

Quality upgrading in dairy value chains - Mixed methods evidence from southwestern Uganda

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Abstract

Quality upgrading may be lagging in value chains where assessment and traceability of the quality of the underlying commodity is challenging. In Uganda's southwestern milk shed, a variety of initiatives are trying to increase the quality of raw milk in dairy value chains. These initiatives generally involve the introduction of technologies that enable measurement of key quality parameters at strategic nodes in the value chain, in conjunction with a system that allows for tracking of these parameters throughout the supply chain. In this paper, we use a combination of focus group discussions, key informant interviews, and quantitative data that is generated by these initiatives to document outputs, describe emerging outcomes, and reflect on potential impact. We find clear evidence that the quality of milk improved, but effects on milk prices are less obvious.

1 Introduction

Over the past few decades, the dairy subsector in Uganda has undergone significant transformation, evolving from a predominantly subsistence activity to a vibrant and dynamic industry. This growth has been driven by a combination of government initiatives, such as the Dairy Industry Act of 1998, which established the Dairy Development Authority (DDA) to regulate and promote the sector, and increasing private sector investments, particularly in the southwestern milk shed. Enhanced infrastructure such as a network of milk collection centers with coolers, improved breeding practices and the introduction of exotic breeds such as Holstein-Friesian and Jersey cows, and the introduction of better milk handling practices and processing technologies have also played crucial

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roles. As a result, milk production has increased substantially, contributing to improved livelihoods for many smallholder farmers, boosting national nutrition, and opening up new opportunities for export markets (Van Campenhout, Minten, and Swinnen, 2021; Ignowski et al., 2022).

Despite the modernization of Uganda’s dairy subsector, there is still a notable absence of quality premiums. This is surprising, given that enhancing milk quality is crucial for boosting productivity at the processor level, as higher quality milk, with better composition parameters such as butterfat and Solids Non-Fats (SNF), can yield more final products from the same amount of raw inputs.¹ Indeed, in middle or high-income economies where dairy is culturally important such as India or the Netherlands, the price that farmers get for their raw milk is a direct function of composition parameters such as butterfat and SNF. Previous fieldwork has revealed that also in Uganda processors would be willing to pay for higher quality milk, and farmers are capable of improving milk quality if they would receive appropriate financial incentives.

The absence of a market for quality may be due to challenges in measuring and tracing milk quality upstream (at the farmer and trader level), and subsequent aggregation and bulking of milk of unknown quality milk midstream (at the milk collection centers (MCCs) level). Typically, numerous smallholder farmers supply raw milk to MCCs. While farmers sometimes deliver the milk themselves, more often, transporters or traders are involved.² MCCs serve as the starting point of the cold chain, chilling and aggregating milk in large coolers for onward transport. The milk collected at MCCs is then transferred to larger traders who use milk tankers to deliver it to processors. These processors convert the raw milk into various products for the final market, including UHT milk, pasteurized milk, yogurt, cheese, infant formula, and casein.

Currently, most milk collection centers (MCCs) lack the capacity to accurately test milk composition quality. These centers primarily conduct rudimentary tests for adulteration, such as a gravity based method to test for added water (lactometer), and a test based on stability of the proteins in milk to test for freshness (alcohol test). However, assessing milk composition quality parameters requires more advanced measurement technology. Generally, it is only when milk is delivered to the processor that more advanced testing happens and parameters such as better fat content and SNF are discovered.

The practice of combining milk from individual farmers without precise testing complicates tracking and rewarding of quality. As a result, farmers supplying to MCCs are incentivized to adopt sub-optimal quality practices, such as skimming butterfat from milk for separate sale or adding water to increase volume—behaviors akin to those associated with the common resources problem (Winfree

¹Milk quality refers to both milk sanitation (such as washing hands before milking, maintaining a clean milking parlor, and keeping flies out of the milk), as well as milk composition (such as butter fat content and proteins). In this study, when we talk about milk quality, we are generally referring to quality in terms of milk composition.

²Transporter ship milk from A to B against a fee (usually about UGX100/liter); traders buy milk at the farm-gate and sell further up the value chain (with a similar margin of about UGX100/liter). The latter thus assume ownership of the milk in the process.

and McCluskey, 2005). Stakeholders across the value chain acknowledge that dilution of raw milk and removal of butterfat are widespread practices among farmers, traders, and transporters.

In Uganda’s southwestern milk shed, several initiatives are trying to address this problem. In collaboration with the Uganda Dairy Development Authority (DDA), the Netherlands Development Organisation SNV piloted a Quality-Based Milk Payment Scheme (QBMPS) in 2018, installing 15 solar-powered milk analyzers in MCCs. These analyzers measure parameters such as butterfat, SNF, added water, milk temperature, protein content, and corrected lactometer coefficient. The sampling process is non-destructive and takes approximately 30 to 50 seconds, depending on the milk’s temperature. Additionally, a collaboration between IFPRI, CYMMIT, and the DDA, under the CGIAR Rethinking Food Markets Research Initiative, is conducting a field experiment involving the installation of milk analyzers across about 150 MCCs. Pearl Dairies, the largest processor in the region, has also begun implementing QBMPS in its own MCCs.

