Milk quality assurance in smallholder-dominated dairy chains

Lessons from Uganda and Kenya | April 2020

Authors: Asaah Ndambi[1], Sabdiyo Dido[2] and Şeyda Özkan Gülzari[1]

Background and problem statement

Milk production is increasing in most African countries, due mainly to growing local demand and the nutritional transition linked to urbanization, socio-economic development, and the rise of the middle class [1]. In Kenya, government support and the introduction of a school milk programme have been the major drivers of the expansion in the demand for, and output of, milk [1]. The demand for milk across sub-Saharan Africa is expected to more than triple by 2050 [2]. In this scenario, the highest growth in consumption is predicted for east Africa, where mixed crop-livestock systems continue to be the main producers of milk [2]. These projections emphasise the need for policy support directed at increasing nutrition security, generating a regular income for smallholders, and creating job opportunities along the entire dairy value chain [3].

Under the current system, quality assurance is challenging because small volumes of milk are delivered by a large number of smallholder farmers, who do not always practice good farm management. When there is little or no incentive to improve quality, management practices such as milk handling and hygiene, feeding, and prophylaxis towards diseases, as well as the withdrawal periods for antibiotics and other medications, can be compromised. The large number of intermediaries involved in the chain, the presence of a dominant informal market, and the weak enforcement of milk quality regulations further hinder quality improvements. Examples of good practices to improve milk quality can also be found in Africa however, such as the quality-based milk payment systems (QBMPS) piloted in Kenya and Uganda. In this practice brief, we aim to compare and contrast the QBMPS in Uganda and Kenya in terms of the requirements, lessons learnt, and the prerequisites for potential success in upscaling.

What is milk quality?

Milk quality refers to the chemical, physical, technological, bacteriological, and aesthetic characteristics of the product [4]. It signifies that the milk is routinely checked against predetermined standards, including total bacteria count, somatic cell count, fat content, and solids non-fat contents, such as lactose, protein, and minerals [5].

1 Wageningen University & Research, PO Box 338, 6700 AH Wageningen, the Netherlands
2 Senior Technical Adviser Value Chain and Agribusiness, CTA, Wageningen, the Netherlands

Highlights

African milk producers and processors have been facing the challenging task of improving milk quality and quantity simultaneously. Strict, but realistic measures must be used to improve milk quality to the levels required to assure consumers safety and acceptable to trading partners.

For such measures to function properly, they must be processor-driven, and the system must be transparent to build trust among the actors. Furthermore, we suggest that the processors involved make provision for capacity building to chain actors, make affordable testing equipment available at service centres, and gather support from the public sector to create an enabling environment and to prevent unfair competition between the informal and formal sector.

To prevent drop-out and maintain the interest of the participants, it is recommended that a QBMPS starts with few and/or less-stringent quality parameters and progressively increase stringency. In this way, as farmers improve quality by applying the knowledge obtained from trainings, required standards can gradually increase. This would require agile project management skills and a good system to supervise, monitor and evaluate the progress and activities.

A quick look at dairy interventions aimed at improving milk quality in eastern and southern Africa

In general, innovations with the potential to improve milk quality relate to dairy breeding, feeding, milking procedures, markets, technology, and information transfer. Challenges in the transfer of technology and knowledge potentially impedes the success of interventions to increase milk quality [6]; therefore, bottom-up, participatory modes of delivering information aimed at increasing farmers' knowledge are emerging [7]. When farmers group together to sell milk, for example, it is easier for innovations regarding milk quality to be spread and for this quality to be maintained through the collection centres, which may increase the technical and financial efficiency of the producers [8].

Though most of these options seem to have resulted in an increased volume of milk (e.g. [9] and [7]), few studies have reported the causal relationships between pre-defined quality criteria and the results of the interventions. Studies identifying farmer perceptions on what affects milk quality (e.g. hygiene, transport, and breed, as reported by [5]) are useful, but should include a clear link to quality parameters. There is therefore an increasing sector-wide trend for a shift from payment based solely on milk volumes to awarding premiums based on milk quality, such as the QBMPS ([10] and [5]). QBMPS have been successfully implemented in India [11] and Brazil [12], though it is uncommon in East Africa as milk payment is still based on volume. Based on the outcomes of existing QBMPS pilots in Uganda and Kenya, we anticipate that such systems would also be successful in eastern and southern Africa. In the following sections, we will compare the QBMPS in Uganda and Kenya. Note that the case studies presented below were conducted in the respective countries by different actors and involving smallholder farmers; therefore, in this study, we focus on a comparison only.

