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3R Research Report 005
WLR Report 1165

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Summary
This report describes and assesses a milk quality assurance innovation, the milk quality tracking and tracing system (MQT&T) and Quality-Based Milk Payment System (QBMPS) project. The project was piloted by Happy Cow Ltd (HC), a medium-scale processor in Nakuru, Kenya, and its milk suppliers. The objective of the pilot project was to offer a proof of concept to track and trace milk quality within a smallholder-dominated supply chain and to develop and implement a payment system based on the quality of raw milk delivered. The assessment adapted the PPPLab Scaling Scan as the main framework to enumerate the various project investments, interventions and achievements and to reflect on the success factors, shortcomings and preconditions required for QBMPS scalability.

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Cover photo: Milk grading and collection from a collection point using a truck (photo Dirk Harting)

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The authors

Shortened forms

ABR	antibiotic residues
ATM	automated teller machine
B2B	business-to-business
CBE	collection and bulking enterprise
DALYs	disability-adjusted life years
HC	Happy Cow Ltd
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KDPA	Kenyan Dairy Processors Association
KEBS	Kenya Bureau of Standards
KES	Kenyan shilling
KMDP	Kenya Market-led Dairy Programme
LSF	large-scale farmer
MCC	milk chain coordinator
MCP	milk collection point
M&E	monitoring and evaluation
MoALFI	Ministry of Agriculture, Livestock, Fisheries and Irrigation
MSF	medium-scale farmer
MQT&T	milk quality tracking and tracing system
QBMPS	quality-based milk payment system
SAP	Structural Adjustments Programme
SNV	SNV Netherlands Development Organisation
SOP	standard operating procedures
TBC	total bacterial count (same as TPC)
TPC	total plate count (same as TBC)

Summary

The safety and quality of milk and dairy products is an important selling point to consumers. In Kenya, this quality has become a matter of growing concern over the past 25 years as the result of several well-documented developments. Enhanced quality and safety assurance of milk and dairy products is necessary to make the Kenyan sector competitive and credible with regard to making the wellbeing of consumers the first priority. Quality assurance requires that all chain actors play their role in milk handling. Convincing actors to change their milk-handling behaviour is no easy task, and efforts by one chain actor are futile when other chain actors are not motivated to collaborate. One way forward in the improvement of milk hygiene, food safety and competitiveness of Kenyan dairy products is to rein in the informal sector that supplies 70% of the milk (unpasteurized) to consumers and to address the high cost and low quality of inputs that are stifling dairy farmers. The informal sector in particular has been criticised for flouting Kenya Dairy Board regulations, undermining dairy cooperatives through direct procurement from farmers and evading taxation. This partly characterises the "unlevel" playing field that is the Kenyan dairy sector.

To enhance safety and quality, the sector needs innovative and successful examples of market-driven approaches that are relatively easy to copy and implement by others. These solutions are likely to work in tandem with a stepwise introduction of regulations that aim to support a fair, competitive and sustainable industry.

This report describes and assesses one such innovation, the milk quality tracking and tracing system (MQT&T) and Quality-Based Milk Payment System (QBMPS) project. The project was piloted by Happy Cow Ltd (HC), a medium-scale processor in Nakuru, and its milk suppliers, Olenguruone Dairy Farmers Cooperative Society and New Ngorika Milk Producers Limited. Quality of milk intake is particularly important to HC, which produces cheese and yoghurt. The project was funded by the Embassy of the Kingdom of the Netherlands (Kenya) and supported by the SNV Kenya Market-led Dairy Programme. The pilot project objective was to offer a proof of concept to track and trace milk quality and to develop and implement a payment system based on the quality of raw milk delivered to HC.

The report is in two main sections. The first describes the rationale, design and implementation framework of the QBMPS pilot project within the context of the Kenyan dairy sector and the challenges the industry faces related to assuring milk quality and safety. The pilot was designed to demonstrate the potential for a QBMPS in a complex smallholder supply chain in the Kenyan dairy sector, which has been characterized as lacking a level playing field in relation to the implementation of existing policy and regulatory frameworks.

The second section provides a multidimensional assessment of the pilot project, with an in-depth review of the lessons learned in implementing the new systems: what worked well and what did not. The assessment adapted the Scaling Scan as the main framework (PPPLab 2018) to enumerate the various project investments, interventions and achievements and to reflect on the success factors, shortcomings and preconditions required for QBMPS scalability. The Scaling Scan outlines 10 key "ingredients" that are deemed useful for assessing innovative interventions in the agricultural sector and for reflecting on the lessons learned and potential for scaling. These ingredients are technical solutions, awareness and demand, supply chain development, business case, financing, knowledge and skills, platform and stakeholder collaboration, monitoring and learning, leadership and management, and support of public agencies. The assessment was based on a review of project documents, interviews with project partners and a learning workshop.

The report concludes with lessons learned and recommendations.