This paper employs a mixed methods approach to record outputs, outline emerging outcomes, and assess the potential impact of highlighting milk composition quality at the point of milk aggregation. In particular, it uses quantitative data generated from the IFPRI-CYMMIT-DDA project and complements this with qualitative data obtained from focus group discussions and expert interviews throughout the value chain.

The remainder of this article is organized as follows. We start with a theoretical framework to describe the problem at hand and situate the study in the recent literature. We then describe the context and the IFPRI-CYMMIT-DDA project that we will draw on. Next, we discuss the sources of data and explain how the interlocutors for the focus group discussions and expert interviews were sampled. We then turn to the findings, with sub-sections for impact on quality, impact on prices, and the policy context. We also have a section that discusses some of the factors that may delay or limit the impact of the intervention. A final section concludes.

2 Theoretical framework and related literature

The central research hypothesis posits that a market for quality in the milk supply chain does not develop because milk from large numbers of farmers is pooled, making it difficult to track and attribute quality to individual suppliers. The problem of pooling milk from multiple farmers at collection centers leads to quality dilution, where high-quality milk is mixed with lower-quality milk. This results in uniform pricing and reduces incentives for individual farmers to improve quality. The lack of early-stage testing exacerbates this issue, as only rudimentary tests are conducted, which are insufficient for assessing key quality parameters. Consequently, the true quality of milk is only determined at the processor stage, diminishing the potential for farmers to benefit from producing higher-quality milk.

This scenario shares similarities with the problem of common pool resources,

where individuals do not have an incentive to incur costs if the benefits are shared among many (Winfrey and McCluskey, 2005). In such situations, the benefits of investing in quality improvements are diluted among all contributors, leading to underinvestment in quality-enhancing practices. This common pool resource problem results in economic inefficiency and hinders the development of a market based on quality.

Reducing the cost of quality discovery at the level of the milk collection center (such that it is easy to accurately determine the quality of each individual supplier before it is aggregated in milk tanks) will increase outcomes at that level for several reasons. For instance, it will enable collection centers to turn down suppliers with low quality, which should increase the overall quality of milk aggregated. When milk collection centers are able to independently assess the quality of the milk, they may actively search for processors that are prepared to pay a premium for a particular quality parameter.³ In addition, accurate information about the quality of the milk may also strengthen the bargaining position of the milk collection center vis-a-vis the buyer. The ability to accurately monitor incoming milk may also enable milk collection centers to engage in product differentiation at an early stage, by for instance using one tank to collect high protein milk destined for casseine extraction and using another tank to collect milk that is high in butter fat, to supply to a cheese maker.

We also expect that dairy farmers will benefit from this intervention. Higher prices paid by processors to milk collection centers may trickle down to farmers who may share equally in the increased margin, particularly if the MCCs are cooperatives. Making quality visible midstream should enable milk collection centers to reward farmers for supplying superior milk and increase the overall quality of the milk that the collection center aggregates. If dairy farmers know that the milk collection center has the equipment to test milk, farmers may also demand milk collection centers to test their milk in case there is discussion related to the quality. This may also increase the bargaining power of the farmer when dealing with MCCs.

Our study builds on a substantial body of literature examining the impact of various incentive mechanisms on the quality and production efficiency in dairy value chains. Recent studies provide valuable insights into the dynamics of collective and individual incentives and their effects on milk quality and farmer behavior in different geographic contexts. We confine ourselves to what we feel are the most relevant and most recent studies.

Rao and Shenoy (2023) investigate the role of collective incentives in enhancing group production among rural Indian dairy cooperatives. Their randomized evaluation reveals that village-level cooperatives can effectively address internal collective action problems to improve production quality. However, they also find that in some villages elites opt out of the payment schemes when they cannot control the disclosure of information on how surplus rents are distributed.

³As mentioned earlier, milk quality determines what products can be produced. If the milk collection center discovers their milk has a particularly high butter fat content, it may decide to deliver to a cheese producer who is prepared to pay more for high fat milk than a processor that extracts caseine who is more interested in SNF.

This opting out underscores the friction in surplus allocation within social networks and suggests that transparency-focused initiatives to limit elite capture might inadvertently undermine policy objectives.

[Treurniet \(2021\)](#) examines how individual quality incentives provided by private actors can aid smallholders in enhancing milk quality in Indonesian dairy value chains. By matching observable farmer characteristics, the study demonstrates that individual quality incentives quickly boost milk composition quality. Additionally, when coupled with physical inputs and training, these incentives also significantly improve the hygienic quality of milk. This suggests a multifaceted approach is beneficial in promoting both milk composition quality and milk sanitation.

[Saenger et al. \(2013\)](#) employ a framed field experiment to assess the effectiveness of two incentive instruments—a price penalty for low-quality milk and a bonus for consistently high-quality milk—on farmers’ investments in quality-improving inputs in Vietnam’s dairy sector. Their statistical analysis indicates that the penalty incentivizes farmers to increase their use of quality-enhancing inputs, thereby improving the quality of their output. The bonus payment scheme, however, is shown to be even more effective, yielding higher milk quality. These findings highlight the potential of financial incentives in driving quality improvements in dairy production.

