticides, mycotoxins, bacteria, animal diseases etc., will have priority.

2.2.2. Kenya Dairy Board

KDB describes the objectives of a QBMP system as:

- a) To increase the yield of dairy products.
The yield of dairy products will depend on the total solids content of the milk. The higher the solids content, the higher the processing yields of yoghurt, cheese, milk powder and butter.
- b) To improve the safety and hygiene of the milk.
This is a challenge for the industry and therefore introduction of a payment system that promotes improved sanitation and hygiene will be beneficial.
- c) To prevent adulteration and contaminants in milk.
To discourage farmers from adding water and other contaminants to milk, or from supplying milk-containing antibiotics, a payment system should be designed accordingly.
- d) To ensure fair payment to every producer.
The system has to ensure that farmers who supply high quality milk are adequately compensated.

2.2.3. Processors

Food safety parameters are important to processors, but they may also have other concerns which take priority. These concerns can vary according to the product they manufacture.

Dairy processors manufacturing cheese are interested in a milk supply which is reliably thermo-stable. Also, access to milk with low bacterial and somatic cell counts is of utmost importance to them, as is the absence of antibiotics. Cheese yield conversion ratios carry significant financial implications.

Milk that contains antibiotics cannot be used for processing yoghurt, cultured milk, or cheese, as the presence of the antibiotics acts as an inhibitor of bacterial growth.

To prevent product rancidity, dairy processors manufacturing butter or butter-oil, place high importance on receiving milk that has not been adulterated with hydrogen peroxide, which would deteriorate their product.

Processors of pasteurised liquid milk will be more interested in milk freshness in order to attain improved product shelf life.

2.2.4. CBE's and Farmers

The production sector, selling the milk to the processors, is mainly interested in obtaining a high milk price. They will not be interested in improved milk quality as long as they are not rewarded for increased milk quality, or penalized for bad quality milk. In certain aspects, farmers should have an interest in improving the milk quality. By working more hygienically, the incidence of mastitis and elevated somatic cell counts will decrease. This will lead to a significant improvement in milk production. As soon as QBMP system is introduced, this will change.

The objectives of a QBMP system are:

- a) To purchase milk with a low bacterial count for food safety reasons, to prolong the shelf life of pasteurized milk, and to lower processing costs.
- b) To purchase unadulterated milk without added water, so processors no longer pay the same price for the water as for the milk. Total solids will go up, so less milk powder needs to be added for producing yogurt. Bacterial counts will go down, because added water invariably carries a high bacterial load. The risk of contamination of milk with pesticides and heavy metals will reduce.
- c) To purchase milk free of antibiotics residues. Contamination with antibiotics is a serious food safety risk. Antibiotics cannot be removed during processing. Antibiotics may:
 - Cause serious allergic reactions. Anaphylactic shock is possibly lethal and hospitalization is required to cure it. Antibiotics such as chloramphenicol can lead to a lethal and incurable disease for sensitive people
 - Stop the growth of yogurt bacteria.
 - Disturb the ripening process in cheese
- d) To obtain a higher fat percentage in the milk, so from one litre of milk more butter or ghee can be produced. Farmers have to change the rations and genetics of the cattle to achieve this. It is a very slow process.
- e) To obtain a higher protein percentage in the milk, so from one litre of milk more cheese can be produced. Farmers have to change ration and genetics of the cattle to achieve this. It is a very slow process.
- f) To get more milk in the dry season and less in the wet season. This system is although not officially, already in place in Kenya. During the dry season milk prices will go up.

2.3. Milk Quality Parameters

For the introductory phase of a QBMP-system, it is important not to make the system design too complicated. The processor has to set his priorities with regard to the parameters of importance to him. Also, appropriate testing equipment and sampling equipment, together with written operating procedures have to be made available.

2.3.1. Parameters for indirect assessment of bacterial quality

In general for quality based payment systems, the following test parameters can be used to assess the mesophilic bacterial count:

- Alcohol test
- Methylene blue reduction test
- Resazurin test
- Total Plate Count
- Bacterial Count

The detection of pathogenic bacteria normally is not included in a payment system, because though raw milk may contain pathogenic organisms, they have no significance provided the milk is heat treated. In a correctly operated pasteurisation system, all pathogens are destroyed at the time/temperature relationship of 73°C for 16 seconds.

2.3.2 Compositional Analysis

The following parameters for chemical composition quality can be identified.

Milk composition: In many QBMP systems the chemical composition of the raw milk is included as a payment parameter. The payment is made for fat, protein and total solids content. It may be for one component or for all, depending on the design of the specific system. The fat and protein content of milk varies from animal to animal, and is influenced by a number of factors:

- Genetic breed
- The ration fed
- Season
- Age of the cow
- Stage of lactation
- Adulteration of the milk

Chemical composition can be measured in different ways. A milk analyser is most suitable for determination of the chemical composition of milk. Milk composition analysers measure the following components:

- Fat
- Protein
- Lactose
- SNF
- Total Solids
- Calculated Freezing Point / Water adulteration percentage

Milk analysers are available in different capacities and qualities. Prices vary from 500 to 50.000 Euros. The Gerber method, which is the traditional wet chemistry method for measuring fat content, is the cheapest option of all the available methods to determine fat levels in milk. Combining Gerber results with the density of the milk can provide information on the solid non-fat (SNF) content of the milk.

Milk adulteration: In order to increase milk quality test results milk suppliers may add adulterants to the milk in order to achieve apparently better results. This is of course a criminal fraudulent practice. Tests are available to detect the presence of adulterants and when identified, financial penalties need to be applied to discourage the offenders. Some examples:

- Starch to improve density
- Malto-dextrin to improve density
- Salt to improve density
- Bi-carbonate to improve density & acidity
- Peroxide to decrease bacteria counts
- Melamine to increase protein content

Water adulteration: One of the major quality issues in many countries is the adulteration of milk with water. Water does not only decrease the total solids in milk, but the added water may not be of drinking-water quality and may contain undesirable microorganisms and/or chemical substances. The detection of more than 15% added water in supplied raw milk is quite common. Adulteration by added water can be detected by several instrumental methods, of varying accuracy:

- Lactodensimeter
- Milk analyser
- Cryoscope

Antibiotics and other growth inhibitors: Antibiotics in milk present a serious health risk. The presence of antibiotics slows down fermentation processes in yoghurt and cheese-making processes, and may even cause a process to fail. Antibiotics are used in dairy farming to treat bacterial infections in cattle. When antibiotics are administered to cattle, the milk has to be withdrawn. The withdrawal time is indicated on the accompanying drug labelling. Through ignorance and mistakes, milk containing antibiotics is frequently delivered to the dairies. In Kenya many dairies do not check for the presence of antibiotics in milk.

Antibiotics in milk can be tested by:

- 3 hour broad spectrum incubation tests
- 5 minute specific antibiotic tests

Milk containing antibiotics has to be rejected, and suppliers of antibiotic milk should be financially penalized.

Aflatoxins: Aflatoxins are of major concern for the feed and dairy industry in Kenya. At the moment the dairy industry does not have ready access to a laboratory with capacity to test for aflatoxins. There are simple fast semi-quantitative test kits commercially available. Kits using ELISA (enzyme-linked immunosorbent assay) technology are available to test on the farm as well as commercially. The cost per test on the farm (USA prices) is usually about \$20 to \$25 when prorating the cost of the incubator to conduct the test.

2.3.3. Physical Parameters

Somatic Cells: For cheese-makers the Somatic Cell Count is relevant to the efficiency of the cheese-making process. Accurate determination of the somatic cell count requires advanced and expensive laboratory analytical instrumentation. Though a number of plants in Kenya do process cheese, the volumes are insufficient to justify major expenditure on the purchase of high- end analytical instrumentation to be used for general application.

Somatic cell counts are used as an indicator of mastitis. Various useful low cost testing methods are commercially available. These may be included in QBMP systems where the parameter is of interest to a cheese-making plant.

Foreign matter: Milk can be rejected when straw, dirt, manure, concentrates, or any other physical contaminants are detected in the milk. Also other organoleptic abnormalities in colour and odour will lead to rejection of the milk. Traditionally, the parameter has been used as a quality test for milk. The method, described in an International Dairy Federation standard, requires filtration of 1 litre of milk through a standard cotton pad. The dirt left on the cotton pad surface is then compared with a set of standard photographs, each representing a grade. Using the method, the milk can be conveniently graded for cleanliness. The method has the advantage of being objective.

Assessment of milk quality by visual inspection for dirt, colour and taints is subjective and the results cannot be quantified. The person inspecting the milk will be required to make subjective decisions about quality and ultimately whether to accept or reject a batch of milk. This kind of decision, without the support of measurable numerical data, will lead to conflict as farmers will argue against decisions to reject milk. To avoid conflict arising from such situations, we suggest that organoleptic assessment should not be included in a pilot trial QBMP system. However, if testing equipment for the cotton pad filter method is made available, then this test could be included.

2.4. Price Structuring and Calculations

2.4.1. Principle

A QBMP system is not an instrument to increase the milk price. According to certain selected test parameters, incentives, and penalties are applied to the milk price. The simplest way is to introduce a three grades system of extra quality milk, standard milk, and second-class milk. In general they are constructed to ensure that:

5-10%	of the milk is extra quality milk
75% - 85%	of the milk is standard or first-class milk
10% - 15%	of the milk is sub-standard or second-class milk

The penalty deduction applied to the sub-standard milk will pay for the extra-quality milk.

The payment system could be expanded to more than three quality bands. This would provide greater opportunity for farmers to move up to the next band. Assuming the use of three quality bands for payment, an example of a quality band payment structure, for bacteriological and chemical quality is presented in Table II.1.

Table II.1: An example of a payment structure for a QBMP system

Price Band	Bacteriological Quality	Notes
Standard Price (100%) Paid for milk in Standard Grade Band	To be determined	1. The thresholds are set to ensure that 75% - 85% of farmers receive the standard price. 2. Deductions made for Lower Grade should finance the Supplementary Payment for Superior Grade. This aspect of the trial needs to be monitored.
Supplementary Payment (100% + 1-2 KShs/litre) Paid for milk in Superior Grade Band	To be determined	
Deducted Payment (100% - 1-2 KShs/litre) Paid for milk in Lower Grade Band	To be determined	
Differential Payment for Chemical Quality		
Fat Content	<p>The weight of fat will be calculated (Percent Fat x Kgs Milk = Kgs fat). Fat will be priced at X KShs/kg</p> <p>Standard Price (100% + X KShs/kg above 3.25% will be paid.</p> <p>Standard Price minus X KShs/kg below 3.25% will be paid for milk containing less than 3.25%</p>	<p>1. The COMESA Standard has set the legal minimum fat content at 3.25%</p> <p>2. Payment according to weight of fat delivered will reduce the incentive to adulterate with added water.</p>
Adulteration of Milk		
Added Water	The weekly milk samples delivered to the laboratory for Total Plate Counts will also be tested for Freezing Point Depression. The calculated volume of added water will be deducted from the volume of milk delivered.	The sample used for this test will be a weekly sample, but the calculated volume of water to be deducted will be applied to the total volume of milk delive-

		red by the farmer for the whole of the previous week.
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As milk quality improves, the parameter thresholds have to be raised and readjusted at intervals. The objective would always be to distribute the milk payment according to the following scheme.

Superior Grade (Grade 1)	Milk whose quality exceeds Standard Grade <u>Target: 5% to 10% of all milk in the system</u>
Standard Grade (Grade 2)	Milk whose quality is standard grade and which consequently receives the Target/Standard Price <u>Target: 75% to 85% of all milk in the system</u>
Reduced Grade (Grade 3)	Milk whose quality is below standard grade and which consequently a deduction is made to the price paid <u>Target: 10% to 15% of all milk in the system</u>

2.4.2. Rolling Averages

To make the system less draconic to the farmers and to remove the potentially catastrophic negative effect of a single bad result in any calendar month, the payment system should be constructed in such a way as to use rolling averages. An administrative mechanism can be put into place to deal with instances of a single atypical result.