Checking the intended business change pathway of QBMPS
The QBMPS can be characterized as a sociotechnical innovation that entails a series of business change processes, including behavioural, technological and organizational. The thinking behind the project can be summarized as:

- HC implements the project in close collaboration with its two supplying collection and bulking enterprises (CBEs).
- The CBE's and HC's supply chain is upgraded, starting from routes in which project milk is being collected; milk collection points are constructed; laboratories at CBEs and HC are

upgraded; farmer "can groups" are formed; a range of hardware investments are made; collection and milk-handling routines are adjusted; farmers, CBE staff, transporters and graders are trained and advised on good milk production and handling practices.

- To first track and trace the quality of milk and then price milk based on quality, milk sampling is organized when the milk is received by transporters in the routes, at the CBEs and at HC; testing is organized as per a pre-determined milk sampling and testing regime.
- A bonus payment system is developed based on the scores of milk tested for a set of parameters; payment by HC to CBEs and by CBEs to farmers is made.
- The intended result of the changes is that the quality of milk supplied to HC is improved and that volumes increase.

The Kenyan dairy development context is fraught with many challenges that contribute to low levels of compliance with milk safety and quality standards, be they national, regional or international. Therefore, from the onset the pilot was an ambitious endeavour.

Key findings and lessons learned

The project resulted in progress in a number of areas. This includes adoption of some good practices by all actors (processor, farmers, CBEs, transporters) in the supply chain that resulted in a level of improvement in the safety and quality of milk. These changes are linked to investments that were enabled through the project, including upgrading and introducing testing infrastructure at HC and the CBEs, integrating improved chilling technology and other structures at the CBEs, capacity-building of various actors and some improvement in supply chain coordination. A cost–benefit analysis of the business case shows that farmers clearly benefit from a QBMPS. In the short term, the processor and the CBEs incur more costs, but a QBMPS is a long-term investment. Importantly, the findings from the project have put the issue of addressing milk quality and safety firmly on the national agenda.

However, a number of circumstances were beyond the influence of project partners; these concern difficulties in the operating climate in the Kenyan dairy sector. The basic, necessary infrastructure and institutions are not yet in place, such as mandatory use of aluminium cans for milk handling and transportation, clean water, milk-cooling facilities, milk-testing equipment and milk grading. Changing behaviour is complex and takes time. It requires deliberate strategies, including those that are not about economic incentives. The competition for milk volumes due to increased consumer demand has overshadowed the embracing of quality and safety parameters as the industry grows.

The following lessons can be drawn from this pilot project:

- **Designing a QBMPS:** The proposed model was borrowed from a smallholder milk supply chain in another context. At the start it was insufficiently adapted to Kenyan circumstances. The scope was too ambitious, with too many parameters to implement and track properly within the short project time frame. It would have been better to start with fewer milk quality parameters for testing bonus payment.
- **Management of pilot:** The pilot required strong managerial and technical skills to implement all the required activities in the project. This includes knowledge of food safety issues, milk-testing protocols and data collection, management and analysis for business decision-making. There were capacity gaps related to these areas that needed to be filled.
- **Importance of a champion:** There was strong commitment by HC management to use their long experience in the sector and insights from the pilot to flag milk quality and safety as a critical issue that could threaten the sustainable and competitive development of the entire industry in Kenya. Having such a champion is critical to pushing such an important agenda.
- **Technology options:** The current milk-testing system is expensive, considering that it is testing the milk of smallholder farmers who market less than 10 kg of milk per day. There is a need to continuously search for new testing technology and equipment that is more cost-effective. Also, optimizing the milk-testing regime (scope of parameters, frequency of testing and point of testing) is important to make the system financially sustainable.
- **Farmer behaviour change:** A proper mix of instruments is needed to motivate farmers to change milk-handling practices, considering their socioeconomic and cultural contexts. Introduction of a QBMPS needs to be accompanied by a combination of training and extension support along with financial incentives and penalties.

- **Business case:** What does it take to invest in a QBMPS? What is the business case? Who benefits and who loses? Is win–win possible? A cost–benefit analysis shows that farmers benefit from the system, while processors and CBEs incur more costs, at least in the beginning. The project design and its implementation would have benefited from business-case thinking for each stakeholder, linked to stronger risk assessment and risk management plans. The system should also make financial sense to all the actors involved. In addition, milk pricing remains a thorny issue that may require policy and market interventions to ensure fairness.
- **Public–private business partnerships:** Donors who are promoting and supporting these arrangements need to take into account the fragility of existing business relationships and development interventions and the capacity of the private sector to implement such arrangements. We observe that at the conceptualization of the project this was not sufficiently taken into account by all parties, including Kenya Market-led Dairy Programme (KMDP) as fund manager and the Embassy of the Kingdom of the Netherlands (EKN) as donor. During implementation both KMDP and HC recognized these fragile relationships, the market dynamics at work and the behavioural change required, and made several adjustments to the implementation strategy. The lesson here is that development actors and private sector actors need to avoid undue stress on business partnerships, overly optimistic assumptions about what it takes to make public–private partnerships successful in complex contexts (agrifood sector) and unrealistic impact expectations.
- **Scalability of the model:** Based on project partners' self-assessment of the scaling potential of the QBMPS, it was noted that various dimensions of the model need further development for the concept to be scalable within Kenya. A mid-term evaluation of the QBMPS pilot (Harting and Katothya 2016) characterized the pilot as a systemic and radical innovation and provided some initial reflections on its scaling. As a systemic and radical innovation, the QBMPS needed to develop and adapt solutions that would result in three outcomes to reach a point of scalability: an enhanced shared vision and values between the business partners and industry actors about the issues at hand; reduced risk and uncertainties of the system given the prevailing context (especially among farmers and CBEs); consolidation and sustainment of the innovation by distributing the benefits among all actors. The results from this current assessment indicate mixed level of success towards the noted outcomes, which affects the potential for scalability.