Together, these studies illustrate the varying impacts of collective versus individual incentives and the importance of appropriate incentive structures in promoting milk quality improvements across different dairy value chains.

3 Context and initiatives to increase milk quality

Over the past decade, the dairy sub-sector in Uganda has changed dramatically. Particularly in the areas around Mbarara, commonly referred to as the south-western milk shed, an influx of foreign direct investment has created the pre-conditions for modern dairy value chains to emerge ([Van Campenhout, Minten, and Swinnen, 2021](#)). The area now has an extensive network of milk cooling and collection centers that link smallholder farmers to a cluster of processors. In the dairy value chain, quality is particularly important. Milk quality determines how much end product (eg cheese, caseine, milk powder,..) can be obtained from a given quantity of milk. Furthermore, it goes without saying that the protection of milk from dirt and contamination is important for food safety, as milk is very unstable.

At the same time, it is surprising that there seems to be no market for quality in the sub-sector (while this is generally the case in more developed dairy value chain where the price is not a fixed price per liter of milk supplied. Generally, payment differs per dairy farmer, depending on the protein and fat and lactose content of the milk supplied by the farmer⁴). For instance, using recently collected survey data, we find that of a sample of 2000 farmers that sold to milk collection centers, only 6 percent indicated that they received a

⁴<https://www.frieslandcampina.com/owned-by-farmers/milk-price-system/>

quality premium. From 114 milk collection centers that were included in the survey, we found that only about 18 percent (sometimes) paid a price premium to farmers. At the same time, expert interviews with processors indicate that their main challenge is related to sourcing milk of sufficient quality, pointing out issues related to butter fat content and solid non-fat content of the milk. They also say that they would be willing to pay for it.

The intervention that we focus on is the one by CGIAR. In close collaboration with DDA, milk analyzers were installed in a random sample of milk collection centers. These can be used to test milk samples of individual farmers or traders that supply to the milk collection centers to establish quality of incoming milk, as well as to test samples from the milk tankers when milk is picked up by traders or processors. The milk analyzers were delivered with clear Standard Operating Procedure and MCC managers were trained on how to use and maintain them.

In addition to the milk analyzers, an ICT mediated system to keep track of milk quantity and quality was also developed and deployed. In particular, a custom Android application was developed that allows MCCs to register farmers and/or traders that deliver or buy milk. For these farmers or traders, MCC managers can then record milk deliveries (or milk purchases), including quantities delivered and price agreed, as well as a range of quality parameters that can be read from milk analyzer, such as butter fat and protein content. The application can also provide MCC managers with simple reports at the MCC level, such as the average butter fat (weighted by quantities supplied) over a specified period (today, yesterday, last week, last two weeks and custom data range). Reports by farmer are also possible, such that MCC managers can determine the total sum to be paid to a farmer for milk delivered in the last 14 days. The application, which is pre-installed on a Samsung galaxy tab A7 with sim-card for mobile internet, backs up data in the cloud, but is designed following an off-line first principle as some MCCs may not have coverage. The application also sends SMS receipts with quantities and quality parameters to farmers if so desired.

Finally, for the MCC intervention, we also developed a poster to be displayed at MCCs informing farmers that the MCC now has a milk analyzer that can determine milk quality for free. The poster was designed by a local artist. This was done to increase transparency and fairness and we hope it encourages farmers to demand testing if they feel they are being disadvantaged.

While most of that data analyzed in this paper draws from the CGIAR project, it should be kept in mind that we build on the SNV/DDA pilot of 2018, from which also some insights emerged. Furthermore, at about the same time as the CGIAR project, Pearl, the largest processor in the area, has started experimenting with its own (producer led) quality based payment system. Their pilot also involves the installation of milk analyzers in MCCs that are connected to an application on a table computer that runs an application that keeps track of milk supplied by farmers.⁵ They are focusing on their own processor run

⁵In some of the MCCs that were also selected for the CGIAR project, Pearl is actually

MCCs, and roll out at a rate of 3 MCCs every few months. The fact that Pearl works with its own collection centers means that they can pay a quality premium directly to suppliers. Pearl sends a pdf with all samples to farmers every 15 days, for full transparency.

4 Sources of data and sampling

A first data source is baseline survey data that was collected before the start of the CGIAR project. We collected data at two levels. First, data was collected on a total of 125 MCCs where the MCC manager was interviewed. Second, we sampled farmers from the catchment areas of these 125 MCCs (about 18 per MCC) leading to a sample of 2,260 farmers.⁶

A second data source consists of the data on samples taken using the milk analyzers that was submitted between the start of the project and now by the MCCs. At the time of this study, about 30,000 submissions of samples were recorded. Each submission provides data on milk quality of the sample (butter fat, Solid Non Fat), total quantity from which the sample was taken, price paid for the milk, and date of entry in the application.⁷

A third data source consists of qualitative data in the form of semi-structured interviews with different actors in the dairy value chain, such as processors, MCC owners, MCC managers, and focus group discussions with milk traders, transporters and farmers. We also held key informant interviews with policy makers and civil servants that are involved in the sector.⁸

To decide on the sample for the qualitative data collections, we used the submission data mentioned above to select 4 milk collection centers. The first milk collection center MCC_216 has very consistent submissions, about 20 to 25 submissions per day (top panel in Figure 1). Over the course of 6 months, this led to almost 3000 submissions. The second MCC, MCC_93, also has submissions over the entire 6 month period, but submissions are less consistent, with more than 100 submissions on some days and only a few on others (see second panel in Table 1). In the 6 month period since installation, this led to about 2000 submission. Third, MCC_542, shown in the bottom panel of Figure 1, shows some submissions in the first few months after installation of the milk analyzers, but submissions stopped after the new year. This MCC reordered a total of about 430 samples. Finally, MCC_553 never really started submitting.

