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

Richard Ariong[*], Jordan Chamberlin[†], Sarah Wairimu Kariuki[†], Bjorn Van Campenhout[‡]

May 8, 2024

Abstract

In value chains where quality of the underlying commodity is hard to observe and track, quality upgrading my be challenging. In Uganda's southwestern milk shed, a variety of initiatives are trying to increase the quality of raw milk in dairy value chains. This generally involves the installation of equipment that enables measurement of key quality parameters at strategic nodes in the value chain, and the development of a system that allows for tracking of these parameters. 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.

1 Introduction

A central feature of dairy value chains is aggregation and bulking mid-stream. In a typical dairy value chain, dozens or smallholder farmers supply raw milk to a milk collection center (MCC). Sometimes, farmers take the milk to these collection points themselves, but often a transporter is used or a trader is involved that buys milk from multiple farmers and sells this to the MCC.[1] MCCs are the start of the cold chain: they chill the milk in large coolers and aggregate for onward transport. The milk collected in these MCCs is in turn offloaded to larger traders that use milk tankers and deliver to processors. Processors process the raw milk into products for the final market such as UHT, pasteurized milk, yogurt, cheese, infant formula, caseine, etc.

[*]Development Strategy and Governance Division, International Food Policy Research Institute, Kampala, Uganda

[†]CIMMYT, Nairobi, Kenia

[‡]Development Strategy and Governance Division, International Food Policy Research Institute, Leuven, Belgium

[1]Transporter ship milk from A to B against a fee; traders buy milk at the farm-gate and sell further up the value chain. The latter thus assume ownership of the milk in the process.

Currently most MCCs do not have the capacity to accurately test milk quality[2]. Most MCCs only engage in rudimentary testing for adulteration (using a gravity based test with a device called a lactometer) and freshness (using the alcohol test). However, for the processors, composition parameters such as butter fat percentage and Solid Non-Fats (SNF) are important, as it determines their productivity. However, to measure these quality parameters, more sophisticated measurement technology is needed.

The fact that milk from individual farmers is poured together without accurate testing makes it hard to track (and reward) quality. In fact, there is risk of free-riding because individual quality cannot be traced. Indeed, farmers have an incentive to supply low quality milk as profit maximizing farmers (and other stakeholders upstream such as traders and middlemen) would remove some butter fat to sell on the side or/and add some water to increase the quantity of milk. Stakeholders throughout the value chain agree that adding water to raw milk and separating butter fat is widespread.

In Uganda's southwestern milk shed, a variety of initiatives are trying to increase the quality of raw milk in dairy value chains. Together with the Uganda Dairy Development Authority (DDA), SNV piloted a Quality-Based Milk Payment Scheme (QBMPS) in 2018, which involved the installation of 15 solar-powered milk analysers in cooperatives, processors and the DDA lab.[3] A collaboration between IFPRI, CYMMIT and the DDA, as part of the CGIAR Rethinking Food Markets Research Initiative is currently conducting a field experiment that includes the installation of milk analyzers that involves about 150 MCCs and about 3,000 farmers. Pearl Dairies, the largest processor in the area, has also started rolling out QBMPS in its own MCCs.

This paper uses a mixed methods approach to document outputs, describe emerging outcomes and reflect on potential impact.

The remainder of this article is organized as follows. We start with

2 Theoretical framework

One potential reason why a market for quality does not develop may be related to the fact that milk from individual farmers is poured together, making it hard to track quality. In general, at the start of the cold chain in milk collection centers, only rudimentary testing is done, and equipment to track quality parameters that are most relevant for the development of a market for quality is lacking. Only when milk reaches the processor, these quality parameters are revealed.

[2]Milk 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.

[3]Milk analyzers show butter fat, solid non-fats, added water, temperature of milk, protein content, and corrected lactometer coefficient. Taking a sample is non-destructive and takes about 30 to 50 seconds depending on the temperature of the milk.

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.[4] 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 at the level of the milk collection centers. 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 at a reasonable cost, farmers may also demand milk collection centers to test their milk in case there is discussion related to the quality.

3 Related Literature

Our study is related to a large literature. Some of the most recent articles include:

- Rao and Shenoy (2023) explore the effect of collective incentives on group production among rural Indian dairy cooperatives. In a randomized evaluation, they find village-level cooperatives can solve internal collective action problems to improve production quality. However, some village elites decline payments when they cannot control information disclosure. Opting out reflects frictions in allocating surplus within a social network, and suggests some transparency-based efforts to limit elite capture may undermine policy goals.

- Treurniet (2021) uses matching on observable farmer characteristics to study how individual quality incentives provided by private actors can help smallholders to improve milk quality. In the Indonesian dairy value chains they study, individual quality incentives increased the compositional quality of milk quickly after its introduction. Together with phys-

[4] As 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.

ical inputs and training, individual quality incentives also increased the hygienic quality of milk.

- Saenger et al. (2013) use framed field experiment to evaluate the impact of two incentive instruments: a price penalty for low quality and a bonus for consistent high quality milk on farmers' investment in quality-improving inputs among contract farmers in the Vietnamese dairy sector. Statistical analysis suggests that the penalty drives farmers into higher input use, resulting in better output quality. The bonus payment generates even higher quality milk.