Recommendations

We make several recommendations to ensure the significant investments of the pilot are leveraged in fine-tuning a QBMPS that would work better in the Kenyan context and can be adopted and scaled up by multiple actors.

Recommendations for Happy Cow (and other processors)

- **Investment in an integrated management system for a data-driven business model:** The QBMPS is a heavily data-driven business model. It requires investment in integrated systems that enable seamless data capture, storage and analytics at different critical testing points at both CBE and processor level. It also requires managerial capacity to continuously use the analytics to guide business decision-making.
- **Business partnership management:** To continue with the QBMPS, HC and other processors wanting to invest in such a system will need to carefully and deliberately build strong and mutually beneficial (win–win) business partnerships with suppliers and other actors in the chain.
- **Leveraging the Kenya Accreditation Service (KENAS) accredited laboratory services:** The accreditation of the HC laboratory offers opportunities to grow a new business line. This has to be strategically developed.
- **Business case:** The business case of the QBMPS would really be proven if (and when) HC moves towards premium dairy products. This would not only increase returns on investments, but also demonstrate QBMPS as a means to an end.

Recommendations for the sector/industry

- **Transferability:** Industry actors should lead the efforts in entrenching QBMPS in their supply chain, drawing lessons from the HC pilot. Wider application should make the system leaner and more cost-effective, yielding results at scale.
- **Scalability:** More needs to be done to increase momentum in scaling the QBMPS. As an industry-wide agenda, it will be important to support stakeholder engagement that enables

exchange and learning among the different actors, to fine-tune a system that will be workable nationwide.

- **Widespread improvements:** Efforts by all industry actors to improve milk volumes and quality should be concurrent. The investments needed for QBMPS need to be recovered through increased milk intake levels, with attention for benefits by all actors.
- **Technology:** The sector needs to embrace technologies that enable affordable on-time testing and transmission of results. Some of this technology is already available in the market; other technology may need to be co-developed through innovation partnerships.

Recommendations for the public sector

- **Public investment:** Assessment of the public health costs and benefits of a QBMPS in Kenya (Ndambi et al. 2018) demonstrated the huge benefits in ensuring milk safety to consumers. This makes a good case for public agencies (Kenya Dairy Board; Ministry of Health; Ministry of Agriculture, Livestock, Fisheries and Irrigation) to push for the necessary public investment to entrench such a system in the sector.
- **Cooling technology:** The experience of HC revealed that attention is required for appropriate (faster) cooling technology. Current efforts by government agencies in procuring milk-cooling tanks may not have paid sufficient attention to this and should look to remedy this situation if milk quality assurance is to be successful at large scale.

Recommendations for development partners and donors

- **Roles of supporting agencies:** SNV-KMDP's multiple roles in providing external support – financing, management advice and technical advice – requires some attention. How can an innovation like this best be financed? Should the fund manager be co-implementing or take more of a monitoring role? International technical support was important for the project, but did not always match the needs of HC, the CBEs and the context. HC was sometimes hesitant to involve external expertise, as they felt experts had insufficient knowledge of the local context. More clarity of roles might have helped in managing expectations within the CBEs, HC and KMDP.
- **Synergy to help scaling up:** Momentum has been created to drive the dairy sector in Kenya towards quality and safety through this QBMPS pilot. Many development programmes are now supporting this critical issue. Development programmes should create synergy, rather than duplicate efforts, in their contribution to the scaling-up of such a system in the country.
- **Public–private partnerships:** Supporting public–private partnerships as a modality for fast-tracking innovative solutions in dairy (agro-) sector development is important. However, more attention should be paid to understanding the workings of such partnerships and the challenges that emerge. This calls for new approaches in how to design projects.