MCC_216 is located in Kirihura and is managed by a woman. The MCC is a farmer cooperative and has been in operation for about 10 years. It has about 25 members, and at baseline the manager reported that on a typical day, between 22 and 30 farmers supply milk to the MCC, which is consistent with the

using the equipment from the CGIAR project for their QBMPs

⁶The questionnaires for the MCC survey can be found [here](#), the data [here](#). The questionnaires for the farmer survey can be found [here](#), the data [here](#).

⁷A portal that we developed to look at some statistics and trends using this data can be found [here](#). There is also a link to the [underlying data](#).

⁸The guiding questions for the focus group discussions and key informant interviews can be found [here](#).

number of samples reported each day in Figure 1. Total capacity of the MCC is 3000 liters. In the dry season, capacity utilization is at 33 percent, while in the rainy season the MCC collects up to 4000 liters of raw milk per day. The manager indicates that they do not pay a premium for high quality milk. The MCC generally sells to a processor (Pearl Dairy) and has formal agreement. Quality is measured using a lactometer before shipping to Pearl. Also here, no premium for quality is paid.

Located in Kazo district, MCC_93 is a fairly new cooperative with more than 200 members. On an average day, in the dry season, about 130 farmers supply to the MCC, and this number increases to about 150 during the rainy season. The MCC does not pay a premium for quality to supplying farmers. Total cooler capacity is 3,238 liters. On an average day in the dry season, 5000 liters is collected, and this increases to 8,200 in the rainy season. The MCC also normally sells to a processor, and this processor, Lakeside, does pay a premium for quality.

MCC_542 is located in Kiriura. The MCC is privately owned and has been in operation for about 20 years. It has electricity from the mains but did not have a milk analyzer at baseline. The MCC receives milk from about 25 to 30 farmers on an average day, depending on the season. The MCC reports a total capacity of almost 7000 liters, but only uses up to 3000 liters in the rainy season. Capacity utilization reduces to 1500 liters in the dry season. The MCC does not pay a quality premium to farmers. The MCC sold about 3000 liters a day to a processor, Amos Dairies, in the week preceding the baseline survey. Amos Dairies did not pay a quality premium.

MCC_553 is also located in Kiriura. This MCC is also privately owned and has been in operation for about 5 years. The MCC has a total capacity of 5000 liters. During the rainy season, the MCC operates at 100 percent capacity, but volumes reduce to 1000 liters in the dry season. This milk is supplied by 30 to 50 customers per day. The MCC sold to both Pear Dairies and Amos Dairies in the week preceding the baseline survey, but also here no quality premia were paid by the processors.

In each of these three MCCs, we will select 3 farmers. The three farmers we select for the first two (treatment) MCCs are:

- one farmer that was identified as a customer of the MCC at the time of baseline data collection and was also found among the list of farmers that submitted milk to the MCC.
- one farmer that was identified as a customer of the MCC at the time of baseline data collection but did not feature in the list of farmers that submitted milk to the MCC. This is potentially a dairy farmer that shifted to another channel.
- one farmer that was not sampled as a customer of the MCC at the time of baseline data collection and was also found among the list of farmers that submitted milk to the MCC. This is potentially a new customer.

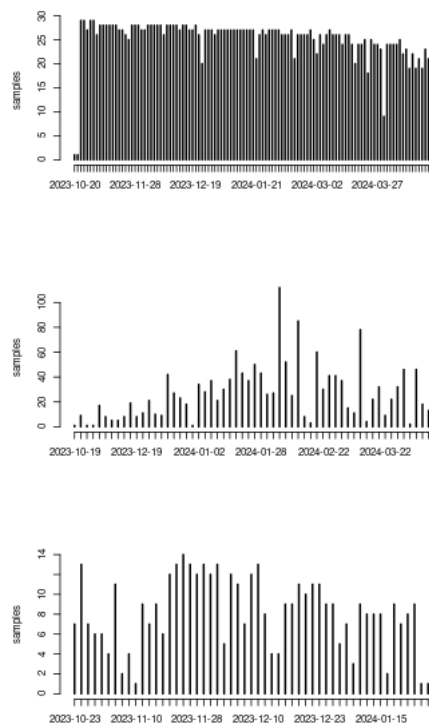


Figure 1: Sample submissions to MCCs

We stratified farmers to make sure we had 50% that delivered themselves to MCCs and 50% that were using a trader to get their milk to the MCCs. Even though we did not survey these traders at baseline and we do not plan to survey them at endline, this qualitative midline provided an excellent opportunity to get some insights on them. We thus selected two farmers from the baseline: one that was directly connected and one that was connected through a trader. In the latter case, the trader was also interviewed.