Example of an administrative procedure for dealing with a single atypical high result

When, out of the three tests performed during a calendar month, one result is atypical, and then the calculated monthly Quality Band will be raised to the next highest band. The following conditions must exist to permit this administrative procedure to be applied:

- A. The reason for the atypical monthly Quality Band result has been caused by a single atypical test result out of the three tests that were performed.
- B. For each of the four months preceding the atypical result, the milk supplied by the producer tested Standard Quality or Superior Quality.
- C. The atypical result was not obtained from a sample taken by a farm extension worker.

When there is an atypical result, the dairy laboratory will not carry out a repeat test on a new sample in order to seek an improved test result.

Cancellation of an atypical result will only be done if it is clear that the cause of the high result was a procedural fault in the dairy laboratory.

Each quality parameter would be tested perhaps 3 times per month, but the farmer's payment grade would be determined for example, on the basis of the rolling average of the past 5 or 6 test results, thus reducing the effect of a single bad result on the average in a single calendar month. Suitable tables would need to be devised for each quality parameter. This would give the individual farmers more opportunity to improve his results, as his milk price would be less affected by a single bad result. The results of the tests would determine the grade of the milk and consequently the price paid to the farmer.

To protect farmers, appropriate test results accuracy and methodology correctness review mechanisms will need to be built into the system design.

The design of the payment system is flexible. In the following box is an example of a payment system that links the payment to the farmers to the quality of the milk delivered from the bulk-cooling tank. If the milk received in the plant from the cooling tank is not of Standard or Superior quality, then an individual farmer cannot receive payment for superior quality.

Payments to farmers who market their milk through milk collecting stations will be paid as follows:

At the end of each month, the farmer will inform the dairy plant of the volume of milk he has delivered during the month.

The monthly Quality Band will be determined as the arithmetical average of three randomly selected and tested samples, taken at the milk collection centre when the milk was delivered.

Payment for Superior Quality to a farmer, requires that the result of three tests on samples taken from the collection tank in the milk collection centre during the course of the month, also be at least Superior or Standard Quality.

2.4.3. Base Price

The simplest way to set up a QBMP system is to start with a standard or basic milk price. This is the price the buyer is willing to pay for a kilogram or litre of milk. This price will be set according to the same procedure as the buyer is currently accustomed to.

A more advanced way to set a standard price is, by calculating the weight of fat or protein (Europe), or calculating weight of fat and SNF (India). Example:

Protein% = 3% Protein unit = 5 shillings

Fat% = 4% Fat unit = 4 shillings

$(\text{Protein unit} \times \text{Protein}\%) + (\text{Fat unit} \times \text{Fat}\%) = \text{milk price per kg}$
 $(5 \times 3) + (4 \times 4) = 31 \text{ shilling}$

This is nearly similar to a basic price, when the average fat and protein percentage are known. The advantage of this system is that the buyer does not pay for added water. When butter and ghee are profitable the buyer can increase the price paid for a kilogram of fat. Similarly, when cheese prices are high, the price of a kilogram of protein can be increased. In Europe, when food processors were losing money on butter production, the fat unit became negative.

2.4.4. Setting the base price

Setting the base-price by processors can be done in various ways:

- By creating a benchmark with the competition.
- According to world market prices for dairy commodities. The processors calculate what the price of butterfat and protein is per kilogram if they were to buy products on the world market.
- According to guidelines set by the government
- On a base of a rolling average of the milk prices paid in the country for a certain period.
- Other suitable formulas

For co-operatives it is simpler. They can just calculate the sum of what the processor pays and deduct the cost and depreciation of their milk collection system.

Changing the base milk price will change the individual milk price.

2.4.5. Additional parameters

Other parameters can be added when the base price is set. This should be done gradually, adding only one parameter at a time. According to the importance of the parameter, the incentives and penalties are set. Adulteration with antibiotics is in most payments systems heavily penalized. Also adulteration with chemicals will usually lead to severe price reductions. These penalties will be applied together with the result that the milk will be rejected. Water adulteration should also be a reason to apply penalties.

It can be decided to introduce a rolling average if tests results vary widely and this would lead to significant differences in milk price for a supplier per payment period. Using rolling average methodology means that the milk is not paid per test result, but over an average of the results over a certain period.

Every buyer has to decide the value of an applied incentive or penalty. In this respect there are no rules of thumb or guidelines.

A detailed description of how to structure and calculate a simple milk payment structure is given in the resource book "Milk Testing and Payment Systems" issued by the FAO.

2.5. The Relationship between the Milk Base Price and Production Costs

One of the major errors made in thinking about milk price, is the assumption that there is a correlation between the milk price and the production cost. In a free market, supply and demand set the price. Considering the situation in Kenya:

- Influence of the world market is small due to high import levies of around 60%.
- In areas with high demand, the big cities, the price of milk is considerably higher.

The result is that in the Nairobi periphery it is possible to produce milk for a relatively high cost price. Here are to be found zero-grazing farms, where all feed and fodder has to be procured by the farmer, while far from the cities, dairy farming becomes more extensive. The land becomes cheaper and grazing becomes an economical livestock management alternative.

Also there is a significant difference in scale. Farms with high cattle numbers require mechanization. Mechanization reduces the gross margin per animal, but due to increased production, the overall margin increases.

The result is that throughout the country there is a significant variation in the production cost of milk.

Within the time allocation of the consultancy, the consultants were unable to conduct any primary research or gather financial data on the profitability of dairy farming in Kenya. Discussions with farmers made it clear that ownership of cows provides a reliable source of daily income, which is important to the economics and security of many family farms. As elsewhere in the world, the value of the income depends on a series of variables which are not all within the control of the individual farmers. For the small farmers, holding one to three cows, the value is in the cash flow that the milk sales provide, together with the availability of milk for daily consumption.

Larger scale farms with 20 to 100 cows were visited. Production costs were reported to be 21 to 25 Kshs, while the sale price was quoted at 31 Kshs/litre, giving a profit margin in the range of 20%-30%.

In some instances, the farmers reported that they could possibly further reduce feeding costs by changing the feed ration, by substituting high protein grasses to replace purchased soya or cotton cakes.

Information provided by Mr. A Jansen (SNV), reportedly based on an ILRI publication, indicated that the cost for extensive “grazing” farms was estimated at Kshs 18, and for intensive “zero grazing” farms was estimated at Kshs 22. Mr. Tahir Mahmood from Nestle confirmed this data. He remarked that sometimes the production cost could range from Kshs 16 to 28, depending on rainfall patterns and the occurrence of prolonged drought.

These reported figures and data indicate that dairy farming in Kenya at present is or can be made to be profitable. This is also exemplified by the high demand and prices of heifers and increased total milk production over the last 10 years

2.6. Structure of the cold chain

The structure of the cold chain is variable and in most cases insufficient. During field visits it was apparent that a variety of different modes of transport are used to collect milk. Milk is collected by bike, donkey cart, motorbike, car, truck, etc. Farmers bring the milk to collecting centres, or milk is collected from their houses. After milk collection, it is brought to cooling stations, sub-collection points or directly to the processor. In most cases milk is only collected once per day. This is done in the morning and begins around 6:00 am or earlier, and may continue until noon.

The natural antibacterial substances in milk will prevent bacterial growth for approximately 3 hours, after which bacterial growth will increase exponentially.

To maintain the quality of the milk it is important that milk should be cooled within 3 hours after milking. During field visits it was observed that this was rarely done. At milk collection centres, the only test regularly performed was the organoleptic test. The way it was carried out was not consistent with best practices. Though used in many milk collection centres, the alcohol test is not a standard test used in every collection centre. Temperature measurement was not observed at any of the collection centres visited.

It is fundamental to best practices that milk should be collected twice a day. Under the current usual practice of only collecting once a day, farmers invariably mix morning with evening milk that has already stood at ambient temperature overnight.

Processors and intermediary collectors should be encouraged to shorten the collection time to reduce the time the milk remains un-cooled. It was observed, that milk was routinely allowed to stand in the heat of the sun waiting for pick up.

To change these handling practices will require considerable effort of organization and discipline. It may be possible to insert into the QBMP system, a supplementary payment incentive to be paid for milk which arrives at the cooling centre before a fixed time of day.

Milk cooling facilities are available. The capacities of the tanks in the centres visited, were in the range 5,000 – 10,000 litres. Large capacity tanks, beyond the current milk production capacity of the locality, encourage less frequent collection. Under such circumstances, if milk is collected only every third day, the bacteriological quality of the milk will deteriorate despite refrigeration. The situation will be compounded when power cuts occur or when the operator turns off the power to conserve energy consumption, a common practice followed in milk collection centres.

From the roadside collection points the milk is transported in churns to the collection centre. Most cooling tanks visited, were bulking stations. These tanks require five or six hours to cool the milk down, and are not an optimal design for rapid cooling. An improvement would be to install a small plate cooler in the tank inlet line. In this way, milk would be immediately cooled as it enters the tank. Ideally there should be small coolers/chilling tanks of 500 – 1,000 litres at the sub-collection points close to the farms.

It can be concluded that even if there is sufficient cooling capacity, due to inefficient organization of the milk collection structure, milk is not cooled down quickly enough to prevent spoilage and to maintain good microbiological quality. The introduction of a QBMP system will be part of the solution.

2.7. The Influence of Regulatory Mechanisms on a QBMP System

Given the requirements set by the consumer market, and facing ever increasing competition worldwide, companies find themselves forced to adopt strategies to meet the quality requirements imposed not only by the market but also by State regulators. In the food industry, beyond the issue of product quality, food safety has become a decisive factor for the satisfactory performance of the sector. To minimize contamination risks and uncertainties regarding the attributes of a food product, companies began to use voluntary regulatory mechanisms to reduce problems affecting the quality of the products they manufacture, and in order to improve relationships with their suppliers, or even to inform consumers about the quality and safety attributes of products that they produce.

An interesting example can be illustrated by the dairy sector in Brazil, which faced serious challenges in providing quality and reliable products. The data indicated that from 9.5 billion litres produced in 2009, 33% was produced informally, i.e. there was no inspection by the health authorities. Evidence of adulterated milk was identified in 3,000 milk samples analysed by the Ministry of Agriculture in 2010. To prevent major damage to the industry, the processors and health authorities responded by increasing the surveillance and regulatory inspection operations. There is some similarity with the extent of the contamination problem in Kenyan milk. Regulatory inspection in Kenya needs to become more effective.

It is recognised that the adoption of regulatory mechanisms, besides providing improvements in product quality, also will enable a processing company to improve its market position. If milk quality standards are equally and consistently applied to both the processing industry and the raw milk market, this would help to create a level playing field for the processors and reduce unfair competition.

In search of a stronger competitive advantage, companies are looking for new management practices. This is the reality in most dairy sector industries worldwide. Issues such as food safety, environmental friendly practices, and corporate social responsibility are gaining importance in all sectors. This requires the application of quality control and assurance systems whose scope captures the entire value chain from “farm to fork”.

In the food sector, including the dairy sector, there is a growing requirement from government agencies, retailers and consumers that companies should develop and adopt comprehensively monitored and controlled operations that guarantee safe products. In this sense, companies are increasingly being required to comply with new laws and dynamics of the market to meet food safety requirements.

To adopt, implement and manage such QA systems is a major challenge since it requires control over the entire value chain. This is the more challenging in sectors or economies, like Kenya, where

parallel markets exist, and enforcement by the responsible authorities is low and government is unable to guarantee a level playing field.

Yet in Kenya, with a fast growing middle class, there is increasing consumer awareness of food safety, which poses both a challenge, and an opportunity for the processing industry to distinguish itself from the raw milk trader community, as supplier of safe and nutritious products.