Introduction

The safety and quality of milk and dairy products is an important selling point to consumers. In Kenya, this quality has deteriorated significantly over the past 25 years as a result of several well-documented developments, including:

The safety and quality of milk and dairy products is an important selling point to consumers. In Kenya, this quality has become a matter of growing concern over the past 25 years as the result of several well-documented developments including:

- a deep crisis in the sector following the Structural Adjustment Programme (SAP) reforms of the IMF and World Bank in the early 1990s, after which chain actors struggled for survival (FAO, 2011);
- competition for market share between dairy companies following market liberalization in the late 1990s (FAO, 2011; Omore et al; 2005);
- competition between the informal and formal channels (Omore et al., 2005, Rademaker et al., 2017);
- increasing demand for dairy products beyond what is produced, especially in the cities, leading to longer and more risk-prone supply chains in relation to safety and quality (Rademaker et al., 2017; USAID-KAVES, 2015);
- insufficient monitoring and enforcement of quality standards by the relevant agencies (FAO, 2011; KCDMS, 2018; Ndungu et al., 2016);
- a culture of "not guilty unless caught" that condones unethical practices (Ndungu et al., 2016);
- increased urbanization and demographic pressures causing increased competition for land for construction, crop production and livestock production, leading to high costs of production and use of substandard feeds (Rademaker et al., 2017; USAID-KAVES 2015).

Together, these factors have led to an undesirable situation, in which marketed products often do not meet quality and safety standards, the formal marketing channels are outcompeted by the informal ones and Kenya's competitiveness in the East African region is compromised (Bebe et al. 2018; Kashongwe et al. 2017; Makau et al. 2016).

Enhanced quality and safety assurance of milk and dairy products is necessary to make the Kenyan sector competitive and credible as an industry that places the wellbeing of consumers as its highest priority. Quality assurance requires that all chain actors play their role. Convincing actors to change their milk-handling behaviour is no easy task, and efforts by one chain actor are futile when other chain actors are not motivated to collaborate.

One way forward in the improvement of milk hygiene, food safety and competitiveness of Kenyan dairy products is to rein in the informal sector that supplies 70% of the milk (unpasteurized) to consumers and to address the high cost and low quality of inputs that are stifling dairy farmers. The informal sector in particular has been criticised for flouting Kenya Dairy Board regulations, undermining dairy cooperatives through direct procurement from farmers and evading taxation. This partly characterises the "unlevel" playing field that is the Kenyan dairy sector, whose producers are mostly smallholders. There is need to explore solutions to level the playing field to enable fair competition in driving sustainable sector development. India, for example, has addressed the informal milk marketing challenge by requiring dairy traders to procure milk through authorized dairy cooperatives.

To enhance safety and quality, the sector needs innovative and successful examples of market-driven approaches that are relatively easy to copy and implement by others, especially in a smallholder-dominated context. These solutions are likely to be introduced in tandem with a stepwise introduction of regulations that aim to support a competitive and sustainable industry. Public actors need to strongly push for quality assurance for the benefit of consumers (food safety and affordability) and the nation (employment, revenues and public health). There have been ongoing efforts by the KDB in the context of the East African Community (EAC) at large to streamline food safety regulations as way to find solutions for sanitizing and regulating local food value chains. This has resulted in a drawn-out attempt to

This assessment looked at:

- ✓ prevailing practices in the smallholder milk collection chain and their drivers
- ✓ costs and benefits of the QBMPS
- ✓ the quality of raw milk supplied
- ✓ pre-conditions to be met for successful QBMPS implementation.

introduce new regulations, including the proposed Dairy Industry Act 2018, which has triggered debate and revealed the competing interests that make it difficult to advance a sector-wide agenda on safety and quality.

In this context, how can innovative solutions and investment be made in the Kenyan dairy industry and a business case developed for enhancing the quality and safety of milk and dairy products?

This report describes and assesses one such innovation, the Quality-Based Milk Payment System (QBMPS) project piloted by Happy Cow Ltd, Nakuru, funded by the Embassy of the Kingdom of the Netherlands with support of the SNV Kenya Market-led Dairy Programme (KMDP). As a pilot, the QBMPS project was designed to demonstrate the potential for QBMPS in a complex smallholder supply chain in the Kenyan dairy sector, where pricing is based on volume and which has been characterized as lacking a level playing field. This is mainly in relation to the co-existence of a dominant informal market with a smaller formal market that is pushing to grow but mostly operates below capacity. After 3.5 years of implementing the pilot, the partner organizations would like to get an independent assessment of the successes and failures of the project – and the underlying reasons for them – and its scalability.

The report is divided into two main parts. Section 1 describes the context of the Kenyan dairy sector and comprehensively documents the rationale, design and implementation framework of the QBMPS pilot project. The authors are grateful to SNV-KMDP and Happy Cow staff for valuable and major input in this section. Section 2 provides a multidimensional assessment of the results and outcomes of the project. It provides an in-depth review of the lessons learned in implementing the systems: what worked well and what did not. The methodology used – building on and adapting the PPPLab Scaling Scan framework – is elaborated on in section 2.1, after which each "ingredient" in the assessment is discussed separately. The report concludes with lessons learned and recommendations.