5 Results

In most MCCs, the lactometers were in use when we entered. Farmers also indicate that they never have to insist on being tested. MCC managers are also very transparent about the results. Even in the MCC we did not receive any record from, it seemed the machine was used in the first few months. The MCC manager told us that he stopped testing because of understaffing. Farmers from the MCC told us that they were tested a few times in the beginning, but when asked to be tested recently, the MCC manager told them there was no cleaning reagents anymore.

Even though the application was also appreciated by MCC managers, the use of the application was less visible. In one MCC, the MCC manager told us that he did not use written records anymore and had completely gone digital (we could not check this because the MCC was closed when we visited). In other cases, it is often still the case that MCC managers keep books and then copy into the app. One manager told us that he used the book because his customers did not trust the application.

5.1 Impact on milk quality

“We used to only look at density with a lactometer, which is not really precise. Now with these machines we can detect even if there is just a single drop of water” - Ruth Niwanereza, MCC manager of Rwabigyemano

Actors throughout the value chain agreed that the milk analyzers had a significant effect on milk quality. These primary effects manifested particularly in terms of reductions in instances where water was added to the milk, and in an increase in butter fat content of the raw milk.

Water is added to raw milk to increase quantity and hence total revenue derived from selling more milk. Qualitative data suggests that addition of water happened at all links in the value chain. For instance, traders reported that farmers sometimes leave water on the bottom of their milk cans. MCC managers reported that traders sometimes pass by their homes and add water to increase the volumes they supply to MCCs. Farmers report that MCCs sometimes complains that the milk that the transporter brings contains water, even though the farmer did not add water to the milk. This can happen if transporters replace

some share of raw milk with water and side sell this milk. We also heard reports that MCC managers sometimes add water to the milk tankers where milk is aggregated.

The increase in butter fat content is due to the fact that, before the milk analyzers, farmers (or traders) often separate butter fat from milk before selling to milk collection centers. This milk fat is then used to make local ghee. There are different ways in which butter fat is extracted from raw milk. The most effective way is to use a machine called a separator. These machines have seen a remarkable increase in use during Covid-19 when movement restrictions affected milk collection and marketing. Farmers recount that some villages or trading centers are known for providing these services, and traders and transporters would pass by these villages to increase their margin. Other, less sophisticated ways of removing fat involves gently blowing the bubbles that form after milking from the milk which also contains most of the fat. This is a method that is often used by farmers.

MCCs indicate that the likelihood that processors or traders reject their milk has reduced due to the milk analyzers. In one specific case, acceptance rates went from 80 percent to 100%. The likelihood that suppliers to the MCC (farmers and traders) were rejected by the MCC increased in the first few weeks after the installation of the milk analyzers, but reduced rapidly once farmers and traders learned that from now on their milk would be systematically tested. MCCs indicate that most farmers and traders that scored poorly during initial tests were able to improve. However, there is also a share of farmers that was not willing or able to improve and stopped supplying to the MCC with the milk analyzer.⁹ Farmers also confirm that rejections have reduced in the long run. They like the milk analyzers because it means they are now certain to get a market for their milk.

We now turn to the data to confirm some of these findings. We first look at rejection of farmers by milk collection centers. As stakeholders indicate that reductions were strongest in the first few weeks after installation, we compare averages in the first week after installation to averages in the last week of data collection.

An interesting secondary effect of the milk analyzers is an increase in the freshness of the milk. This indirect effect is caused by the fact that, to skim the milk of butter fat, the milk has to rest for a few hours and so farmers delay transporting milk to the MCC where milk is chilled. With milk analyzers installed, farmers are discouraged to skim milk and so there is also no point in delaying delivery. As a result milk arrives earlier in the MCC.

Another interesting secondary effect is a reduction in milk quantities. MCC

⁹We did some further probing on what happened to those that stopped supplying to the MCC. In some cases, these farmers went out of business or started supplying the informal sector. Sometimes it was argued that these farmers turned to MCCs that did not have milk analyzers. However, the CGIAR intervention was designed in such a way that MCCs that were close to each other all received a milk analyzer (clustered randomization). This seemed to have worked to some extent: in one MCC, when asked where rejected milk went to, the MCC manager said that “incidentally, all the other MCCs in the neighborhood also received a milk analyzer, so farmers or traders that add water or remove fat have nowhere to run to.”

managers indicated that it was more difficult to fill their tanks due to the fact that they rejected more milk immediately after the installation, and the fact that they lost some suppliers that would or could not change their practices. Furthermore, now that farmers and traders can not add water to their milk anymore, the milk analyzer also led to a reduction of quantities on the intensive margin.