In more developed economies the food sector has developed stringent quality control systems that encompass the entire chain, partly as a marketing strategy and partly to reduce the risk of legal action and claims from retailers, consumers and governments triggered by contaminated and sub-standard quality products that pose risks in terms of public health. GMP does not start at the gate of the food & feed processing industry but extends to operations of the supplier of the raw materials. This has taken such direction that it is common practice for large food processors and retail chains to audit their suppliers at site, irrespective of the fact that these comply with and are accredited by all the relevant government bodies or industry associations.

The private sector in more developed economies have designed and comply with voluntary quality control and assurance systems, that even go beyond the minimum standards set by government authorities. Even in industries where enforcement is stringent and robust. Usually this is done for marketing purposes and branding. Examples include brand image creation, labelling design and information, internal standards, traceability, and quality seals and certificates to identify adoption of an industry quality standard. The company uses the mechanisms if it considers it appropriate to their business interests and targets, and also to meet consumer expectations.

QBMP-systems are a tool to increase quality, consistency, efficiency and profitability along the value chain, as much as it is a mechanism to position the actors in the chain as credible producers and processors of safe and nutritious products.

Introduction and management of such a system goes hand-in-glove with QA handbooks and manuals that describe standards and standard operational procedures (SOPs) for all the actors in the chain (farmers, dairy societies, transporters, graders, processors and distributors). The compilation of a quality manual needs to be accompanied by training of all critical staff who are involved along the chain. The manual will contain documents that define the specifications of the raw milk being received, the operating procedures for receiving, recording, and handling, storing and selling the milk. The documentation will describe how the milk is to be tested, and how the operator must respond to non-conforming results. It will include SOPs describing how the equipment is to be used and maintained.

2.8. Supportive Structures Required for a QBMP System

A QBMP-system needs to be embedded and informed by supportive structures put in place by the participants.

a) Cooperation within the dairy chain

The dairy processor can introduce a QBMP for a CBE, but when the CBE does not introduce a similar QBMP system for the farmers, the inspectors and the transporters, the system will not have the desired effect.

b) An operational extension service

When suppliers and the other participants in the chain do not have sufficient technical knowledge and capacity to improve the results of a quality parameter, the parameter will not be effective in improving milk quality. In particular, hygiene awareness will require significant training inputs.

c) Testing equipment available

Appropriate milk testing equipment suitable for conducting each specific test, needs to be made available.

d) Sampling plan created

Milk from each supplier, both the farmer and the CBE, requires regular testing on the QBMP parameters. This will require an effective sampling plan and a tracking and tracing system.

e) Individual payment to each supplier

A QBMP-system is most effective when farmers are paid on individual test results. When this is not possible, group testing per milk container, sub-group or milk collection point can be considered as an alternative.

f) Regular payment of milk

It is essential that milk suppliers have trust in the dairy. Therefore it is of utmost importance that all suppliers in the dairy chain, including intermediaries as well as farmers, are paid regularly. Farmers and intermediaries will not be motivated to improve if payment is slow or delayed.

g) Collection twice a day

To prevent high bacterial counts, it is necessary to cool the milk immediately or at least as soon as possible after milking. The target should be to cool the milk to below 4°C within not more than 3 hours of milking. When evening milk is left at ambient temperature overnight, to be added to morning milk, the bacteriological quality of the mixed milk will be poor. Under such circumstances, using bacterial count tests for a QBMP system will be an exercise in futility, as bacterial numbers will invariably be high and the only solution is to cool evening milk.

h) Baseline determination

Before introducing a QBMP it is necessary to conduct a baseline survey in order to determine the range of values for each of the payment parameters, currently being detected in the milk supply. Knowing the range of values commonly found, and by constructing distribution curves, this will enable the system designers to select define the bands and select the thresholds for each of the milk bands.

i) Parallel test run implemented

After having chosen the parameters and its incentives and penalties, the QBMP should be operated as a dry run for a period of time, alongside the existing system, in order to examine its financial impact. The dry run period may extend from 4 to 6 months. This will allow sufficient time for the participants to understand the system and to begin to take action to improve the quality of the milk they produce and for those who succeed to experience financial rewards.

j) Transparency for the suppliers

Each supplier should be notified about his own test results in order to enable him to introduce changes and to take appropriate actions. It is helpful to publish test results publicly. This stimulates discussion and peer pressure amongst the farmers in their attempts to achieve improve milk quality

k) A proper recording system in place

A QBMP-system needs effective management and a reliable data recording system.

l) Full management support

Introduction of a QBMP system will give rise to much discussion between the farmers, the laboratory staff, the CBE management, the transporters and the processor. In order to control conflicts the management has to give and demonstrate full cooperation with the system to be introduced.

3 Introducing QBMP Systems

: GM-MPE
 : UNIT MANAGER / SUPERVISOR
 : GRADER(S)
 : Q/C SUPERVISOR
RAW MILK QUALITY REPORT
 MPE REGIONAL MANAGER

Meter	Time	Temp °C	L.A	RT	%BF	Density	%S.N.F	ALC	H ₂ O ₂	Antibiotics	% Acid in 10	Remarks
Hy Sids			0.13-0.14	5-6	≥ 3.5	1.028-1.032	≥ 8.5	Neg	Neg	Neg	0	
20	1737	13.2	0.13	6		1.0280		-Va	-Va	-Va		OK
21	1751			6		1.0275		-Va	-Va	-Va		OK
22	1757			6		1.0275		-Va	-Va	-Va		OK
23	1807			2,3		1.0275		+Va	-Va	-Va		6 CRT-E
24	1811			6		1.0275		-Va	-Va	-Va		OK
25	1718			5		1.0275		-Va	-Va	-Va		OK
26	1730	4.0	0.13	6		1.0280		-Va	-Va	-Va		OK
TOTAL = 6 - 5 CRT-E												
- RT = 16 CRT-E												
27	0420	3.5	0.13	6	16/01/13	1.0280		-Va	-Va	-Va		OK
28	0424			6		1.0275		-Va	-Va	-Va		OK
29	0433			6		1.0275		-Va	-Va	-Va		OK
30	0450			5		1.0275		-Va	-Va	-Va		OK
31	0458			6		1.0275		-Va	-Va	-Va		OK
32	0500			6		1.0275		-Va	-Va	-Va		OK
33	0515			6		1.0280		-Va	-Va	-Va		OK
34	0522			6		1.0280		-Va	-Va	-Va		OK
35	0526			2		1.0275		+Va	-Va	-Va		6 CRT-E
36	0540			6		1.0275		-Va	-Va	-Va		OK
37	0541			6		1.0275		-Va	-Va	-Va		OK
38	0547			6		1.0277		-Va	-Va	-Va		OK
39	0637			6		1.0275		-Va	-Va	-Va		OK
40	0713	4.0	0.13	6		1.0280		-Va	-Va	-Va		OK
41	0726			6		1.0275		-Va	-Va	-Va		OK
42	0753			6		1.0275		-Va	-Va	-Va		OK
43	0821			6		1.0275		-Va	-Va	-Va		OK

3.1. Review of selected QBMP Systems

The use of QBMP-systems to improve milk quality is widespread throughout the world. The systems that have been put in place in different countries range from quite simple to quite complex. The type of system chosen depends on the level of development of the local industry, local needs, market dynamics and the structure and operational modalities of the milk collection system.

3.1.1. The Netherlands

In the Netherlands milk price is based on fat and protein units. Next to this, premiums and penalties are given according to a similar schedule as given here.

<u>Item</u>	<u>Frequency of Sampling</u>	<u>Standard</u>	<u>Bonus%</u>
Total Plate Count	Every delivery	≤ 50.000 cfu / ml	2
		≤100.000 per ml	1
		>100.000 en ≤250.000 per ml	0
		>250.000 per ml	-1
Somat. Cell Count	Twice a month	≤400.000 cells per ml	1
		>400.000 cells per ml	0
Purity	Once a month	Gradation 1 /Good	0
		Gradation 2 /Bad	-2
Butyric Acid	Once a month	No gas formation (--)	0
		Gas formation in both tubes (++)	-2
		Gas formation in one tube (+-)	Suspicious

Furthermore there are incentives for seasonality. Because most dairy farmers are member of the major multi-national dairy co-operative (Friesland Campina) dividend is also paid as an increase in milk price.

3.1.2. United States of America

Prior to the 1970's, milk quality in developed dairy markets was driven by government regulatory systems. The appropriate government agency developed raw milk quality standards and through its system of enforcement, regulated the quality of milk. There was no price incentive nor was there a price penalty. A dairy farmer could be denied the right to sell milk if found not to be in compliance with the regulations.

While the government regulations continued to set the minimum standards for raw milk quality, in the 1970's the market gradually became the driver of milk quality as a result of a shift from primarily a fluid milk market to a manufactured product market, particularly cheese. Technology advancements in the 1980's allowed the dairy industry to gain better access to analytical data with

consequent improved understanding of milk components, such as solids not fat, and this expanded the opportunities for increased manufacturing efficiencies and new product development. A key area was an understanding the relationship between milk quality and milk components.

The Land O'Lakes milk component and quality pricing system is called, Total Value Pricing, and reflects the value that milk has for the specific products that are manufactured at a dairy processing plant. In Wisconsin the core product is cheese and the Total Value Pricing pays incentives for total pounds or kilograms of cheese solids as well as quality incentives for somatic cell count and bacteria counts. At the Melrose, Minnesota dairy plant the core product is whey protein and the Total Value Pricing is heavily weighted upon somatic cell counts because of the direct correlation between low somatic cell count and high protein yield from milk. Finally the Volga dairy plant in Volga, South Dakota is a manufacturer of mozzarella cheese and the Total Value Pricing is the correlation between somatic cell count and pounds of protein, which is calculated to a hundred weight of milk equivalent. All three programs differ because the markets differ. The conclusion to be drawn is that Kenya will need to develop a milk quality incentive program that reflects the Kenya market and the current milk supply.

3.1.3. India

In parts of India (personal experiences in the Punjab – Consultant De Leeuw) there is a great similarity with the situation in Kenya. This includes the status of milk quality. Around the big cities, hawkers control the milk market. Co-operative & private dairies buy the surplus milk. The farmer sells the milk to a middleman. The middleman sells the milk to the processor.

Some private dairies pay the middlemen according to a QBMP system. The payment is based on fat and solid non-fat content. Most middlemen have an electronic weighing scale and a milk analyser attached to a computer. This enables them to pay also according to quality to the farmer.

One multi-national dairy processor determines total plate count and aflatoxins per cooling unit (mostly one per middleman). The test results are included in the payment system. This gives the middlemen and the farmers, a common responsibility to deliver good quality milk. The processor checks if the middleman is paying the farmers correctly. This processor has established a large extension organisation to check and support middlemen and farmers. This way they are able to collect unadulterated milk with a total plate count around 1.000.000 cfu/ml.

3.1.4. Indonesia

In Indonesia most milk is collected by dairy co-operatives. Dairy co-operatives sell the milk to private processors. Most of these private processors pay according to a QBMP system. This is sometimes a rather simple system. One of factories pays according to grades based on total plate count and total solids. For many years this system did not result in a better milk quality, because co-operatives were unable to pay their farmers according to quality. In one of the projects executed by The Friesian in the last couple of years, one co-operative was able to introduce a QBMP system to its farmers. This became a success.

The co-operative acquired a milk analyser and an extension team was established. The extension team has 10 young extension officers. The co-operative has 7,000 active members and delivers about 170,000 kilogram of milk per day. About 40 milk collection centres collect milk, where milk is collected twice a day and is collected hot. From the milk collecting centres the milk is brought to a cooling centre.