1 Project background

1.1 Kenyan dairy sector profile

Kenya is the leading milk producer in East Africa. Dairy is the largest agricultural subsector in Kenya in terms of income and employment creation. It contributes 4% to overall GDP and 14% to agricultural GDP. The high-potential dairy areas are concentrated in Kenya's highlands (> 1,400 m elevation), which have a very conducive climate for dairy cows. The main milk-producing areas are the North Rift region (i.e. Uasin Gishu, Trans Nzoia, Nandi and Bomet counties), Nakuru and Nyandarua counties, Kiambu and Murang'a counties and the Mount Kenya belt running from Nyeri via Embu to the higher parts of Tharaka Nithi and Meru counties.

Currently the sector provides income and employment to over 1.5 million households across the dairy value chain: farmers and their families, transporters, traders and vendors, employees of dairy societies, milk processors, input and service providers, retailers and distributors (Box 1.1). In terms of food and nutrition security, milk is consumed by almost all Kenyans on a daily basis, with an average annual per capita consumption estimated at 100–120 litres[1] milk equivalent (MoALF 2013).

Kenya's dairy industry is driven by the private sector, which took over after the collapse of Kenya Cooperative Creameries (KCC) and the cutback of government services and input supply systems in the 1990s. The latter was caused by the SAP of the IMF and World Bank. From 2000 onwards, the sector started showing impressive growth figures again. According to the Kenya Dairy Board (KDB), total milk production from all livestock amounted to 5.3 billion litres in 2016, up from 4.9 billion litres in 2011 (KDB 2018). The World Dairy Situation report (IDF 2016) estimated that 3.9 billion litres of milk in Kenya was from cows. Smallholder dairy farming households, of which there are an estimated 1.8 million, produce around 80% of this (MoALF 2010a). However, knowing that most rural households keep a cow for home consumption of raw milk, this number may be an overestimation; fewer smallholders may actually have commercialized dairies and see it as a core business.

Box 1.1 *Key figures on demography and the dairy sector in Kenya.*

Land size	: 580,367 km^2 (14 x Netherlands)
Population	: 2000: 31 million; 2015: 46 million; 2050: 85 million
Distribution	: 80% of population on 20% of land space
Urbanization	: 4.3% annually; 2015: 27% in urban centres; 2050: 50%
Nairobi	: 2015: 3.5 million inhabitants
Middle class	: 2014: 8% lower middle class and middle class; 2030: 18%
Dairy pockets	: Kenyan highlands (> 1,400 m elevation), good temp., soils and rainfall
Milk production	: 2014: 3.9 billion litres cow milk/year (IDF 2016)
Consumption	: 110–120 litres per capita per year
No. of smallholders	: Est. 1 million smallholders with 3–5 dairy cows (cross/purebreds) [2]
No. of MSFs/LSFs	: Est. 2,000–4,000 farms with > 25 cows
No. of dairy cows	: 3.8 million purebreds and crossbreds (2014)
No. of dairy coops	: > 200 (collection, bulking, marketing, inputs and services)
No. of processors	: 28
Big five	: Brookside, New KCC, Githunguri, Sameer Daima, Meru Central Dairy Farmers Union, (85%)
Milk processed	: 2001: 152 million litres; 2016: 625 million litres
Milk marketed	: 55% of total production; approximately 70% as raw milk and 30% processed

(Source: Blonk et al. 2017)

[1] We follow sources on the use of litres and kilograms of milk. These are used interchangeably. We have refrained from harmonizing them, as this may lead to loss of precision,

[2] Variations between statistics quoted on the number of households and farmers involved in dairy farming in Kenya are hard to reconcile. Lack of reliable and current data remains a key limitation in the sector. We relied on various sources for the numbers in this summary table (Blonk et al. 2017; KCDMS, 2018; KDB, 2018; Makoni et al., 2015; Rademaker et al., 2016; USAID-KAVES, 2015), but it is beyond the scope of this report to resolve this longstanding issue.

Depending on size of landholdings, different feeding systems are present: free grazing, semi zero-grazing (with improved pastures) and zero-grazing. Soils and climate are very suitable for production of quality (preserved) fodders and for pastures. However, success depends on available skills, knowledge and technology, which are very limited. Hence, the fodder subsector is underdeveloped, in spite of huge sales volumes of (low quality) hay.

As Box 1.2 points out, the dairy sector is dynamic, with high growth figures of marketed milk. Farmers, dairy societies and processors invest in raw milk production, collection and cold chain and in processing of pasteurized milk, long-life products (extended shelf life and ultra-high heat treatment), yoghurts, cheese, butter and milk powder. Anecdotal evidence suggests that average raw milk prices paid to farmers by cooperatives and processors have increased from Kenyan shilling (KES) 28 to KES 38 per kg over the past 7-8 years. However, there is significant fluctuation in price depending on the season (dry or wet) and on the distance to urban centres and processing sites. Farmers and dairy cooperatives selling to traders operating in the raw milk market (or directly to consumers) realize a higher price per kg of milk. This can reach KES 60 per kg in milk-deficit areas.

