Piloting a Quality-Based Milk Payment System (QBMPS) in Kenya

Pilote un système de paiement du lait à la qualité au Kenya.

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1. Introduction

Happy Cow Ltd (HC) is a dairy processor based in Nakuru, Kenya, specialized in producing cheese and yoghurt. Towards the end of 2014, HC submitted a proposal to the SNV Kenya Market-led Dairy Programme (KMDP), funded by the Embassy of the Kingdom of the Netherlands, to pilot a Quality Based Milk Payment System (QBMPS) to address major quality challenges in the raw milk supply chain as outlined below. HC was awarded funding for the pilot in partnership with New Ngorika Milk Producers Ltd in Nyandarua County and Olenguruone Dairy Farmers Cooperative Society in Nakuru County. These two entities are also referred to as Cooperatives (Coops), Collecting and Bulking Enterprises (CBEs); hereafter referred to as Ngorika and Olenguorune respectively. Together they have over 2,500 registered small-scale dairy farmers.

2. Problem statement

Challenges in the raw milk supply chain

In Kenya, small scale farmers produce over 80% of the total milk. These farmers are estimated at 1.5 million and individually market an average of about 8 kg of milk daily. Poor infrastructure and milk payment based on quantities are challenges in the value chain that cannot guarantee good quality of raw milk. HC decided to investigate the quality of raw milk received from its two major suppliers and engaged an accredited laboratory. Table 1 shows some examples of the historical data resulting from these quality analyses. The results indicated major challenges in Total Plate Count (TPC) and antibiotic residues in raw milk; far above Kenya Bureau of Standards (KEBS).
Table 1: HC’s historical quality analysis data for TPC, Resazurin and Antibiotic residues for the two CBEs

<table>
<thead>
<tr>
<th>DATE</th>
<th>CBE</th>
<th>TPC/ML</th>
<th>Resazurin</th>
<th>Antibiotic residues</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEBS Standards</td>
<td>&lt; 2,000,000</td>
<td>4-6</td>
<td>&lt; 4 PPB</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7/6/05</td>
<td>BULK SILO</td>
<td>98,000,000</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>1/11/14</td>
<td>Coop B</td>
<td>190,000,000</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>POSITIVE</td>
</tr>
<tr>
<td>3</td>
<td>19/11/14</td>
<td>Coop A</td>
<td>110,000,000</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>POSITIVE</td>
</tr>
<tr>
<td>4</td>
<td>28/01/15</td>
<td>Coop A</td>
<td>160,000,000</td>
<td>4</td>
</tr>
</tbody>
</table>

Other major challenges in the Kenyan dairy value chain include: farm-gate collection and poor roads causing delays in milk collection, lack of reliable potable water source and cold chain rules not being observed. This coupled with a milk market which is volume based with low awareness on quality, and dairy cooperatives and processors not being proactive to improve milk quality, aggravates the milk quality challenges. In addition, over 70% of the total milk produced in Kenya is marketed through a thriving informal channel with minimal quality checks. Disputable practices also exist in the raw milk collection: use of dirty plastic jerry cans, sometimes use of preservatives, cooperatives/processors accepting raw milk that has been rejected elsewhere, milk collection beyond the recommended 2 hours and then stored in inefficient milk coolers. All these practises cause high bacterial counts in raw milk. The Kenya Dairy Board (KDB) is constrained in enforcing and applying dairy standards to curb all these challenges.

Milk quality and health/safety concerns

Preservatives that are sometimes used such as hydrogen peroxide (H2O2) mask bad hygienic practices and the free radicals released by H2O2 can have negative health effects, such as DNA mutation and cancer. Antibiotic (AB) residues contribute to allergic reactions and development of resistant pathogens. In processing they restrict production of fermented milk products. Adulterants act as microbial contamination sources. High bacterial counts lead to high raw milk rejection rates and production of heat resistant enzymes which affects the shelf life of the finished dairy products.

This paper presents some findings and implementation activities of the pilot project on QBMPS for the period January 2015 to December 2018.

3. Project approach/methodology

Interpretation of Zero Setting results

A baseline study was conducted in mid-2015 at Ngorika and Olenguruone catchment areas. The challenges in raw milk quality included: high bacterial load (TBC/TPC); high rates of antibiotic residues; incidences of mastitis; adulteration cases; lack of correlation between Resazurin test and TPC and inefficiency of the installed milk coolers. Figure 1 shows increased TPC at different sampling levels. A major contributing factor was the inefficiency of milk coolers available at the cooperatives.

Figure 1: TPC at different sampling levels.
Figure 2 illustrates the major cold-chain rule: “fresh raw milk needs to be cooled within 3 hours after milking below 4 °C”. This is because the natural preservative in milk (lactoperoxidase enzyme) is still present. The results of the zero-setting indicate violation of this rule; the time interval can easily exceed 6 hours after milking compromising the quality of the raw milk.

Based on the above results, several interventions were required to arrest microbial multiplication. They include: enhanced hygiene practices, fast delivery and cooling (Plate Heat Exchanger), removal of plastic containers at the farm level and during transportation.

**Track and Trace (T&T) system for quality payment mode**

The QBMPS pilot project also implemented a track and trace (T&T) system to monitor milk quality in specific milk can which is assigned to a group of farmers allowing for quality payments of milk to farmers. The objective of a T&T system was to identify milk quality at critical points in the collection chain, identify farmers, milk cans, milk collection points and routes, and identify causes of quality losses and taking corrective actions to improve quality.

A computer software was developed to link individual farmers to a certain 50 litre milk can at HC and at the coops. These cans were randomly tested twice per month on quality parameters at the HC laboratory (see box 1). But first, milk has to pass all acceptance tests at the CBE platform.