Water adulteration was considered to be the primary problem. First of all, a sampling system was developed in which farmers were sampled individually, four times a month. Milk was analysed on composition and calculated freezing point. These analytical results were publically published at the milk collecting centres. Bad freezing point results were marked red. Extension officers visited farmers with bad freezing point results, during milking. A sample of unadulterated milk was taken and analysed. It appeared that from the 200 samples taken this way, none had a bad freezing point. This was reported to the farmers. No penalties were given. This way the farmers knew that water adulteration could be traced.

After this exercise a payment change with penalties for milk with high freezing points was proposed. The results per individual farmer and the effect on the milk price were published at the milk collection centre. For the moment the milk price stayed the same. Two months later, the deductions were introduced into the QBMP system. The result was significant. Within 6 months, the total solids increased from <11.5% to >12.0%. Also the total plate count halved, because the water was identified as being one of the main sources of bacteria in milk.

3.1.5. Vietnam

In Vietnam two large private processors control the dairy market. The informal market is small. The processors mostly own milk collection centres. Both dairies pay according to milk quality. One of the dairies controls the microbiology of the milk with the methylene blue reduction test, the other procured a Bactoscope three years ago, after having operated successfully for many years using the resazurin test. With help of the resazurin test average, the TPC test results averaged around 1,000,000 cfu/ml. At the moment with help of the Bactoscope, the count average is approximately 500,000 cfu/ml.

Both factories have introduced a special feature into their milk payment system. All farmers are audited once or twice a year on good dairy practice farming. An inspector from the dairy processor visits the farm and looks at animal welfare, drug usage, hygiene, and feeding. He or she scores the farm according to a checklist. When the score is good, the farmer receives an incentive by an increase in the basic milk price for that farm.

3.1.6. Zambia

The Zambian raw milk quality standards are attached (Annex 5). Although the standards are titled “Parmalat”, these standards are being applied by both Parmalat and ZamMilk, which accounts for 100% of the commercial farmers and 85% of smallholder farmers who deliver milk-to-milk collection centres in Zambia. The incentive within the Zambia milk-pricing program is that if milk does not meet the standards, then it is rejected. The pricing of milk is based upon the requirement that farmers must meet the minimum standards to receive a base price and from that point payment is increased based upon components.

The Zambia system evolved over time with Parmalat as the leader in the dairy sector. Initially, Parmalat only received milk from large commercial farmers. With the development of milk collection centres, smallholder dairy farmers began to participate in delivery of milk to Parmalat provided they met the same standards as the commercial farmers. Testing is done at the processing plant and to manage costs and logistics, only bulk milk is sampled. If a farmer or milk collection centre fails a test, Parmalat milk quality field technicians are mobilized to rectify the problem.

There are two key features of the dairy value chain in Zambia that allow the milk quality system to work well. First, the informal milk market channel is very small. The informal milk channel in Lusaka,

the capital city, is estimated to be between 10,000 and 12,000 litres per day. Secondly, the amount of milk provided by smallholder dairy farmers is growing but currently accounts for 20% of the milk supplied. The commercial farmers who supply 80% of the milk have developed a quality culture over time and have a strong relationship with the dairy processors, both Parmalat and ZamMilk.

3.1.7. Zimbabwe

The National Association of Dairy Farmers has been the cohesive and driving force behind Zimbabwe's dairy processors to implement a dairy quality incentive payment program. The dairy sector has adopted a component pricing system based upon a base of total solids of 12.21% and the current price is 40-cents (US) per litre. The actual payment converts the percentage into kilograms so that farmers are being paid on a weight basis, not percentage. Total bacteria count and somatic cell count incentives and reductions are made but each dairy plant uses their own standards and some dairy plants also have a volume incentive. The testing of samples is done at the laboratory of the National Association of Dairy Farmers and the processors pay for the testing. The National Association of Dairy Farmers also has extension technical staff to assist farmers to "trouble shoot" quality problems.

Zimbabwe is much like Zambia regarding the larger market share of commercial farmers but there is an increasing market share of smallholder dairy farmers. The component pricing away from pricing based strictly on volume has been cited as a catalytic event in developing the dairy sector. There is an interesting remark from the CEO of the National Association of Dairy Farmers regarding the impact of the component pricing system and quality incentives, "small holder dairy farmers have always had the capacity to produce a quality product but now they have the incentive to produce it".

3.1.8. China

A number of central laboratories were established in China to implement quality based payment. The payment programmes include the usual quality parameters such as acidity and methylene blue. The laboratories were also equipped with the high-end milk component analysers to enable fat, protein, and solids analysis. Payment systems based on the weight of fat and protein was introduced. The relative prices paid per kilogram of fat or protein can be adjusted to suit seasonal changes in milk volume.

In conclusion there are many examples of successful raw milk quality incentive payment programs that are market driven. All of those cited in the previous section, including the Land O'Lakes model, provide for a base pricing according components, butterfat, and solids not fat. The market value for butterfat and solids can be calculated and the farmers can be compensated based upon total kilograms produced. In each of the programs reviewed milk adulteration is tested for and positive samples are heavily penalized. The programs also have a microbiological quality factor, either total bacteria count and/or somatic cell count, which can increase or decrease the component price based upon the standards established. Finally each of the programs provides field support from the processor, cooperative, or association to assist farmers in adopting management practices that will lead to improve milk quality and to obtain the reward levels of milk pricing.

3.1.9. Kenya

If the market drives quality then it is not surprising that there is a dairy processor in Kenya who pays a quality incentive. Bio Foods Dairy has a strong position on the Kenya market with a reputation as a producer of high quality dairy products. The raw milk quality incentive payment programme is market driven. The programme rewards farmers for high components and low bacteria counts, both of which are needed to market quality dairy products under the Bio name.

Bio has been successful in implementing a raw milk quality payment program because the company is selective regarding the farms from which it procures milk. There are 10 farms, with 4 of those farmers providing 75% of the raw milk. This small number of farmers allows the programme to be manageable and also allows the buyer / seller relationship to be fostered and productive.

3.1.10. The Potential for launching a QBMP-system in Kenya

In Kenya, the farm gate milk price fluctuates for reasons of season, supply and demand, capriciousness of the traders and the dairy plants etc., all of which is out of the farmer's control. On a daily basis, frequently the individual farmer cannot determine or be assured of the price he will receive for the milk he produces and sells. Experience internationally, has clearly demonstrated that financial reward drives farmers to improve the chemical and microbiological quality of milk produced. The milk quality targets adopted in a graded payment for quality scheme need to be chosen with an appreciation of what is realistically attainable by the majority of farmers.

To launch a National QBMP-system in Kenya would call for a massive effort, and predictably it would be a high-risk exercise. With a semi-traditional, partly commercialised dairy sector, and an estimated one million smallholder dairy farmers, a national consensus and ability to switch over "overnight" to a QBMP system, must be regarded as being unrealistic and unachievable.

One of the consultants (Foreman) previously participated in a national QBMP implementation programme where an entire national dairy industry moved into the new system en masse. The payment system included TPC, titratable acidity, antibiotics detection, water adulteration, organoleptic evaluation and temperature. The shift was accomplished smoothly and successfully because the dairy sector was well structured and organized, and the suppliers were highly skilled. In this setting, the main efforts that were called for were to provide the testing laboratories, which were located in the processing plants, with the technical capacity to perform high numbers of tests, and installing computerised recording and reporting systems for results, while also informing and sensitizing the farmers. Government ministries and the regulator were closely involved in the effort and their positive cooperation and participation ensured success.

In the local context of Kenya, where the industry is characterised by fragmentation of collection and distribution systems, and with insufficient milk cooling and transportation infrastructure, the imposition of a QBMP system from above could not be expected to succeed. It would almost certainly meet with opposition from parties who have interests to protect. To avoid conflicts with uncooperative partners, rather, it is suggested the way to move forward is to support one or more pilot trials in cooperation with interested processors and CBEs.

If these trials are successful this could be up-scaled by the same processor and other processors can replicate. Expansion and participation of new players should be based on voluntary participation. The proposed Milk Quality Council could act as the source of information, instruction, and guidance in setting up new systems elsewhere in the milk shed or beyond.

It would be the task of the regulator to provide support to the pilot trials and further development of QBMP-systems. Their role would be to sensitize farmers on the short and long term benefits and to strictly enforce milk standards and good practice upon the informal sector.

3.2. Sector Preparedness for piloting a QBMP-system

3.2.1. Context

CBEs, hawkers and traders have the contact and relationship with the farmer. They sell the milk to the highest bidder. This is a possible constraint for a successful introduction of a QBMP system. When dairy processors are not able to offer a competitive base-price, the intermediaries will sell to others. Currently, at the time of writing this report, traders and hawkers are reportedly paying a significantly higher price for milk than the processors, especially around urban centres. During the field trips we observed that prices up to 60 Kshs per litre were mentioned, while processors pay just over 30 Kshs. Due to their ability to collect from rural areas located some distance from the main urban centres, processors are able to collect relatively cheap milk.

It seems that dairy processors are unable to add sufficient value to their products, to give them the leverage which would enable them to control the raw milk market. In this respect, the hawkers are setting the benchmark for milk quality and its price, instead of the dairy processors. The latter have a tendency to lower and compromise their own standards in order to be able to access sufficient volumes. This is a systemic issue that is partly caused by the lack of enforcement by the regulatory authorities, of milk standards across the sector.

With a large and indigenous raw milk market, processors should seek to articulate more strongly their competitive value and the benefits to the consumer of value addition. This should lead to more investment in the supply chain to improve productivity, quality and loyalty and the production of high-quality and safe liquid milk. The benefits to the processor would be products with improved shelf life and improved quality value-added products for the growing middle and lower middle class. This is the motivation for dairy processors to implement a QBMP system.

The strategy suggested in this study report is to first pilot a QBMP-system with interested and committed processors, followed by scaling up through slow expansion and voluntary participation. Once QBMP systems are piloted and shown to be successful, the results will be discussed, reviewed, and publicized throughout the industry. Success always attracts new participants. Policy makers, regulators and processors should provide maximum technical support and facilitate and train farmer groups and CBEs who want to implement a QBMP system.

3.2.2. Kenya Dairy Board

The Kenya Dairy Board views the introduction of a QBMP-system as a major step forward for the sector. KDB in fact advised SNV in 2012 to address this issue under KMDP (Annex 4) and has worked on the same issue with Land O' Lakes. KDB is intending to run a three months pilot to set a baseline for a QBMP system for selected CBEs and processor(s).

3.2.3. Processors and CBEs

In November 2011, SNV organised a workshop with the participation of the procurement managers of the major Kenyan dairy processors. The minutes of the meeting and the participant list are attached to this report (Annex 3). At the workshop participants showed a clear interest in a QBMP-system and this was confirmed during the study mission in all of our meetings. In all discussions throughout the study, the stakeholders showed great interest in exploring participation in a pilot and three declared they were interested in participating (see Section 5).

The prevailing attitudes of CBEs towards QBMP are less clear. Those CBEs visited during the mission were positive, but the whole concept of a QBMP is very new to them. This applies in fact to the entire industry, where only a handful of farmers and one dairy processor are actively engaged in operating a QBMP-system. Therefore general experience throughout the industry is minimal and this applies both to processors, CBEs and farmers.

It was observed that dairy processors often did not entirely understand the concept of a QBMP-system. The general response was the observation that in a QBMP-system the milk price would inevitably be forced to rise. It required considerable effort to explain that in a QBMP system the milk price remains the same. Also in our conversations with stakeholders we found that there is concern that milk will be lost to the competition, once penalties are put in place for below standard quality. We, as consultants, were unable to satisfactorily remove this concern, in spite of the fact that we shared the evidence of international experience which has demonstrated that farmers who are part of a QBMP-system usually also increase productivity.

The processors and CBEs will need close technical support from SNV as the QBMP system is transitioned through its introductory phase. The stakeholders understand the concept and the advantages to be gained from a QBMP system, but are uncertain about the implications of the technical and organisational changes that will be necessary to implement the system. In this respect support from KMDP will be very important to develop and drive the development of a successful pilot. Such a pilot and the required support should be planned to cover at least a period of 2-3 years.