The effect of the milk analyzers on milk quality also trickles down to transporters. Farmers told us that transporters used to add water to the milk they transported, which allowed them to earn something extra. The introduction of the milk analyzers exposed this practice: farmers that received complaints from the MCC that they found water in their milk (but did not add the water themselves) now take samples at the farm gate and take these to the MCC for testing and then confront the transporters with the result. This was confirmed by a transporter we talked to: While he indicated at the beginning of the interview that they liked the milk analyzers, he also informally mentioned at the end that the machines are limiting trader business as they can now not top up with water.

When we asked traders how the milk analyzers had impacted his business, they admitted that they used to deliver bad quality milk. They indicated that the main problem was added water (about 4 percent). According to the traders, the water was added to the milk by farmers, who leave some water in the cans before they start milking. Traders indicated that about half of the farmers did this. They fixed this problem by becoming more serious with their lactometer. They now test each sample that they aggregate at the farmgate and only buy when the reading is 30 (while they used to buy at 26-27 before). This is because they learned that a reading of 26-27 can still mean there is water, but if it is 29-30 there is guaranteed no water. They told farmers that they bought from that they needed to change, and while most did, traders also indicate they lost a some suppliers after the introduction of the milk analyzers who could not or refused to change.

A trader that links farmers to milk collection centers essentially moves the problem that milk analyzers solve one link upstream the value chain. Indeed, at the farm-gate, traders collect and aggregate raw milk without the capacity to test. Traders therefore asked if there are ways in which the parameters of importance can also be made visible at the farm-gate.

The most dramatic effects on quality were reported by the processor that is implementing the QBMPs. The processor indicated that before the introduction of the QBMPs, only about 50% of the milk was suitable for UHT (which requires good quality milk). In the sample that uses the QBMPs, this share has gone up to 90%.

5.2 Impact on price

Impact on price was much less evident than impact on quality. In general, the processor determines the price of milk, which is normally fixed for 15 days. Most MCC owners and managers indicate that processors just accept or reject milk based on their tests. They do not pay a price premium for the quality

parameters that they ultimately deem important. This was also confirmed by the processor we interviewed, who indicated that once the minimal standards are met, every supplier receives the same price. At the time of the qualitative fieldwork, the price was 600 UGX per liter.

However, when probing further, subtle price effects can be found. For instance, one MCC manager indicated that since the milk analyzer was installed, the processor they supply to was less likely to apply deductions to the price of milk in cases the milk was not up to standard. Before the milk analyzer, these deductions would happen rather frequently (about twice every fortnight). The deductions seem to depend on the quality and how good you can negotiate. While one MCC manager indicated the deductions are small (1-2% of the price), the manager of another MCC said the deductions were more around 4 to 8 %. The MCC manager indicated that this loss was borne by the MCC, but farmers indicate that these deductions were also reflected in the prices they received. However, now that there is a machine, farmers also indicated that they will not share in the loss anymore because now they know they are not to blame.

Another MCC manager initially also indicated that processors do not pay a price premium. However, this particular MCC works with a trader the picks the milk from them and then ships the milk to a processor. The MCC manager told us that some few months ago, the trader could now take the milk to a different processor because of the improved quality, and that this processor paid a higher price than the one they used to work with. The MCC manager recounted that they indeed received part of the price increase, and that this was also passed down to the farmers. The price premium was about 30 UGX or 5 percent of the going market price.

While there seems to be some differentiation at the MCC level, there is no differentiation at the farmer level. That is, if the MCC is paid a premium, this is shared equally among farmers. Many farmers seem to be fine with this. Especially in cooperatives, the view is that different prices within the same group would create conflict. On the one hand, they seem to understand that if the processor is not paying for quality, the MCC has no other choice than to follow and also does not need to pay for quality. But there also seems to be a good sense of community. Many farmers indicated that it is more important to improve the quality of all farmers, as opposed to differentiating between farmers.

The largest effect on price was observed in the Pearl MCCs. Price is decided on the basis of butter fat (base is 3.3 % with +UGX10 per .1 increase) and SNF (base is 8.5 with +UGX10 per .1 increase). Note that this demonstrates substantial scope for quality premia, as farmers in our sample get an average butter fat rate of 4% and SNF around 8.6. So with a base price of, say 500, the average farmer would get 580 UGX per liter, amounting to a 16 percent quality premium.

Farmers in one MCC indicated that the milk analyzers actually led to a reduction in the price that they were getting for their milk, or a reduction in the profits they could make from milk. This is due to the fact that most farmers do not transport milk to the MCC themselves, but either work with traders (who buy their milk at the farm gate and then sell this milk to MCCs) or transporters

(that charge a transportation fee for transporting milk from the farm gate to the MCC). According to the farmers, before the arrival of the milk analyzers, many if not most of the traders and transporters would add water and/or skim butter fat before delivering to the MCC, allowing them to increase their margin. Now that the MCCs have installed milk analyzers, this has become harder. Farmers complain that as a result, traders' willingness to pay for raw milk at the farm gate has reduced, and transporters have started increasing their fees.

As a result, traders are now asking higher fees for transport, or they are offering lower prices to the farmers they buy from.

One farmer said that he thinks the drop in price during wet season is not as large as it used to be.