A comparison of quality-based milk payment systems (QBMPS)

What is a QBMPS?

A QBMPS puts the focus of payment for milk not only on the quantity but also on milk procurement based on the quality, quantity and timing parameters [13]. The milk quality attributes considered vary from processor to processor, but may include physical (density, freezing point), chemical (total solids, antibiotic residues, and adulteration), and microbial (total plate counts (TPC)) traits. Some socio-economic parameters, such as biodiversity protection and animal welfare, might also be considered as quality criteria. A QBMPS does not necessarily introduce a new pricing setting, but modifies the existing price structure to improve the quality and safety of the milk [10].

The structure of and background to QBMPS in Uganda

A QBMPS was piloted in Uganda from 2016, with the aim of improving the quality of milk sourced by three processors in the Mbarara district. This pilot was part of The Inclusive Dairy Enterprise (TIDE) project implemented by the SNV Netherlands Development Organisation in partnership with the Ugandan Dairy Development Authority (DDA), and was funded by the Embassy of the Kingdom of the Netherlands in Uganda. The actors and roles involved are summarized in Table 1.

Table 1. The actors involved in the design and implementation of the QBMPS in Uganda [14]

Actors (ordered alphabetically)	Role
Bles Dairies Consultancy BV	Technical support
Dairy Development Authority	Ring testing of equipment, calibration of testing equipment, training of cooperative workers and farmers; supervision and monitoring; some SoPs.
Farmers	Producing good-quality milk, delivering to cooperatives or directly to the processor (in the case of the small-scale processor)
Processors	Sourcing milk, setting up quality criteria, providing bonus payments, buying testing equipment, training staff and farmers on good hygienic practices, developing standard operating procedures
SNV[1]	Designing and facilitating QBMPS implementation and broker linkages.
UCCCU[2] and Cooperatives	Bulking and sampling of milk produced by individual farmers for quality parameters, setting up quality criteria (negotiated with processors), buying testing equipment, training farmers and staff on milk quality, managing bonus payments provided by processors

Source: [1]Netherlands Development Agency
[2]Uganda Crane Creameries Cooperative Union

Three processors were selected for their capacity to handle milk: Pearl Dairy is a large-scale processor with a capacity of 800,000 L/day; Lakeside Dairy is a medium-scale processor with a capacity of 100,000 L/day; and Sanatos is a small-scale processor with a capacity of 5,000 L/day. A total of 1,300 farmers delivered milk to the three processors. The implementation activities included capacity building of cooperative staff, farmers, DDA staff, Uganda Crane Creameries Cooperative Union (UCCCU) extension staff; purchasing and distributing 15 milk analysers; zero setting (baseline) for the milk quality parameters and equipment; ring testing the laboratory equipment; and negotiating the standards and bonus payments [14].

All three processors used both butterfat and solids non-fat as parameters for the QBMPS, though the levels of bonus payments were slightly different for each processor (Table 2). Individual milk samples and bulk milk were tested at the milk collection centres (MCC) using a milk analyser. Milk was rejected if it was delivered outside the collection time (between 6:00 am and 9:00 am and between 4:00 pm and 7:00 pm). Milk delivered in a plastic can that failed the freshness (e.g., alcohol and resazurin) test was also rejected. An equipment ring testing between the different stakeholders' labs was organised and managed by the DDA to guarantee the reliability and comparability of test results, thus building more trust among the stakeholders. A strong collaboration was observed between all the above stakeholders.

A similar brand of milk analyser (Picture 1) was used by all processors to test the bulk milk, and this was used as a base for payments done once every two weeks. The analyser can be powered by a solar-powered battery for use when there is no electricity.