3.2.4. Farmers

We found that farmers are in general enthusiastic about participating in a QBMP system. They believe that they will receive more money for the milk. This is a misconception as explained above. Initially the average milk price will stay the same. Only when milk quality improvements lead to efficiency gains in the chain, cost reductions and better quality end-products with higher margins, will the milk price increase. Nevertheless farmers will benefit from the introduction of the system. Milk quality improvement at the farm will go hand in hand with an increase in milk production volumes.

3.3. Selection of Parameters for a Pilot QBMP-system

3.3.1 Based on Processor's Target Market and Environment

As discussed in Paragraph 2.2 (Objectives of a QBMP-system), different processors may have different quality requirements, depending on the products they manufacture. Also local situations can vary, where for one CBE water adulteration may not be a problem, while in another area the issue presents a challenge. In some places the use of antibiotics might be very common due to well-developed dairy practices and veterinary services, whilst elsewhere, demand or availability of antibiotics may be minimal.

The availability of testing facilities is another issue. Kenya does not possess a national dairy laboratory. There are no laboratories equipped to analyse thousands of raw milk samples per day. Also, third-party analytical services are expensive. The result is that processors and co-operatives have to establish their own testing facilities. High-end, high capacity milk analytical instrumentation is expensive and since no one has invested in the equipment, it is unavailable in Kenya. This is not a constraint for the introduction of a QBMP system. By selecting simple readily available common wet chemistry tests, valuable parameters can be incorporated into a QBMP system. When these tests have proven that the QBMP is successful, the purchase of more advanced equipment may be considered.

Therefore, the identification and recommendations for selection of specific milk quality standards and test methods has to be done by the processors and CBEs, who may participate in a KMDP facilitated pilot. Analysis of baseline results, cost considerations, availability of equipment and the target markets of the processors, will lead to the choice of the parameter(s) and tests. It is advised to introduce one parameter at the time into the QBMP system. It will take some months for all the people involved in the system, staff, and farmers, to become adjusted to the system.

3.3.2. Proposed parameters for a QBMP pilot

Nevertheless, based on international best practices and our field visits and discussions in Kenya with stakeholders, a direction can be given regarding the parameters to choose. Currently freshness of milk, water adulteration, contamination with antibiotics, and milk composition appear to be the most likely tests that should be incorporated in the QBMP. Per item, some parameters and tests are suggested:

Freshness:

- Total Plate Count (Plate Count or Petri-film methods)
- Methylene Blue Reduction Test
- Resazurin Test
- Alcohol Test

Water Adulteration:

- Measured freezing point (Cryoscope, freezing point depression)
- Calculated freezing point (Milk composition analyser – indirect calculation)
- Specific Gravity (Lactometer)

Antibiotics:

- Incubation broad spectrum tests like Delvo SP mini test (commercial kit)
- Quick small spectrum tests like for instance the Beta Star test (commercial kit)
- Yoghurt test (growth of culture, Tritetrazolium chloride test or equivalent)

Composition:

- Gerber test
- Gerber test in combination with lacto-densimeter test (calculation by standard formula)
- Milk composition analysers

Some of these tests are time consuming, others are expensive, some are not very precise, and others can only be done in small numbers. These are all considerations which need to be taken into account before implementing a QBMP system.

3.4. A Common Milk Testing System

Currently a range of milk reception tests are recognised under the Kenya/EAC/COMESA Raw Milk Standard. These are listed in the appendix of the Raw Milk Standard.

In the field, the interpretation of the optional test results is not well defined and is open to individual interpretation by those doing the testing and payment for the milk. This situation is reflected by the daily milk reception testing as it is currently performed in the milk collection centres and processing plants. Different combinations of tests may be used at different locations and threshold values are not uniform. In order to eventually apply a national graded payment system based on milk quality

throughout the industry, the industry should consider adopting one single set of threshold values for each of the various tests listed in the Kenya / EAC Raw Milk Standard which would be applied for all raw milk quality assessments. A uniform set of raw milk reception tests and a single system of interpretation of the results and allocation of quality grades, should be applied throughout the milk collection system. Adoption of a uniform set of threshold values to evaluate raw milk quality would bring clarity to milk testing, enabling comparisons to be made at all points where milk is sold and purchased.

3.5. Baseline to Assess In-the-Field Milk Quality Parameters

The way in which milk quality standards and milk price are chosen and graded, depends on the existing situation in the field and upon the needs and priorities of the buyer.

To set the threshold values of the quality grades and the values of the bonus/deduction applied to the milk price, it is necessary to carry out a baseline sampling and analysis of the milk currently being sold by the farmers and the CBE. This is necessary in order to establish the benchmark. The management of the dairy processing plant will then be able to decide which parameters to include in the QBMP system, and at what level the incentives/penalties per grade should be set. The choice of parameters and the level at which grade thresholds are set may vary across the pilots.

3.6. Milk Purchase Contracts

A good business relationship is of great value in creating a sustainable bond between buyer and seller of the milk. A contract can help to make the business relationship clear and legal. As in every contract, both parties have obligations towards each other.

Buyer

1. Promises to purchase all offered milk for a certain period.
2. Pays according to the price structure described in the contract.
3. Pays in accordance to the payment conditions laid down in the contract.
4. Buys at moment of delivery.

Seller

1. Promises to deliver according to the times set by the buyer.
2. Takes all necessary actions required to ensure the milk can pass the raw milk acceptance standard.
3. Does not adulterate the milk.
4. Agrees to the conditions set by the buyer.

These contracts should be made between the processor and farmers, the dairy societies & cooperatives, and if applicable between dairy societies/cooperatives and farmers. All contracts should be drawn up in accordance with national legislation.

CBEs are farmer owned businesses or cooperatives and therefore the relation with the farmers/ members is usually quite good, depending on the performance of the CBE. CBEs provide a variety of services to their members, including milk collection and marketing, sales of animal feeds, veterinary drugs, credit, training and extension services.

In Kenya longer term binding contracts between processors and CBEs/traders, or directly with dairy farmers are less common. Possibly with the exception CBEs where processors have invested in cooling/bulking tanks and some large scale farmers, such as for example those who deliver milk to Bio Foods.

3.7. Cold Chain and Logistics Management

3.7.1. Milk Bulking Centres

Milk bulking centres play an important role in the dairy chain. They enable the collection, bulking and cooling of milk before transportation to the consumer and/or processor. Without bulking centres, milk from certain regions will have no value because it cannot reach possible buyers before spoilage. The presence of bulking stations is essential for creating market access and the development of a milk shed.

Different players within the dairy chain may own bulking stations in Kenya's main milk sheds:

- Dairy processors
- CBEs (dairy societies and farmer owned companies)
- Milk traders
- Large-scale farmers

By operating a bulking station value is added to the milk. At the moment there is a lack of cooling capacity, especially along the milk collection routes. The milk produced on small scale farms, selling a few litres of milk daily, is particularly badly handled. On these farms evening milk is not cooled. In the morning it is mixed with the morning milk and taken to the roadside for collection. When collected the few litres are mixed with neighbours' milk and the churns are left by the roadside for perhaps several hours until collection for transportation to the processor or cooler. By morning, the bacteria in the un-chilled evening milk are in the logarithmic phase. The lag phase in bacterial growth is usually 3 to 4 hours, depending on the species, the temperature and the available nutrients. In the case of warm milk, all the ingredients are present to drive the fast growth of the bacteria present. When warm evening milk is mixed with fresh morning milk, the lag phase of the bacteria in the fresh morning milk is substantially shortened and the bacterial population very quickly moves into the logarithmic phase of exponential growth.

The ideal solution would be to equip groups of farms with small communal satellite coolers of 200–500 litres capacity. These could be located on farms where there is access to power, and shared between clusters of neighbouring farms. The major problem that needs to be addressed is access to power. Consequently there are technical difficulties which would need to be resolved, essentially the power source. In an attempt to provide technical solutions to the power supply problem for small scale milk coolers, in recent years work has been done in developing solar and chemically powered milk coolers. At the date of this report, the status of these developments is not known. In Uganda, the consultant (Foreman) in cooperation with an engineering department at a US university, supported development of a chemically powered system designed to cool 50 litre milk cans. The current status of this development work is unknown.

3.7.2. Milk handling and Logistics

Efficient cold chain and logistics management plays an important role. Hygienic milk handling by the farmer and the transporter in clean aluminium milk cans is key to the production of low count milk.

Leaving cans of milk for several hours, in the heat of day, at the roadside for collection, is the Achilles heel of the entire dairy industry. To prevent or delay rapid bacterial growth, milk must be cooled within 2-3 hours of milking. Under the present collection system in many parts of rural Kenya it is certain that the bacteria have started their logarithmic phase by the time the milk reaches a cooling centre. This is reflected by the limit set in the standard that the titratable acidity of the milk should

not be more than 0.17% lactic acid. This threshold is high and indicates that the milk is already souring. Milk freshly taken from the cow has a titratable acidity of 0.135% to 0.14%. Values higher than 0.14% indicate that bacterial growth has started. Apparently, the dairy industry in Kenya has accepted souring milk as a norm and a standard.

Thought should be given to strategic long-term solutions. Possible directions could be centrally located refrigerated containers for storing the milk cans, or perhaps small 100-200 litres capacity refrigerated farm cooling tanks located beside farm clusters to which the local farmers could bring the milk directly, always provided that there is a power supply. A 2-phase power supply would in that case be sufficient. To achieve immediate cooling, bulking tanks can be fitted with small plate coolers. A Lennox-type chilling unit can supply the chilling water. This type of system is very effective. The milk is immediately cooled to 3-4°C as it enters the tank.

3.7.3. Protocols and Training

For a QBMP system to work effectively, Standard Operational Procedures need to be prepared for all the participants along the chain (farmers, milk testers at collection and bulking centres, transporters etc.), in terms of milk handling and testing. The new Dairy Regulations contains sections on Good Management Practices applicable to all the different stages in the chain and these should be communicated in clearly written operating procedures. Training is an important component to prepare the people who will operate the system.

3.8. The Role of Laboratories in the QBMP System

Laboratories are an essential component of a food quality control system. The establishment of laboratories requires considerable capital investment in infrastructure, operating costs, and maintenance. Therefore, careful planning is required to achieve optimum results.

Most laboratories in the country are not accredited and many are limited in their capacity to process large numbers of samples on a daily basis. There is a deficiency in capacity in terms of the availability of analytical instrumentation and equipment, and in some cases of procedural skills. Analabs is UKAC/ILAC certified for most analytical methods required for milk and milk products, however the laboratory lacks some essential equipment. For the purposes of testing milk for a QBMP system, to keep running costs down, testing should be done at the milk collection centres and by the processors. The daily testing operations should be under the nominal supervision of the locally appointed Milk Quality Committee. Implementation will require attention to the following:

- Test equipment is reliable and maintenance to ensure trouble free operation
- Reagents and chemicals are sourced from approved manufacturers
- Standard operating procedures and work instructions are written and provided to the laboratory staff.
- Laboratory staff is qualified to perform the tests. Training will probably be required.
- Control mechanisms are in place. This can be a function of the local Milk Quality committee.
- The system is regularly audited, internally & externally.

3.9. Organisational Structures and Mechanisms

3.9.1. Credible financial systems and timely payments

The proposed changes in the milk payments structure requires good financial administration. Manual records, digital records, or a combination of both will need to be adopted. The essential requirement is that it is done accurately. Digital recording would be the preferred method. Accurate calculation of the effects of the changes in payment is crucial, and digital recording would simplify the task.

The payment system will be most effective if each supplier's milk is tested and paid for individually. Milk payments must be done promptly on the date agreed with the suppliers. Irregular payments will negatively impact on motivation levels and will erode the trust between the suppliers and the buyers. Agreements on modalities and the level of payment (per grade) need to be laid down in clear contracts signed by the parties involved.