There are also indirect effects. Due to the fact that milk quantities are reduced, prices of milk have gone up.

non-price incentives

Even though farmers do not get a premium price, all farmers we talked to indicated that they were very happy with the machine. Among the dairy farmers, there is a certain pride that farmers in the region are known for their good quality. It is a question of honor. However, farmers also indicated that they want to be ready for QBP.

It may be that we just picked out. Indeed one farmer commented that

“when you bring the police to an area with thieves, do you think the thieves will like the police”

6 Other

Farmers indicate they are locked in a low equilibrium. The low price that processors offer means that farmers can not make necessary investments (such as supplements) to increase the quality. This means processors receive low quality and hence do not pay a good price.

A QBP may also have an indirect effect on the **animals**. Higher yielding animals that give milk with higher butter fat will fetch a higher price.

Similarly farmers noted that if a price premium is paid, this will have an important effect on **peer learning**. Farmers will want to know what the farmer that gets the higher prices is doing, so they can copy it and also fetch a higher price.

7 Analysis

Figure 2 shows milk prices over the first six months after the milk analyzers were installed. The figure clearly shows the seasonality in milk supply, with prices falling below 500 UGX per liter in the main rainy season around November, and then gradually increasing up to 900 UGX per liter in the first few months of 2024 when precipitation levels are at their lowest levels. Smaller rains in march and april reduced prices somewhat.

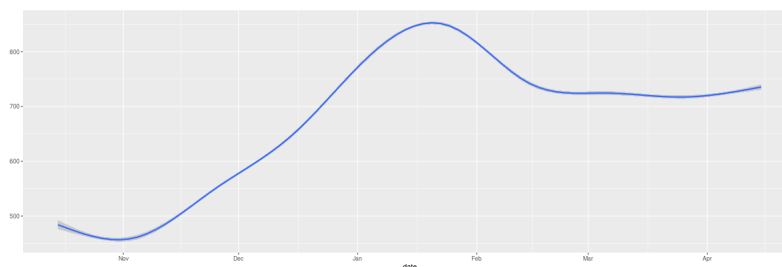


Figure 2: Milk prices

8 Focus group discussions with Policy makers

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Use of data: EU wants to see the quality of raw materials, so our data potentially opens up EU markets. When the algerians came, they wanted to know the entire value chain and were constantly asking questions on how the DDA is guaranteeing quality at each node in the value chain. It was argued that if this data would have been available, DDA would have been able to strike a better deal. Exporters will also be very happy with this data. It can also be used to influence standards and to attract investors. Finally, it also shows that the DDA has the capacity to set up a tracking system like this. This can be useful if additional data is needed. For example, more and more the EU is worried about drug residues and heavy metals. The system demonstrates that, in principle, it would be possible to add extra parameters to the app if equipement is installed that allows measurement.

Quality assurance is a line in the budget. Usually not a lot was written in this line because they had not milk analyzers to calibrate. However, now that machines are there, there is something that can be monitored, so this also means that more can be allocated in the budget. To help with this, we were asked to provide DDA with a detailed costing of calibration.

Currently, pearl is rolling this out only in their own milk collection centers. However, they said that in the long run, they also want to assist cooperatives and even traders with these machines. However, they also realize that an extension component may be needed.

Pearl indicated that they wanted to pay price premia to traders and co-operatives as well (as opposed to directly to farmers) but they were met with resistance from traders. This is probably because traders often add water to milk and so they threatened to take their milk to other milk processors. This seems to suggest the industry is stuck in a low level equilibrium where processors prefer to get more low quality milk without paying a premium as opposed to less high quality milk at a higher cost. Farmers, on the other hand, had lots of

questions. For instance, when they mention the UNBS minimal standard of 3.3 they got worried they would not be able to sell their milk. But after informing them that 3.3 is really a minimum and to get below that you really need to start adulterating milk (like adding water or skimming butter fat) they are reassured. Once the system is in operation, they are very happy with it because, as illustrated in the example above they easily get prices that are 15-20 percent higher.

However, the person at pearl was very optimistic about the future. He claimed that within three months from now, there will be no way back. As Pearl is the largest processor, the others have no choice but to follow.

The person at pearl also indicated that this is just the start of quality upgrading. Taking the case of India as an example, prices are determined on the basis of matrices combining different parameters. But also safety parameters are considered. For instance, they also test for drug residues etc. While this is costly, he was convinced strategies will be developed to deal with this challenge. For instance in India, they do cluster sampling to eventually identify the farmer who is responsible for contamination.

The results of the quality based payment system is very visible for the processor. The person at Pearl claimed that before the introduction of the QBP system, only about 50 percent of the milk was suitable for UHT production (which needs high quality milk). Now, this has increased to about 90 percent.

Meeting at Kampe dairies (Kiriuhura). This is the MCC that started off well, but around new year submissions stopped. The MCC manager explained that this was due to Foot and mouth disease that led to a closure of the MCCs in the area.

The manager also underscores the importance of milk analyzers. He says that before the milk analyzers, the processor they work with (Amos) would often deduct 10 UGX per liter if the quality was low. Since they received the machines, this has never happened (while it used to happen about 2 times every two weeks).