Picture 1. Milk analyser and accessories used in Mbarara for determining the milk quality for the QBMPS. Photo taken by Asaah Ndambi

Table 2. QBMPS bonus criteria of each of the Ugandan processors [14]

Parameter	Pearl Dairy	Lakeside Dairy	Sanatos
Butterfat	>3.8%	>3.8%	>3.8%
Solids non-fat	>8.5%	>8.5%	>8.5%
Entity receiving bonus payment	Cooperatives	Cooperatives	Individual farmers
Bonus payment	~10% base price	~5–10% base price	Variable,[1] - above 10%)

[1]*Bonus payment stays above 10% and varied depending on the total supply and amount of milk that qualified*

The structure of and background to QBMPS in Kenya

The QBMPS pilot project in Kenya was implemented by Happy Cow Ltd,. a processor based in Nakuru county processing an average of 9000 L milk/day. This pilot was supported by the SNV Kenya Market-Led Dairy Program (KMDP), funded by the Embassy of the Kingdom of the Netherlands in Kenya. The organisational structure differed from that which was used in Uganda (Figure 1).

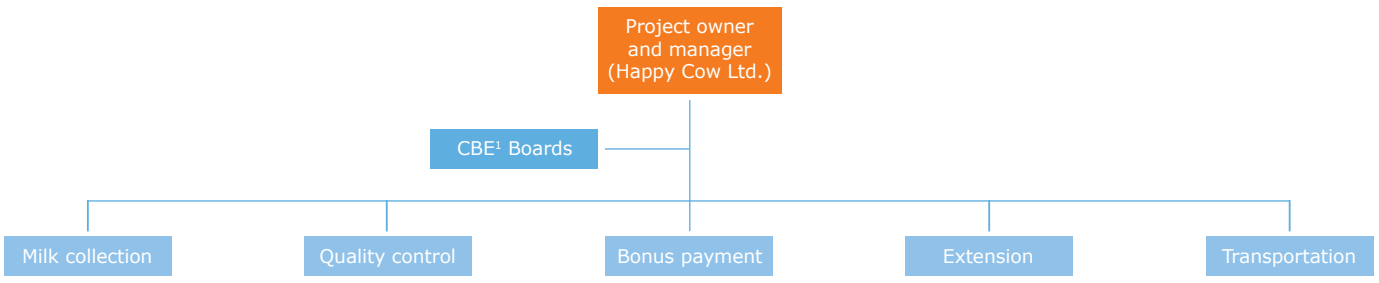

Figure 1. The management and implementation structure of QBMPS in Kenya. Adapted from [15]

[1]*Collection and bulking enterprise*

In this system, milk collection is supervised by a milk chain coordinator employed by the collection and bulking enterprise (CBE). The MCC also ensures that all actors along the chain are appropriately trained and perform their tasks correctly. At some collection centres, a farmer called a prefect plays a key role in checking and supporting other farmers. At the collection centres, a grader employed by the CBE performs acceptance tests on milk samples from individual farmers, such as lactometer analyses, organoleptic tests, and sometimes acidity analyses using an alcohol gun. Milk deemed acceptable is then handed to the transporter, who takes the milk to the cooperative where it is tested again (Picture 2a and b).

Picture 2a. Milk sampling at the cooperative platform

Picture 2b. Milk analysis at the lab. Photo permission 2a and 2b Happy Cow Ltd.

The processor sources most of its milk from two cooperatives that collect milk from smallholders in Nakuru and Nyandarua counties. The parameters used for the QBMPS are the TPC, the presence of antibiotic residues in the milk, adulteration (measured by the freezing point), and the total solids (Table 3).

Table 3. Test parameters used in the QBMPS in Kenya [6]

Test parameter	Grade	QBMPS standard[1]	Premium score[2]
Total plate count (TPC; cfu[3]/mL)	A	0–2,000,000	50
	B	2,000,001–10,000,000	0
	C	>10,000,000	−50
Antibiotic residues	All	Negative	15[4]
Freezing point	All	<−0.500oC	20[5]
Total solids	All	>11%	15[5]

[1] *Standard developed by the processor*
[2] *Premium or penalty score given to milk of the corresponding QBMPS standard*
[3] *Colony forming units*
[4] *Milk positive for antibiotic residues is discarded*
[5] *Otherwise a score of 0*

The bulk milk is analysed daily for all the parameters mentioned in Table 3. To reduce the costs for testing individual milk samples, about 5–10 farmers are grouped such that their supplied volumes can be combined to fill a 50-L can. Farmers are kept in the same groups throughout the payment period to ensure continuity and consistency in the payment system. Milk sampling is performed according to a randomized scheme that ensures that the milk cans from each group are tested twice a month. The payment module is based on a summation of the premium scores obtained (Table 3). Two finance administrators (one from the processor and one from the cooperative) record the bonus payments, which are made monthly based on the results from the two random samples. Milk with a total

score above 70 is considered premium milk and receives a +2 KES (0.02 USD as of 18 March 2020) bonus/L milk. Milk with a total score between 40 and 69 is considered standard milk and receives a +1 KES bonus/L milk, while milk with a total score below 40 is not given a bonus or penalty.