3.9.2. Quality control

All parameters required for calculating the milk price need to be measured and the results recorded precisely. This requires that all the relevant procedures need to be described in work instructions and Standard Operating Procedures (SOPs). Staffs need to be trained to execute these instructions and procedures. Control mechanisms need to be put into place to monitor the instructions and procedures.

3.9.3. Recording and tracking of Data

When KMDP implement the pilot trials for QBMP-systems in Kenya, it will be necessary to design one data uniform collection system, which will be used at each of the pilot or trial locations. A manual or computerized data system (e.g. spread sheet programme) should be prepared to include and track milk deliveries per farmer.

The following suggested minimum list of data should be recorded and tracked. Any additional data thought to be necessary by the stakeholders may be added as required.

Table III.1: Data to be recorded for a QBMP system

<u>Data Item</u>	<u>Farm level</u>	<u>Bulking Centre level</u>	<u>Processor Level</u>
Farmer's Name		+	
Farm Producer No.		+	
Date of milk delivery	+	+	
Volume of milk (litres)	+	+	+
Results of laboratory tests		+	+
Time milk received		+	+
Date notification of laboratory test results sent to the farmer		+	
Date notification of laboratory results sent to the bulking centre			+
Date and content of all communications made to the farmer by extension worker		+	
Date and content of all notifications made to the bulking centre from farmers and from the processor / extension worker			+
Results of the calculation of the monthly Grade		+	+
Calculation of the actual monthly payment	+	+	

to be made to the farmer		
Calculation of the actual monthly payment to be made to the bulking centre	+	+
Complaints / comments from farmers and bulking centre	+	+

3.9.4. Reporting Results and Communication with the Farmers

Test results must be reported back to the farmer and to the bulking centre without delay. The results should be given to the farmers and the bulking centre the same day they become available. In Kenya, this could be conveniently done using the mobile phone networks.

Inevitably, between the farmers and the collection centre where their milk is tested, and between the collection centre and the processing plant where the bulking centre's milk is tested, there may be an element of mistrust and perhaps suspicion that the testing is not being carried out fairly or competently. From time to time, there may be accusations that the results are being manipulated to lower the price of the milk. From the farmers' point of view, his milk is tested without him being able to see how it is tested. For the farmer the test is largely an unknown 'black box'. When the results are not as per his expectations, then there is likely to be a critical reaction.

Therefore, it is essential that the system be managed completely transparently. To help in the process, we recommend the installation of a Milk Quality Council/Committee for each pilot

3.9.5. Milk Quality Council

A QBMP system deals with two components, milk quality and the money payment. Both are potentially sources for conflict. An essential requirement for success is transparency in all the QBMP procedures and operations.

To manage the payment system and to achieve transparency it is proposed that a stakeholders committee be appointed to supervise the system. The committee could be designated as the Milk Quality Council/Committee (MQC). Its function would be to oversee the operation of the QBMP system, through a system of data collection, reporting to the stakeholders, monitoring and review. The committee membership should be composed of elected representatives from the farmers and the processors who are participants in the QBMP, perhaps together with a representative of the Kenya Dairy Board (KDB). The committee could possibly be chaired by KDB, or alternatively by a person elected from within the committee membership. Its functions could be:

- To oversee all matters pertaining to the management and operation of the QBMP system.
- To provide public transparency for all the operations and procedures.
- To act as the linkage between the farmers, the collection centre and the processor.
- To supervise the sampling, testing and distribution of results.
- To elect and form an independent appeals committee.

3.9.6. Appeals Committee

An important element of the proposed QBMP is the formation of an Appeals Committee where farmers and CBEs can lodge complaints and resolve disputes. The members of the Appeals Committee would be elected representatives from the farmers, CBEs and an appointee of the processor. The committee chairman must be impartial and not connected to any of the stakeholders. The Committee Secretary receives and files complaints and appeals from the stakeholders, calls for meetings and produce minutes. The appeals committee should meet every two months in order to listen to and respond to complaints from farmers and CBEs.

3.9.7. Extension Services

Crucial to success is the establishment of an extension service or model, with extension officers assuring the proper communication between all levels in the chain: the farmers, collection centres, transporters, CBE and the processor. Information must flow rapidly and easily. Test results must be reported immediately when they are available. When results are unsatisfactory the extension officer identifies within 24 hours with the farmer the cause of the poor result and advises on proper action. The details of each-visit will be recorded in a Farm Visit Report, a copy being left with the farmer and a copy passed to the management committee. Extension officers should be accountable to the processor and equipped with a motorcycle and a mobile phone.

3.10. Possible Role of the Kenya Dairy Board

The financial impetus to improve quality and hence the price received, would act to influence the individual farmer to improve the quality of the raw milk he produces and ultimately aid in long term planning and investment in infrastructure at the farm level. The farmer would have the opportunity to receive an improved price and this would require that he supply milk, which conforms to certain clearly defined quality standards.

With a system of this kind successfully operating in the formal stream, it may be expected that many of the farmers in the informal stream would develop a wish to move over to the formal stream and escape the price and marketing uncertainties that are inherent within the informal system.

KDB, operating in cooperation with a stakeholder 'Milk Quality Committee' could participate in controlling the raw milk quality grading system within the formal stream, while of course continuing to look after the informal stream, and reinforce its status as the figurehead for its smooth operation. KDB would be regulating the processing plants, by means of its regulatory inspectors and through them could extend its 'quality' reach down through the MCCs within the formal system.

As an adjunct to the graded payment for quality system, the control of milk quality in the formal stream would be supported by a requirement for the collection and/or delivery of a minimum number of regulatory samples of raw milk and milk products from the Milk Collection Centres and Processing Plants to laboratories approved by the Regulatory Agency. The sampling and testing schedule requirements are defined in the text of the New Dairy Regulations. The sampling, monitoring, and inspection of the analytical results data would be monitored and collected by KDB. By this means, KDB regulatory inspectors would have access to a continuous flow of laboratory results for raw milk and milk products from the milk collection centres and the processing plants, providing supporting data for the purpose of monitoring the graded payment for quality system.

The informal stream still has to be monitored and controlled while the participants are being encouraged to shift over to the formal stream. KDB will do this through the regulatory inspectors who will act to inspect the milk traders, and handling practices and the transport used for hauling milk, milk coolers, and raw milk selling points. Milk cooling centres in the informal stream should be subject to regulatory inspection and required to meet GMP requirements in order to be issued an annual business or 'Quality Performer' licence requirement. Issuance of the licence should require implementation of GMP.

The traders who buy, haul, and sell milk could come under some kind of control by requiring them to attend a milk quality workshop and issuing them an annual 'Quality Performer' licence. The milk coolers that they supply will be subject to routine formal regulatory inspection and hopefully that would create a measure of back-flow pressure onto the traders that would require them to take on some degree of responsibility for the quality of their operations.

In the scenario described, the impetus for quality improvement can be expected to come from the farmers in the formal stream who enjoy an opportunity to earn an improved milk price. Control of the grades would be the responsibility of the stakeholder 'Milk Quality Committee'. The KDB regulatory inspectors working under the umbrella of the Milk Quality Council would undertake ensuring correct performance of the testing.

4. Milk Testing in a QBMP Pilot



4.1. Overview of Milk Quality Tests

The commonly used tests for various parameters used in QBMP-systems are listed in the table below.

Table IV.1: Commonly Used Tests in QBMP Systems

<u>Test</u>	<u>Purpose/Parameter</u>
Total Plate Count	Determination of bacteriological quality using a direct counting method.
Methylene blue	Determination of bacteriological quality using an indirect method.
Resazurin test	Determination of bacteriological quality using an indirect method.
pH	Measures the hydrogen ion concentration, too indicate if milk is due to the presence of lactic acid.
Cryoscopy	Detection of adulteration by added water using a direct method.
Specific Gravity	Detection of adulteration by added water using an indirect method.
Organoleptic	Detection of odours, taints and discolouration.
Temperature	Verification that the milk has been cooled.
Antibiotics detection	Detection of antibiotics.
Titrateable acidity	Detection of lactic acid production, which is an indirect measure of bacterial growth – commonly referred to as ‘Freshness’.
Alcohol	Detection of lactic acid production which is an indirect measure of bacterial growth.
Alizarin-alcohol	Detection of lactic acid production incorporating a dye to provide a visual result, which is an indirect measure of bacterial growth.
Clot on boiling	Detection of protein stability.
Fat content	Measure of the percentage fat in the milk.
Protein content	Measure of the percentage protein in the milk.
Solids content	Measure of the percentage solids content in the milk.
Notes	
Total Plate Count	This is a direct method and is the internationally approved reference method. It is empirical and requires experienced laboratory technicians to be able produce repeatable results.
Methylene blue	Is crude and is an indirect method used to measure bacteriological numbers. It is simple to do and is suited to testing large numbers of samples.
Resazurin test	Is crude and is an indirect method used to measure bacteriological numbers. It is simple to do and is suited to testing large numbers of samples.
Cryoscopy	Precise, accurate to $\pm 0.02\%$ added water detection. Can also be used to detect the presence of chemicals, which may have been added. The latter can be confirmed by a pH test.
pH	As bacteria in milk grow they utilize lactose and produce lactic acid. This test detects the presence of the acid (hydrogen ion concentration) and so indicates the growth of bacteria. Very accurate. It can be used together with cryoscopy to confirm the presence of adulteration by added chemicals.
Specific Gravity	Must be performed precisely according to the Standard method. Must include temperature compensation. Must be done on a stable surface. No direct correlation between specific gravity and percentage added water.

	There is great variation in cow samples and regional samples. Normal milk usually falls in the range 1.030 – 1.032. In Kenya 1.028 is generally used as a threshold value. In the consultants' view, this value indicates the presence of added water.
Organoleptic	An essential test. Samples should be tasted for evaluation, but only after laboratory pasteurization in a test tube.
Temperature	In Kenya where warm milk collection prevails in much of the farm collection system, the test has no practical use. It is only relevant to the collection centre to the processor link.
Antibiotics detection	For both public health and processing reasons this is an essential test. Commercial test kits (Delvotest and similar) are relatively expensive per test. A simpler acidification test using yoghurt culture is cheap and simple to use.
Titrateable acidity	Test is very useful and precise. Kenya Standard threshold is 0.17% lactic acid. Fresh milk is 0.13%-0.14%. Milk with 0.17% is sour.
Alcohol	Measures protein stability. As lactic acid accumulates in the milk, the protein denatures and becomes unstable, which will result in coagulation in the pasteurization process. Kenya Standard utilizes Ethyl Alcohol 68% by weight or 75% by volume (density 0.8675 g/ml at 27 °C). It was observed that various concentrations are used in the field.
Alizarin-alcohol	Measures protein stability. As lactic acid accumulates in milk, the protein denatures and becomes unstable. This results in coagulation in the pasteurization process. Test is identical to the alcohol test with the addition of a dye to give a visual colour result.
Clot on boiling	Simple. Measures protein stability.
Fat content	Fat is a high value component. Traditionally payment plans paid extra for high fat content milk. Now QBMP payments are based on the weight of fat. This discourages adulteration with added water.
Protein content	Often used as a QBMP payment parameter, particularly where milk is used for cheese making.
Solids content	Used in QBMP as an indirect measure of adulteration with added water.

The selection of the parameters and the test methods to be used should be guided by the following principles:

- a) Allow the processor and the milk collection centre to identify the test parameters of most importance to them. They may have special requirements.
- b) Select test methods, which provide a range of numerical values. This will enable the construction of quality bands, which are easily understandable.
- c) Set a standard price threshold, which is achievable by 75% to 80% of the farmers.