The MCC manager of Rwabigyemano also indicated that after the milk analyzers were introduced, the quantity collected reduced significantly. This was because they rejected more milk, but also because some farmers stopped supplying because they feared the machine. Some 2 farmers left after the milk analyzer was introduced, others changed (often supplying less).

Rwabigyemano MCC does seem to have received a higher price in response to improved milk. According to the manager, the supplier told them two to three months ago that due to better quality, the price increased by about 30 shillings per liter. This was Amos dairies.

Asked whether instances were observed where farmers take rejected milk to other MCCs, the manager said that this does not seem to be the case because all the milk collection centers in the neighbourhood received the milk analyser at the same time. This suggests that our clustered design has the desired effect of reducing potential spillover effects.

Meeting with Nicolas Assimwe, a business man that has 17 MCCs, 3 of which are in our control group.

Other observations: transporters can now also be crosschecked. The transporters trust the milk analyzers. They will test the milk in the MCC tank and the particular will be filled on a delivery note.

The fact that there is a fixed price also means that farmers do not negotiate. Best farmer gets a price. This is now done based on the data in the app.

From meeting with staff in KLA:DDA has formed a technical working group of milk quality assurance. They want to use this group to convince processors to also start paying for quality. As a national technical working group, they think they will have more impact than just a few MCCs. Our work, and particularly the finding that price differentiation at the processor level may be the final missing piece in arriving at a full blown QBPS, may be key in arriving at this. We were therefore requested to make a report and present these findings to the Executive Director who will then make sure this is discussed in the technical working group.

8.1 Problems:

We brought up the issue on how the DDA is planning to further support the project after we pull out, in particular in terms of sustainability. Julius said that this would be, as much as possible, by creating an enabling environment such that a private service sector can develop alongside the dairy value chain.

DDA is not planning on procuring and installing milk analyzers. This is the role of the industry. For instance, cooperatives may invest in a technology that allows them to capture a quality premium. Alternatively, we already see that processors themselves start installing milk analyzers in their milk collection centers to be able to directly incentivize producers. However, it was argued that currently it is very hard to find the milk analyzers are a reasonable cost. Here, the government can help in attracting investors to set up shop in Mbarara, eg through tax breaks of simplifying non-tax barriers to investment.

In a similar fashion, repairing defunct milk analyzers is not something the DDA can do. However, the DDA has big plans with creating training centers. Here, there could be some kind of training program for technicians that is focused on servicing these machines.

There is high staff turnover in MCCs. In addition, MCC staff can use a refresher once in a while. The question then becomes who should be responsible for this. One way to solve this is to require MCC staff to demonstrate the appropriate level of knowledge. Now, anyone that works in a MCC needs to have a health certificate. In the future, it could be that additional certificates are needed, eg to demonstrate that you have attended a training session at the DDA training center on proper operation of milk analyzers. Refresher courses could be organized.

Other regulations that could be put in place to make sure milk analyzers are available in MCCs and kept in good conditions. A requirement for being recognized as an MCC that can supply the formal value chain, you need to be able to measure a particular set of parameters that go beyond freshness and density, in effect requiring a milk analyzer. Related, you need to be able

to submit this data. Currently, MCCs are required to only submit data on volumes traded. Currently, MCCs are required to have their tanks inspected on a regular basis. Similar regulations may make it necessary for milk analyzers to be recalibrated every three months or so.

Private aggregators and to a lesser extent cooperative MCCs indicated that they found the milk analyzers really useful, but that in addition to challenges in getting them, the cost is also too high. For instance, Nicolas, a private trader that owns different milk collection centers, told us that he was very happy with the machines as he now receives good quality milk that does not get rejected by processors anymore. He wants us to bring more. At the same time, when asked why he does not buy them himself now that he sees the use of it, he says that the machines are very expensive and taxes are high, while his margin is minimal due to high competition and fuel prices.

We bought the machines at 2.4 million a piece. With taxes and importation this will be closer to 3 million UGX. However assuming a QBP system like the one Pearl is piloting becomes more general, a cooperative with 25 members that supply 250 liters each that can increase fat content to 4.1 and SNF to 8.7 will get a premium of 100 UGX per liter. If farmers use 5 percent of this premium to invest in a milk analyzer, they break even after about 100 days. If they only use 1 percent of the premium, the milk analyzer is paid back after 1 year and four months.

Clearly, as long as there is no quality premium in terms of price paid downstream, it seems unlikely that MCCs and traders will be willing to purchase their own machines. But even with modest quality premia, the machines become an investment with a decent return.

9 Conclusion

The main problem seems to be that no quality premium is paid downstream. As a result, MCCs can also not compete on quality, and so being strict means that they lose out: If they reject milk, it goes to the neighbours. Being strict leads to lower volumes, and since the price is fixed they lose out. This will lead to a new equilibrium where MCCs are now testing to make sure they just make the threshold for not being rejected, but there is no real competition on quality.

Processors should realize that not providing a quality premium is to their disadvantage. All should do this. The DDA may have a role to play in liaising with processors and convincing them that there is now a critical mass of MCCs that can test such that a quality based payment scheme can be implemented.

Seasonality is a big problem. When milk supply is low, processors become more lenient. At the same time, a quality premium may mean processors still get sufficient milk.

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