Comparison of QBMPS in Uganda and Kenya

In Table 4, we summarize the main differences and similarities between the QBMPS implemented in Uganda and Kenya.

Table 4. Comparison of the QBMPS in Uganda and Kenya

Criterion	Uganda	Kenya
Number of processors involved	Three	Single
Milk collection method	Direct delivery of milk by farmers to collection centres or processor	Use of transporters is common. Prefects assigned to ensure quality at collection points
Total solids	All	Total plate count
Considered quality parameters	Butterfat	Total solids
	Solids non-fat	Freezing point
		Antibiotic residues
Quality control/ bonus payment	Use of similar milk analyser at cooperative and at processor.	Some tests performed at cooperative. Final tests for payment done at processor.
	Milk from each farmer is tested daily	Tests performed per can of milk (produced by 5–10 farmers) twice monthly
	Results available immediately	Time lag between milk collection and milk quality results
Selection of participants	The most committed MCCs (to producing high quality milk) were selected for the project pilot (except for Sanatos).	Each MCC selected milk collection routes with the most committed farmers.
Involvement of the regulator	Strong involvement of DDA, e.g., in equipment ring testing and supervision	Minimal involvement of Kenya Dairy Board

[1] *MCC: Milk collection centre*

As can be seen in Table 4, the Kenyan QBMPS uses the TPC and antibiotic residues as additional criteria to check milk quality, which implicitly considers the food safety aspect. When the QBMPS was first introduced however, farmers in Kenya were overwhelmed by the procedures that involved testing many parameters before they received a payment. Some farmers swapped groups and the collection of milk by the assigned farmer groups was not always respected by the transporters. Additionally, only a few farmers in Kenya qualified for bonuses, which probably discouraged them from participating in the QBMPS, leading to the slow growth in the number of farmers qualifying for bonus payments in later years [6]. The high cost of testing in Kenya created an additional burden on the processor and/or cooperatives. The presence of milk traders who do not check for milk quality and who often offer a more attractive price and immediate payment may have created a competitive environment in both countries, allowing farmers who could not meet the required quality standards to sell their milk at similar or sometimes even higher prices to such traders. This led to a drop in the number of suppliers at the start of the project, even though some of them later returned to the cooperatives implementing the QBMPS.

The payment of bonuses did not go as smoothly as planned. Inconsistencies were reported in the bonuses paid by the processors in Uganda, and some beneficiaries complained that bonuses were not paid despite being earned. Despite these issues, the quick feedback of test results to farmers in Uganda provided them with the opportunity to immediately relate their milk quality back to their farm practices. In Kenya, on the other hand, this was not possible, because the tests took longer and results were not immediately available.

In both countries, the monitoring and evaluation component of the project did not seem to provide continuous feedback to the project stakeholders regarding the evolution of milk quality standards. The role of the DDA as an arbitrator and calibrator of the milk analysers appears to have provided an impartial control mechanism in Uganda that did not exist in Kenya. However, not all the demands with respect to quality management, seasonality management and calibration of equipment in Uganda could be met in time. The Ugandan QBMPS was particularly affected by seasonality, as it proved challenging to maintain the high quality during the dry season due to a shortage of water and forage.

A recommended procedure for setting up and maintaining a successful QBMPS

Based on the experiences during the two pilot QBMPS in Kenya and Uganda, the overarching condition for a successful QBMPS is that various stakeholders (dairy regulators, processors, farmers, transporters, etc.) should be willing to work towards milk quality assurance and a sustainable QBMPS. We summarize our recommendations for setting up and maintaining a successful QBMPS in Figure 2. It can be noted that a macro socio-cultural dimension is implicitly embodied in the motivations of these six pillars.

Figure 2. Recommended steps when setting up a QBMPS

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