4.2. Milk Reception Testing and Sampling – A Discussion of Relevant Tests

As milk moves along the chain, from farm to the processor, it passes through a series of stations: farm – transporter - milk cooling tank - trader and/or transporter – processing plant. Milk reception tests are chosen according to the requirements and testing capacity of each station in the chain. The tests will also change according to whether the milk is chilled at the beginning of the chain on the farm, or whether chilling takes place at the bulking centre, or only at the end of the chain in the processing plant.

This can be illustrated by examination of the system used by the Dairy Standards Authority in South Africa. As the milk passes from the farm to the processor, the required tests become more sophisticated. This reflects the different testing capacities at each station along the chain.

Table IV.2: South Africa Specifications On-Farm Milk Collection

Test	Specification
Organoleptic	No taints or odours
Temperature	≤ 4°C (legal requirement)
Alizarol	68% v/v (or as required from product specifications)
Sediment / insects	Absent

Table IV.3: South Africa Specifications Plant Reception Tanker Acceptability

Test	Specification
Inhibitory substances	Reject if positive
Alizarol (confirm with Rezasurin)	As recommended by raw milk specifications, R1555 68% (75% UHT), (72% Fresh), (70% all other)
Temperature	≤ 8°C
Titrate acidity (If > 0.19%, but passes all others, accept)	0.14 – 0.19
pH (If outside spec but passes all others, accept)	6.6 – 6.8
Organoleptic	No taints or odours
Freezing point	≤ -0.512°C

Table IV.4: South Africa Specifications Microbiological Specifications for Milk for Further Processing

Standard	R1555 cfu/ml	Recommendation cfu/ml
Total Bacterial Count	<200,000	<50,000
Total bacterial Count (individual cows)	<200,000	<50,000
Total Bacterial Count (Tanker milk delivered at the processing facility)	<200,000	<100,000
Coliforms	100	50
E. coli	Absent	Absent
Pathogens	Absent	Absent

Table IV.5: South Africa Specifications Somatic Cell Count for Milk for Further Processing

R1555	Recommendation
Cow's milk	< 500,000 / ml

The conclusion is that each 'receiver' of the milk as it passes along the chain chooses the test parameters and the thresholds that are important to the receiver. At inception of a QBMP system the thresholds must be chosen so that they reflect the capacity of the milk producers.

To take another more pertinent example, in Kenya/EAC Raw Milk Specification Standard, a series of tests for raw milk are listed. The tests are designated as either 'Normative' or 'Informative'. The normative tests are those that must be done, while the informative tests are optional.

Table IV.6: Tests Prescribed in Kenya/EAC Standard 67: Raw Cow Milk - Specification

Normative	Informative
Organoleptic	Alizarin-alcohol
Temperature	10 minute resazurin
Sediment	30-minute methylene blue
pH	
Clot-on-boiling	
Alcohol	

There is an evident gap between the tests listed in the standard and the general practice in the field. At the milk collection centres visited by the consultants, milk was tested for density (specific gravity), alcohol and organoleptic. Temperature, sediment, pH and clot-on-boiling were not performed. Use of the alizarin-alcohol test was observed in one collection centre. The milk collection centres visited were not equipped with pH meters, sediment testers, or thermometers. Clearly, not all the normative tests are being performed.

The most commonly used test in Kenya milk collection centres is density (specific gravity), but the test is not listed in the standard. This is apparently a discrepancy and suggests that a revision of the standard should be considered.

The tests used to test milk quality on arriving at processing plants in Israel are organoleptic, temperature, acidity, freezing point depression, organoleptic and absence/presence of antibiotics. Until these tests are performed, the milk is not off-loaded from the tanker. The collection system is by bulk tankers, and there are no milk cans in the system. All milk is chilled on the farm. Small producers have small-refrigerated tanks mounted on wheels, which are towed by tractor to the village bulk tank daily. All milk arriving at the processing plants is chilled. Colour reduction tests are not used and were replaced by total bacterial counts performed on every farmer 3 times a month. From these examples, it can be seen that different tests are selected to suit the circumstances and the state of development of the industry.

For QBMP systems, it is preferable to use quantitative tests rather than qualitative tests, because the numerical results obtained from quantitative tests enable development of a graduated scale of results, which can be used for setting grades or qualities. Also, test results expressed as numbers are more easily understood and compared by farmers.

This can be illustrated by the following example using titratable acidity to measure the degree of 'sourness', which is of course an indirect measurement of bacterial growth in the sample. The test gives a numerical result and therefore bands can be selected to set grades.

Table IV.7: Example of grading milk by Titratable Acidity (Soxhlet-Henkel method)

Result	Grade	Remarks
6.0 – 6.4	A	Normal milk
6.5 – 6.8	B	Slightly sour, but can be processed for yoghurt production
6.9 and above	C	Should not be accepted for processing

Titration of 40 ml of milk sample with 0.1N NaOH, phenolphthalein indicator (1% w/v).

4.3. Preferred Tests and Protocols for Raw Milk Testing for a QBMP pilot

At each location where the QBMP trial is to be implemented, the local processor should select the tests of relevance to the plant. As a guideline, the following tests would be representative.

4.3.1. Farm level

Colour, appearance
Freshness – alcohol test and/or Clot-on-boiling

4.3.2 Milk Collection Points along the collection route

Colour, appearance
Freshness – alcohol test

4.3.2. Milk Bulking Centre

Colour, appearance, taste (by laboratory pasteurisation in test tube). (Every delivery).
Alcohol test and/or Clot-on-boiling (Every delivery)
Methylene blue test (Weekly for every farmer)
Temperature in tank (Every 3 hours)
Titratable acidity in tank (Every 6 hours)

4.3.3. Processor

Colour, appearance, taste (by laboratory pasteurisation in test tube). (Every delivery).
Antibiotics (Every delivery)
Titratable acidity (Every delivery)
Specific Gravity (Every delivery)
Cryoscopy (Every delivery)
Total Plate Count (Alternative 1, 3 times/month)
Methylene Blue (Alternative 2, 3 times/month)
Fat content (Every delivery)

In Kenya, at the farm level the essential requirement is to ensure that the milk is clean, and to check that the milk has not soured. The farmer can easily perform these tests. Where farm coolers are used, temperature should also be a parameter.

Table IV.8: Tests for Raw Milk at the Farm

Test	Comment
Organoleptic	No taints, odour or discoloration
Freshness	a) Alcohol test on evening milk before mixing with morning milk would be advisable. b) Clot-on-boiling test.

At the milk collection centre the tests should be more demanding. The objectives are to prevent sour milk from being bulked with fresh milk, and to prevent reception of adulterated milk (chemicals).

Table IV.9: Tests suitable for use at a Milk Collection Centre (MCC)

Test	Comment
Organoleptic Acidity	No taints, odour or discoloration In order of preference: A) Titratable acidity B) Alcohol test C) pH (maintenance of a pH meter can be expected to be a problematic issue in a rural MCC)
Milk analyser (% Fat, % Protein, % Solids, % Added Water by calculation)	Low cost instrument, which needs good maintenance. Difficult to maintain the calibration in a rural MCC. Use at the MCC level is a matter of choice.
10-minute Resazurin	Useful for a QBMP system. Provides an approximate indication of the bacterial load.
Specific Gravity	In a QBMP system the lacto-densimeter preferably should be officially calibrated and the temperature compensation calculated. (A standard method for use of the instrument is provided in Annex XX). Inaccurate, there is no correlation between the result and the percentage of added water. Performed incorrectly in all MCCs visited in this study. Great variance in lacto-densimeters in use in the MCCs. Temperature correction not being done.

5. Pilot Project Proposal



5.1. Pilot Trial Level

Draft Proposal for the introduction of a Quality Based Milk Payment System in Kenya.

5.1.1. Objective

To implement on a pilot level, a Quality Based Payment System for raw milk, as a tool to improve milk quality and food safety, and by this means strengthen the dairy sector.

5.1.2. Context and problem statement

It is evident that there is a significant problem with low bacteriological and chemical quality milk in Kenya's milk supply. Milk is a basic food consumed, amongst others, by infants and the elderly. Its generic 'pure and safe' brand image needs to be safeguarded. This is a matter of trust between consumers and the industry. Low bacteriological quality is commonly overcome by consumers who as a matter of course boil their milk. Chemical adulteration is a more significant hazard, as added chemicals cannot be removed. The perception by consumers that such practices are allowed to happen, creates a damaging negative perception of the industry.

Persistent low quality is a limitation to the production of quality processed products with adequate shelf life. The Kenya Dairy Board views the implementation of a QBMP system as a major and important tool to enhance milk quality (Ref: Annex 4). This study supports this opinion based on the experience gained with QBMP systems by both consultants in various countries, and from reviewing the experiences of others with QBMP systems. Field observations during this mission have shown that current raw milk handling practices frequently do not safeguard milk quality. Introduction of a QBMP system can be an effective tool to provide a solution to this problem.

A number of processors have shown interest and willingness to set up a pilot QBMP system with the support from SNV/KMDP.

This Section contains a proposal for the introduction and implementation of a pilot level QBMP system for raw milk, as a tool to improve milk quality and food safety, and in this way to strengthen the performance of the dairy sector.

5.2. The Process

The introduction and implementation of a pilot QBMP system must be carefully planned. The following steps to achieve this can be identified.

Step 1: Sign MoUs with processors and proposed CBEs for designing and implementing a QBMP system, containing a clear description of the roles and obligations for all collaborating parties. Under this activity, an assessment shall be made of the existence of several critical conditions that need to be in place, or the ability and willingness of the participants to put them in place. It also requires the development of a work plan, time frame and a budget describing the contributions of each party in terms of human resources and cash.

During Step 1 also involvement of KDB should be sought, based on its mandate to regulate the sector and the duties and responsibilities that go with it. KDB is planning for a three months pilot to set a baseline for QBMP-systems with selected CBEs and processor(s). If under KMDP agreements and MoUs can be made with interested processors and proposed CBEs, KMDP should look at ways and means to link up and if possible integrate this in Step 2.

This step represents a critical go-or-no-go milestone for the start of the pilot project.

Step 2: Design and implement baseline studies to assess the current milk quality in the selected localities where the pilot trials are to be run, according to preferred or pre-selected parameters. After review of the results of the baseline study the preliminary parameter can be chosen.

Step 3: Decide on testing methods at different levels in the chain and purchase analytical milk testing equipment.

Step 4: Develop a detailed QBMP design, appoint operational staff and identify training needs at the different levels. Prepare SOPs and start training the staff.

Step 5: Start and run a non disclosed milk-testing plan for at least 1 to 3 months to assess the financial implications for the farmer, CBE and the processors. Design the graded payment system and put all the administrative, financial and governance systems in place. Set up a data logging, tracking and tracing system.

Step 6: Fine-tune the proposed QBMP design and present it to the intermediaries and farmers. At this stage, and continuing for at least two months, the QBMP system should be run in parallel to the existing payment system. Everybody will continue to be paid according to the existing system.

Step 7: Do a final review and make adjustments to the QBMP design and start training of the farmers by the extension staff, to demonstrate how to achieve the production of superior quality milk. Conduct workshops to review and explain the outcomes to all the participants. Make adjustments as required.

Step 8: Launch and implement the QBMP system with the graded payment structure.

Step 9: Add additional parameters and adjust the payment system as required.

Step 10: Evaluation and recommendations for scaling up.

Throughout the whole project, training at all levels will be required to achieve optimal results. Introduction of QBMP is not a paper exercise and the participants at all levels need to be committed. The establishment of an effective, competent operational extension team is absolutely essential to the success of the project.

Following successful implementation of one parameter, the procedure can be repeated for an additional parameter.

5.3. Description of Project Results or Milestones

Major project results or milestones have been summarized below. The schedule below presents an example or a template which is not exhaustive and will require additions and fine-tuning by the participants.