The smallholder profile of the sector poses great challenges to the industry in terms of skills development, cost of production, collection and chilling, ability and willingness to invest in enhanced dairy production, seasonal fluctuations in supply, and milk quality. There is, however, a fast-growing segment of entrepreneurial smallholders, medium- and large-scale farmers (MSFs and LSFs) who invest in modern commercial dairy production. While it is estimated that 2,000–4,000 dairy farms have more than 20–25 cows, reliable data on numbers of medium- and large-scale dairy farms (including a clear definition of an MSF and LSF in terms of herd size, milk production or land area) are lacking.

Box 1.2 *Strengths and weaknesses of the Kenyan dairy sector*

Key strengths:

- Robust private sector-driven processing industry and investments and growing interest by international players (Danone, FrieslandCampina, Nestle)
- Nationwide availability and high variety of dairy products for all consumer groups
- Ongoing investments in value added products, including long-life milk and milk powder
- Growing demand for processed milk and milk products due to a growing urban middle class and an emerging dairy export sector
- 365 days/year milk collection by traders, dairy societies and processors in all high-potential dairy production areas from hundreds of thousands of smallholders
- Emerging segment of commercial dairy farmers with ability to invest and innovate
- Wide distribution network and good access to commercial input and service providers
- Conducive fiscal policies and status of key economic sector at the macro level
- Available dairy genetic base that can be improved with proper breeding policies

Key weaknesses:

- Low level of skills and knowledge of almost all farmers (small, medium and large scale)
- Low level of commercialization by smallholders (dairy is not the core business)
- High cost and seasonality of raw milk production due to low ability/skills to produce and preserve quality fodder
- Inefficient and high cost of milk collection
- Substandard milk handling and cold chain resulting in poor milk quality and food safety
- Lack of loyalty between value chain actors and high fragmentation
- Lack of credibility of input suppliers and services providers ("pushing products")
- Large raw milk market and lack of level playing field for the formal sector
- Oligopolistic nature of the processing industry (Brookside acquiring other brands)
- Lack of common vision to steer the dairy industry into a sustainable growth path
- Ineffective sector regulation: policies are not enforced on the ground

(Source: Blonk et al. 2017)

Kenya currently has close to 30 active milk processors (this excludes mini dairies with batch pasteurizers and cottage industry yoghurt production) of which the largest are Brookside, New KCC, Githunguri, Sameer Daima and Meru Central Dairy Cooperative Union Ltd, which together process around 85% of the 1.7 million kg of milk that was processed daily in 2015. The market leaders are Brookside and New KCC.

The market for processed milk and dairy products has seen steady growth in recent years. Annual milk intake by processors grew from 152 million kg in 2001, to 406 million kg in 2009, to

615 million kg in 2015 (KDB 2018). Still, an estimated 60–70% of all marketed milk is sold through the informal sector as raw milk. This lack of level playing field for the formal market is an impediment to its growth. A recent development is the emergence of milk dispensing machines (milk ATMs) in urban centres, which are mostly operated by traders and shopkeepers who may pasteurize the milk for a fee per litre through a processor with over-capacity in the factory. The KDB has licensed over 600 milk ATMs, but control on the quality of milk dispensed through these units is insufficient.

The industry's growth and competitiveness are constrained by low productivity at farm level, seasonality in milk production, milk quality issues, a huge knowledge and skills gap and lack of inclusiveness in the dairy value chain. The prognosis in the dairy master plan (MoALF 2010a, 2010b) shows that, under the current production systems and low productivity levels, demand for milk and dairy products will outstrip (local) supply by 2030. A more recent study (USAID-KAVES, 2015) further confirms that if a "business as usual" scenario is maintained regarding the aforementioned issues, demand will outstrip domestic milk supply (estimated at 4,8 billion litres in 2012) by 1.28 billion litres much sooner, i.e. by the year 2022.

Population growth, a growing middle class and urbanization are important drivers for growth in demand and consumption of milk and dairy products. The population rose from 31 million people in 2000 to 46 million in 2015 and is expected to grow to 85 million in 2050. The urbanization rate is 4.3% per year, which means that the proportion of the population living in urban areas will rise from 27% in 2015 to 50% in 2050. The middle class is expected to grow from 8% of households in 2014 to 18% in 2030 (Moody's 2016).

1.2 General outlook and status of milk quality in Kenya

Milk is an important part of the diet in Kenya and contributes to improved nutrition outcomes. Kenya has the highest milk consumption in sub-Saharan Africa at an average of 115 litres per capita annually. This is projected to almost double to 220 litres per capita by 2030, linked to a 5.8% annual growth (MoALF 2010a, 2010b). An estimated 55% of the milk produced in Kenya is marketed. The country is experiencing a growing demand for milk and dairy products driven by expanding urbanization, a rising middle class and changing dietary patterns. Therefore, while increased consumption may improve nutritional outcomes, poor milk safety threatens the health of consumers.