4 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 farmer[5]). For instance, using recently collected survey data, we find that of a sample of 200 farmers that sold to milk collection centers, only 6 percent indicated that they received a 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 the 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

[5] https://www.frieslandcampina.com/owned-by-farmers/milk-price-system/

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.[6] They are focusing on their own processor run 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.

5 Sources of data and sampling

A first data sources 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 were the MCC manager was interviewed. Second, we

[6] In some of the MCCs that were also selected for the CGIAR project, Pearl is actually using the equipment from the CGIAR project for their QBMPS

sampled farmers from the catchment areas of these 125 MCCs (about 18 per MCC) leading to a sample of 2,260 farmers.[7]

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 submissions 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.[8]

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.[9]

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 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 Diary) 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.

[7] The 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.

[8] A 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.

[9] The guiding questions for the focus group discussions and key informant interviews can be found here.

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 Kirihura. 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 anbout 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 Kirihura. 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 Amost Dairies in the week proceeding 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.

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.

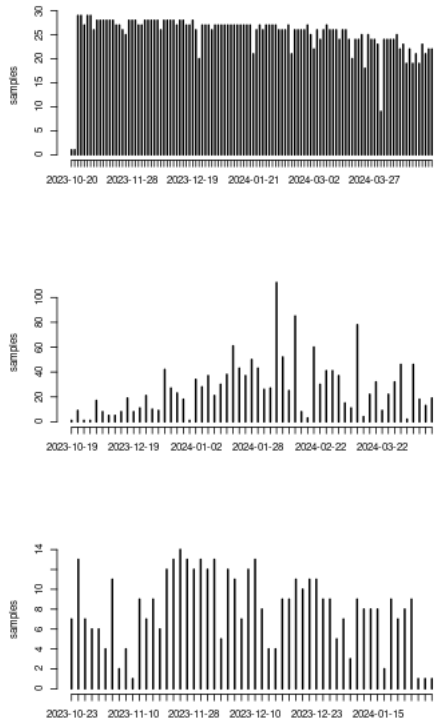

Figure 1: Sample submissions to MCCs

6 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.

6.1 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 fact 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. 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.[10] 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 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 the to earn something extra. The introduction of the milk analyzers exposed this practice: farmers that received complaints from

[10] We 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."

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. The 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 buys 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%.

6.2 Impact on price

Impact on price was much less evident that 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. 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.

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

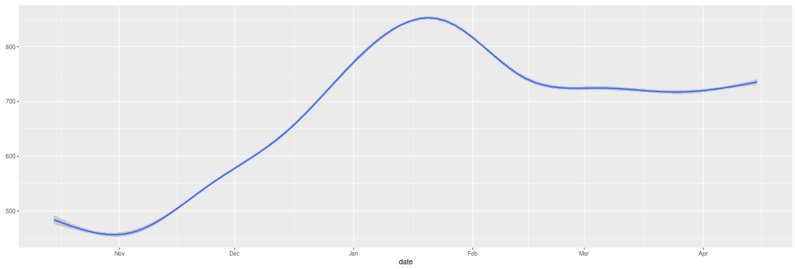

Figure 2: Milk prices

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"

7 Other

Farmers indicate they are locked in a low equlibrium. 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.

8 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.

9 Focus group discussions with Policy makers

Agnes Waguma director technical services, Julius.wandera@dda.go.ug senior lab technician

Stephen Onyait acting principle Planning officer

Joseph Agaba dairy development officer

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 cooperatives 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 reassused. 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 comining different parameters. But also safety parameters are considered. For instance, they also test for drug residues etc. While this is costly, he was convinces strategies will be developed to deal with this challenge. For instance in india, they do cluster sampling to eventually identify the farmer who is reponsible for contamination.

The results of the quality bases 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 diaries (Kirihura). 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 desease 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 neigbourhood 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.

9.1 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 incentives 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 oranized

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 the 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.

10 Conclusion

MCC managers indicate that the current situation is not optimal. If they reject, it goes to the neighbours and the MCC loses out. Being strict leads to lower volumes, and since the price is fixed they loose 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.

References

Rao, M. and A. Shenoy. 2023. "Got (clean) milk? Organization, incentives, and management in Indian dairy cooperatives." *Journal of Economic Behavior & Organization* 212: 708–722.

Saenger, C., M. Qaim, M. Torero, and A. Viceisza. 2013. "Contract farming and smallholder incentives to produce high quality: experimental evidence from the Vietnamese dairy sector." *Agricultural Economics* 44 (3): 297–308.

Treurniet, M. 2021. "The Potency of Quality Incentives: Evidence from the Indonesian Dairy Value Chain." *American Journal of Agricultural Economics* 103 (5): 1661–1678.

Van Campenhout, B., B. Minten, and J. F. Swinnen. 2021. "Leading the way–foreign direct investment and dairy value chain upgrading in Uganda." *Agricultural Economics* 52 (4): 607–631.