Result 1	Preparation	
Description	Inception phase	
Time line	October 2012 – July 2013	
Sub-result	Means of Verification	
1. Preparation of Terms of Reference for a study on the potential of a milk quality based payment system in Kenya	1.1. Written Terms of Reference	

2. Selection of consultant(s)	2.1. Contract with consultant (s).
3. Implementation of the study	3.1. Study report.
4. Approval KMDP Implementation Phase	4.1. Written confirmation by Netherlands Embassy Nairobi
5. Agreement on the pilot project plan.	5.1. MoU between SNV and KDB 5.2. MoU between SNV and the dairy processors involved in the project. 5.3. MoU between SNV and cooperatives and dairy societies involved in the project
6. Monitoring and reporting	6.1. Progress report

Result 2	Baseline	
Description	Performing base-line study in order to choose parameters and to prepare the framework of the QBMP	
Time line	August 2013 – December 2013	
Sub-results	Means of Verification	
1. Set up/design a sampling scheme for the baseline	1.1. Sampling scheme	
2. Purchase milk testing equipment	2.1. Protocol of receipt for all equipment 2.2. Pictures of installed hardware.	
3. Appoint staff and design a training programme	3.1. List of staff and training programme	
4. Train staff (milk graders/samplers, transporters, extension staff, etc.)	4.1. Training logbook with names of participants.	
5. Carry out the baseline study and select preliminary parameter(s)	5.1. Baseline report	
6. Design the QBMP system and putting structures in place	6.1. Proposal for the QBMP for processor to intermediary. 6.2. Proposal for the QBMP for the intermediary to the farmer. 6.3. SOPs for staff. 6.4. Administrative, financial and governance structures described and tested	
7. Monitoring and reporting	7.1. Progress report	

Result 3	QBMP pilot	
Description	Implementation of the QBMP	
Time line	January 2014 – June 2015 (estimated)	
Sub-results	Means of Verification	
1. Perform a non-disclosed run of the QBMP system for assessing the financial implications.	1.1 Non-disclosed run report	
2. Perform a transparent parallel run of the QBMP showing the farmers the test results and the new milk price, next to the existing milk price.	2.1 Parallel run report	

3. Fine-tuning and implementation of the QBMP system.	3.1 Payment and tests report
4. Continuation training milk graders, transporters, bulking centre staff, laboratory technicians, extension staff and so on.	4.1. Updated training logbook
5. New parameters/standards added	5.1. Report
6. Monitoring and reporting	6.1. Progress report

Result 4	Evaluation and scaling up
Description	Evaluation of the pilot and scaling up the pilot to other processors and/or CBEs
Time line	July 2015 – December 2015 (estimated)
Sub-results	Means of Verification
1. Evaluation of the pilot(s) of the implementation phase and roll out of the QBMP to other dairies and cooperatives.	1.1. Evaluation report
2. Recommendations for roll out of QBMP systems to other processors and/or CBEs	1.2. Plan for up-scaling the pilot model to other processors and CBEs

5.4. Project Management and Technical Support

To manage the QBMP pilot projects the following is proposed in terms of project management and backstopping.

SNV Kenya

Position

Project manager *
(part-time 0.5 fte)

Field manager *
(part time 0.5 fte)

* Possibly both positions can be combined

Responsibilities

Programme management and coordination; maintain contacts with dairy industry, KDB
Monitoring timelines, reporting, and budget guidance.
Monitoring field and training program.

Processors and CBEs

Position

Project manager processors
(full time 1.0 fte)
Project Manager CBE
(full time 1.0 fte)

Responsibilities

Project management, maintaining contacts with SNV, KDB, CBE
Project management, maintaining contacts with processor, KDB, SNV

Kenya Dairy Board

Position

Project manager
(part time 0.25 fte)

Responsibilities

Coordination on behalf of KDB, maintaining contacts with SNV, processors and CBEs

Consultant (Expatriate Position)**Position**

Technical Advisor/Trainer
(0.25 fte)

Responsibilities

To give technical advice to all parties involved in the programme.

To train extension officers, milk testers, milk samplers and extension staff on technical issues and advisory skills

5.5. Draft Budget

The proposed budget is approximate and includes costs for 3 pilots. An accurate assessment of the total project costs and the contributions of all parties regarding hardware (e.g. testing equipment and logistics), project management and staffing and other inputs like testing programmes and administrative systems, has not been done. This will be done during Step 1 of the project.

Hardware Specification	No. of Items	Item Price (€)	Subtotal (€)
Lab equipment			
Cryoscope	3	5,000	15,000
Milk analyser	3	10,000	30,000
Water-bath	3	700	2,100
Test tubes	1000	0.25	250
Sample bottles	10000	0.50	5,000
Incubator for bacteriology	3	1,000	3,000
Incubator for Antibiotic testing	1	250	250
Refrigerators	15	400	6,000
Freezers	3	700	2,100
Ice boxes	30	30	900
Miscellaneous	1	15,000	15,000
Sub-total			79,600
Extension support			
Motorbikes	10	3,000	30,000
Laptops	6	500	3,000
Beamers (LCD Projector)	3	500	1,500
Miscellaneous	1	5,000	5,000
Sub-total			39,500
Total in Euro			119,100

Technical Assistance Specification (International for 3 years)						
Consultant (s)	12	missions	21	days	20,000	240,000
Flights	12	tickets			1,200	14,400
Local transport	12	vehicle	21	days	1,500	30,000
DSA	12	missions	21	days	125	31,500
Fieldtrip International	8	persons	7	days		32,000
Miscellaneous						50,000
Total in Euros						397,900

The Technical Assistance Specification is a proposal and must be regarded as an approximate guideline. The proposal is for a period of 3 years.

5.6. Proposed Partners

1. SNV : Project manager
2. Kenya Dairy Board : Institutional support
3. Interested dairy processors : Happy Cow Ltd, Sameer Agricultural & Livestock Ltd, New Kenya Co-operative Creameries Ltd, Brookside (possibly), and Kinangop Dairy Ltd

5.7. Investment Implications

Processors: The principle behind the QBMP system is not to increase the milk price. The bonuses will be paid by the penalties. A higher milk price for the farmer will be the result of the enhanced profitability of the processor due to the anticipated reduced production costs, improved product shelf life and higher market share due to the increased quality of the raw milk and improved brand issue for the processor. The processor is expected to pass a portion of the enhanced earnings back to the farmer.

The costs for the processor will be mainly related to setting up the required administrative systems for quality control and graded payments, improved extension services and quality control.

CBE: For CBE's the situation is similar. CBEs and processors are advised to design and coordinate the systems jointly and to share costs.

CBEs should look at establishing small satellite coolers along the routes, or collecting both morning and evening milk. This may be considered as a pre-condition for successfully embarking upon a QBMP system.

Farmers: For farmers, ultimately the milk price will increase as they will become part of a more competitive and efficient dairy industry. Processors of high quality liquid and value added products need good quality milk and are prepared to pay a higher market price. In addition farmers have enhanced access to extension service and their immediate gain will be increased milk production per cow. In comparable projects elsewhere in the world, production increases of 20% per cow in 3 years have been achieved.

5.8. Risk assessment

There are some risks, which may have an impact on the successful implementation of the project plan:

- The willingness and commitment of the processor/CBEs to participate in a QBMP-pilot and be the drivers of the project.
- QBMP systems are new for Kenya and will require effective managerial and technical capacity at all levels.
- Kenya's milk supply chain is highly fragmented with many smallholders, intermediaries and processors all competing over the same milk. Loyalty in the chain is low.
- Budgetary constraints.

During Step 1 of this proposed project these, and other risks, have to be assessed more precisely and strategies developed to manage them.

5.9. Epilogue

Improvement of the quality of Kenya's raw milk supply is a strategic priority. Experience from many other countries has demonstrated that quality based milk payment systems are effective in achieving bacteriological and chemical quality improvements. A financial incentive at the farm level, complemented by training & extension, to improve milk sanitation and handling practices acts as the driver of the system. Successful application of a QBMP system can be expected to demonstrate quality improvements within 12 months, and perhaps sooner.

The structure of milk production in Kenya, with an estimated one million milk production units, many of whom sell less than 10 litres of milk per day, presents a challenge but is not unique. Similar milk production models exist in other countries, where QBMP systems have been successfully introduced. The challenge is to design a tailor made testing regime with payment incentives, which will fulfil local needs and expectations.

A two-tier payment structure is proposed with two separate payment frameworks. The first system will be from the processor to the cooperative or CBE, the payment being based on the quality of the milk in the cooler. The second system will be from the cooperative to the farmers based on the quality of the milk delivered by each farmer to the cooler. The tests used for each tier will be selected by the receiver of the milk, the cooler being operated by the cooperative, and the processor receiving milk from the cooler.

The tests used in each tier need not be identical. The methylene blue test and the resazurin test both provide an indirect estimate of bacterial quality. They are equivalent test methods. The selection of which test to use should be left to the processors as they may have individual preferences for one over the other.

For simplicity, it is proposed that three quality or payments bands should be set for the start-up phase. Expanding the payment bands from three to five would provide more opportunity for farmers to move up the scale of bands, as the steps would be smaller. The expansion to more bands could be done once all the participants are familiar and comfortable with the system. Consideration should be given to constructing a five-band system for the farmers to cooler tier, and a three-band system for the cooler to processor tier.

The first step in the QBMP pilot is to conduct a baseline study for each of the tests to be included in the payment system. The data generated by the baseline study will enable the planners to determine

average results and construct a distribution curve for each test parameter. With these data, the thresholds for each quality band can be selected. The thresholds should be selected to ensure that 75% to 80% of the farmers achieve the standard price band. The superior price band should be attainable by 5% to 10% of the farmers, while 10% to 15% should find themselves placed in the reduced price band.

The bonus payments due to 5% - 10% of the farmers will be financed by the 10% - 15% who are paid the reduced price for failing to meet the standard price band threshold. As the price incentive drives the farmers to improve the quality, there will be a migration from the reduced price band into the standard price band. At the same time, there will also be a migration from the standard price band up into the bonus price band. As progress is made, and the distribution curve shifts, the planners should then re-set the parameter thresholds upwards to re-establish the requirement of 75% to 80% of farmers falling into the standard price band.

To run a pilot QBMP, it is necessary to have a configuration of a group of farmers who supply milk to a bulking centre, from where the chilled milk is sold to a processor. It would be preferable if the CBE, or the processor, if the plant runs the milk bulking centre, collected both morning and evening milk. The ideal solution, as discussed earlier, would be to position satellite coolers along the collection routes. Without funding, the provision of localised small coolers is not going to materialise in the foreseeable future. However, the inability to cool evening milk is not a limiting factor for operating a QBMP system.

Three processing plants interested in participating in a QBMP system pilot trial were identified. These are NKCC, Sameer and Happy Cow. A fourth one, Brookside showed interest, but would first need to study the consultancy report before making decisions. Due to time constraints, detailed discussions on the selection of CBEs and parameters were not done during the study. Further follow-up discussions with each of the processors to determine the test parameters and to finalise the selection of the participating farmers groups are required.

A QBMP pilot will only succeed when all the parties involved are fully committed to implement and run the system. Since the introduction of a QBMP system is new for Kenya, it is proposed that this is supported by an expert(s) who has/have experience with implementation of these systems elsewhere. Preferably in settings that can be compared to Kenya. This probably infers an international consultant due to the required expertise.

Additionally, SNV, the processors and the CBEs should appoint full time managers to steer the pilots.

For the launch of the project, the (international) consultant would be required to assist the project participants with the following activities:

1. Preparation of MoUs and detailed work plans and project organisation
2. Pre-selection of parameters and design of the baseline testing programme.
3. Prepare the final list of laboratory equipment and disposables required at each location and issue purchase tenders. A qualified consultant should confirm the equipment list.
4. Design the training programme.
5. Design a track & tracing data logging system for management of the pilot trial, which includes all test results data, milk volumes etcetera as described in the report.
6. SNV should create a public committee to oversee and accompany the pilot trial.

Further support is expected to be required during implementation.