Assuring the quality and safety of milk and dairy products has been a persistent issue in the Kenyan dairy sector. This is linked to processors and traders neglecting attention to quality as they compete for milk volumes (among themselves and with traders who sell raw milk). The bulk of the marketed milk (about 88%) is sold as chilled or unchilled raw fresh milk directly to consumers through what are characterized as informal and semi-formal market channels. These channels are characterized by non-compliance with the regulated safety and quality standards and collection of statutory revenues (taxes, cess, levies, VAT; Makoni et al. 2014, Rademaker et al. 2016). Some actors even contend that the policies and regulations related to milk safety are repressive to the informal sector, despite the latter's important contribution to livelihoods and nutrition security in Kenya.

Various studies have shown that the dairy sector broadly faces challenges of low levels of compliance with national, regional and international standards related to quality and safety standards. This relates to microbial load and adulteration, pointing to malpractices such as poor handling (Omore et al. 2005; Foreman and De Leeuw 2013). More recently, other studies have also pointed to other safety concerns including high bacterial load, prevalence of antibiotic residue, unsafe aflatoxin content and unacceptable somatic cell count. Low levels of compliance affect both raw and pasteurized milk, including in the emerging retail innovations of milk ATMs (Bebe et al. 2018; Kosgey et al. 2018; Kashongwe et al. 2017; Langat et al. 2016; Ndungu et al. 2016a, 2016b).

The challenges of quality and safety of marketed milk persist despite efforts in intensive training and awareness creation implemented over the years. Quality and safety of milk has implications for competitive growth of the dairy industry and should concern all actors in the dairy value chain. While there has been growth in domestic demand for milk and dairy products, and there is growing potential for expanding into regional and international markets, the growth is stifled by prevalence of non-compliance to quality standards (Bebe et al., 2018). While only a tiny fraction of Kenya's milk production is exported, in recent years a number of trade conflicts have arisen

when regional importing countries rejected products processed in Kenya on the grounds that Kenya's raw milk production was of insufficient quality (Foreman and De Leeuw 2013).

Dairy industry actors are now paying more attention to milk quality and the safety of dairy products in Kenya. A recent study (Ndambi et al. 2018) shows the enormous costs and potential benefits to society of improving milk quality and safety. From a public good perspective, better quality milk can reduce the burden of health-care costs of treating milk-related illnesses. Poor milk quality also affects the bottom line of private investors, including processors and food companies, due to its effect on product yields and taste and longer shelf life, which affects profit margins and (local and export) market access.

There is now more interest in integrating a QBMPS as one of the options to reorient the sector from being volume-driven towards being quality-focused. This is also informed by the threat the industry is facing from regional and international markets (Woolfrey and Bilal 2017).

1.3 Policy and regulatory framework for milk quality

This section provides a broad overview of the dairy sector policy and regulatory landscape, reflecting on how these have a bearing on ensuring safety and quality issues in the sector. It draws on a recent report of the USAID KCDMS project (RTI International 2018).

The policies of the Government of Kenya and its priorities with regard to economic development, agriculture and food security are framed in a number of documents, of which Vision 2030 brings together Kenya's overall macroeconomic strategies and ambitions. The documents described below derive their direction from Vision 2030. The government acknowledges that the dairy sector is a key agricultural subsector, is led by the private sector and needs to transition to a higher level of competitiveness for sustained growth. The ambition is to increase both local production and consumption of milk and dairy products and to realize a significant increase in exports.

The government's support of the dairy industry focuses on conducive fiscal policies (e.g. zero-rating of imported dairy equipment and loose processed milk) and protective measures through the imposition of a 60% duty on imported milk and dairy products. In the end, this may not lead to a competitive sector and long-term sustainability. Government involvement and investment in dairy extension and training and in-service provision have been reduced to a bare minimum since the SAP of the World Bank in the 1990s. With the liberalization of the industry, the private sector has only gradually been filling this gap.

1.3.1 The policy landscape

The Kenya National Dairy Master Plan 2010–2030 (MoALF 2010a, 2010b) is the overarching policy framework underpinning the development and transformation of the dairy sector. The overall goal of the policy is to improve the livelihoods of actors in the Kenyan dairy industry sector in line with Vision 2030. The specific objectives are improving the productivity and competitiveness of Kenya's dairy and dairy products, positively contributing to the livelihoods of milk-producing households, increasing domestic consumption of milk and milk products, contributing to national food security, transforming the industry into an exporter of dairy animals and products, maximizing dairy exports in regional and global markets, and re-orienting milk processing towards long-life dairy products.

Key among the challenges identified in the policy is compliance with milk quality and safety standards. Specific concerns raised in the policy include hygiene and residues of veterinary drugs. The policy recommends strengthening of the regulatory framework in testing and enforcement and implementation of quality assurance programmes by the private sector.