Milk Collections Points (MCPs) are vital for fast grading and milk collection. Use of a farmer as prefect or transporter as a grader and farmers’ peer pressure, positively influence the milk quality. At the HC laboratory, the milk can samples were analysed to define the QBMPS payment mode. Payment to farmers on quality analysis results are shared with the coops at the beginning of the following month.

<table>
<thead>
<tr>
<th>Test</th>
<th>TPC grade A</th>
<th>TPC grade B</th>
<th>TPC grade C</th>
<th>Antibiotics</th>
<th>Adulteration</th>
<th>Total solids</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>% score</td>
<td>+50</td>
<td>0</td>
<td>-50</td>
<td>+15</td>
<td>+20</td>
<td>+15</td>
<td>100</td>
</tr>
<tr>
<td>Grade</td>
<td>% Payment (score)</td>
<td>Payment</td>
<td>Amount (KSH)</td>
<td>Penalty being only KSH 0.00:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>70-100</td>
<td>Premium</td>
<td>+2</td>
<td>It is difficult to have in Kenya a price neutral payment system (where penalties raised are used to pay for bonuses) since unsatisfied farmers switch easily to another buyer.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>40-69</td>
<td>Standards</td>
<td>+1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>&lt;40</td>
<td>Penalty</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Box 1: QBMPS testing parameters

**QBMPS parameters per can:**

1) Total bacterial count (TPC)
2) Presence of antibiotic residues
3) Adulteration or density
4) Total solids, fat, protein, lactose.

For bench marking purpose:

a) Somatic cell count (per can)
b) Aflatoxin M1 (per tanker)

Table 2: HC payment module consolidated

The project promoted practices to improve raw milk quality, such as: clean milking and care at farm level, use of proper stainless steel (SS) milk cans, use of clean water for can washing, separation of evening and morning milk, timely and fast delivery to milk collection centre, introduction of prefects at MCPs, instant chilling combined with milk cooling tanks, among others. This involved training of all the stakeholders.
4. Results

Achievements

The pilot project has put QBMP high on the agenda in Kenya: QBMP is now included in Strategic Plans of KDB and Kenya Dairy Processors Association (KDPA). Awareness raising took place at all levels with over 30 presentations by HC over the last 3 years. Many forums agreed that Kenya cannot afford to continue paying only for milk volumes due to a range of reasons such as trade and health benefits/losses (Ndambi et al., 2018). Costs and benefits of good quality of milk can also be categorized as follows:

In general: financial and health benefits include expanded export/trade market, prolonged product shelf life, improved product quality and better food safety for improved health.

For processors: main benefits are reduced processing costs and losses and to venture into more quality oriented dairy products and dairy export with higher profit margins.

For farmers: the main benefits are improved income through bonuses and reduced losses, and payment based on composition could encourage proper breeding with higher return per litre.

The project achievements in the four main parameters have been, to date:
- Antibiotic residues: under daily surveillance
- Total Solids: now often within standards
- Adulteration/density: now often within standards
- TPC counts: this remains a major challenge as it is still much above the required standards.

Towards the end of 2018, the HC laboratory was accredited on ISO/IEC 17025:2005 Standards by the Kenya Accreditation Service (KENAS). The laboratory is specifically for dairy parameters. In addition, the HC-QBMP manual was completed and the HC-QBMP-IT program was enhanced for improved reporting and to also cater for outside services.

Major investment has been done by the CBEs to improve milk quality, such as investments in acquiring SS cans, establishing local laboratories and in fast cooling equipment.

Good practices

Some of the good practices to be learned from this pilot project for scaling up a QBMPS include:
- Availability of clean water and electricity at MCPs is obligatory.
- Use of SS cans (no plastic jerry cans) at farm level and transportation.
- Time phased collection.
- Use of plate heat exchanger and chiller are required for effective and immediate cooling.
- Evening milk should not be mixed with morning milk (ideal scenario).
- Good relationship amongst all stakeholders is required for successful implementation of a QBMPS.
- Support from KDB and County representatives is crucial in enforcing dairy regulations.
Supportive external research

According to Ndambi et al. (2018), huge public health and trade benefits justify private, public and donor investments to support setting up a QBMPS. The benefits reported about the HC-QBMPS project include:

1) Bonus payment to farmers of KES 2.00/kg milk for Grade A milk.
2) Net cost of KES 2.50 KES/kg milk need to be met by a more efficient value chain or higher consumer prices.
3) Trade benefits and Health benefits could sum to KES 10.00/kg milk. Health being as a result of avoided costs of milk-related illness.
4) Lack of enforcement at many levels requires consumers and import/export markets to become watchdogs.

5. Observations and conclusions

Some of the main lessons learned from this project include:

a) Infrastructure and milk quality policies at CBEs are currently inadequate
b) The commitment of CBEs or cooperatives and premium payment is a big driving factor for realization of an effective QBMPS.
c) Competition among the informal sector and processors limits success of implementation.
d) To reduce TPC, the basics should be in place such as removal of plastic jerry cans.
e) The T&T system should be scaled-up from a 50 ltr can to a bigger sample size e.g. with 3 cans or more.
f) Implementing a QBMPS requires several years with active KDB participation

6. Recommendations for Scaling-up a QBMP

- Daily use of a Milk Analyser at Cooperative geared towards the basics of a QBMP; improving milk quality.
- Regular use of an ISO accredited dairy laboratory (ISO/IEC 17025:2017 Standard) for monitoring progress in quality:
  - Composition: Fat%, Protein%, SNF%, etc.
  - Microbiology: TPC/SCC/CC
  - Food Safety: Aflatoxin M1, AB Residues, etc.