Sessional Paper No. 2 of 2008 on National Livestock Policy (MoLD 2008) was formulated to address the challenges and shortcomings arising from liberalization in the 1990s and align the sector with Vision 2030. It covered the broader livestock subsectors, including dairy, and issues related to animal genetic resource, livestock nutrition, feeds, inputs, animal diseases and pests, marketing, safety and quality, among others.

The National Veterinary Policy 2015 (MoALF 2015) provides a definite road map for the development of animal resources in Kenya. It addresses animal health, production, welfare, food safety, control of zoonotic diseases, and trade, among other concerns. It directs that the national government regulate food safety while county governments oversee the enforcement of laws

governing food safety. This assessment has shown, however, that the linkage between the State Department of Veterinary Services and the county veterinary offices is weak and the policy is not being implemented.

1.3.2 The regulatory landscape

Milk safety and animal feed safety is principally governed by the **Dairy Industry Act (Cap. 336)** and the **Public Health Act (Cap. 242**). Several other laws and regulations affect dairy, including the **Animal Diseases Act (Cap. 364)**, the **Fertilizer and Animal Feedstuffs Act (Cap. 345)** and the **Standards Act (Cap. 496).** Compliance with these requirements has remained a challenge, thus constraining milk marketing and dairy development.

To address these regulatory gaps, the Kenya Dairy Board (KDB) is currently developing the **Kenya Dairy Industry Regulations**, which are to replace the Dairy Industry Act (Cap. 336), revised edition 2012 [1984]. In 2015 the State Department for Livestock appointed a task force to review the Dairy Regulation and to align it with the new Constitution of Kenya (2010) and the current state of the industry. The draft of the proposed new regulations was shared with stakeholders in 2017. These regulations included sections on a) devolved governance through the counties; b) scenarios for regulation impact assessment, with preference for the option of cost–benefit analysis of enhanced regulations, as opposed to status quo and self-regulation; and c) introduction of quality-based milk payment, to move away from payment being based on volume in order to improve raw milk quality. However, recent developments in the process of finalizing these regulations (Box 1.3) indicate the challenges KDB faces in formulating regulations that reflect the realities of the sector and also point to the limited capacity in terms of the requisite personnel.

Box 1.3 *Update on revising the draft Dairy Regulations 2019.*

On 11 March 2019 KDB convened a stakeholder forum to allow for public participation in revising the draft Dairy Regulations. The major emphasis of the consultation was on milk hygiene and food safety. After a barrage of public and media criticism, KDB withdrew these regulations on 25 March 2019 and consequently allowed for further inclusive consultation and public participation.
Major perceived problems with this process include: a) poor communication of the proposed Regulations; b) unrealistic fees for licensing and severe punitive actions for "non-conforming stakeholders", be they farmers, "informal sector", transporters, processors or distributors; c) too much too soon – the proposed Regulations appear to move the sector from being severely under-regulated to being almost over-regulated. For example, the draft Regulations proposed that farmers will not anymore be allowed to sell milk to their neighbours; this would deny smallholder farmers a logical and decent source of income.

The ensuing public and media debate highlighted two key challenges for the Kenyan dairy sector: a) It is difficult for farmers to lower their costs of production to compete with prices prevailing in the EAC or world market; b) There is a lack of viable service delivery options such as extension, AI, animal health and feed quality assurance following the disappearance of public services after the introduction of the SAP. These two factors have left many farmers without the necessary support to enhance production. The proposed Regulations are silent on these critical issues.

The **Fertilizers and Animal Foodstuffs Act No. 20 of 2015 (Cap. 345)** was enacted to regulate the importation, manufacture and sale of agricultural fertilizers and animal foodstuffs, as well as substances of animal origin intended for the manufacture of such fertilizers and foodstuffs.

The **Consumer Protection Act of 2012** came into force on 14 March 2013 and covers a number of items: it provides for punishment of businesses that for example, knowingly sell substandard goods and lie about how beneficial the price is to the consumer. The Act also prohibits the use of misleading information to sell goods and services. With respect to issues of quality and market malpractices, this Act is particularly relevant to milk and milk products marketing.

1.3.3 Standards: Milk and dairy products

Cap. 496 requires that milk and animal feedstuffs quality and health standards comply with EAC product specifications. The number of standards for milk and dairy products, animal feeds, ingredients

Table 1 *Summary of milk and dairy product standards in Kenya.*

Standard/ Parameter	TPC/TBC (per ml)	Somatic cells (per ml)	Antibiotic residues	Pesticides	Coliforms (per ml)
KEBS / KDB/EAC	< 200,000 > 200,000–1,000,000 > 1,000,000–2,000,000	<300,000	Codex Alimentarius Standards	Aldrin and dieldrin (total): 0.006 Heptachlor and heptachlorepoxide (total): 0.006 DDT and its analogues: 0.05 Lindane: 0.01 SHC + HCH : 0.01 Endrin: 0.01	0–1,000 Very good 1,000–50,000 Good

and test methods for specific product parameters can be bewildering, as standards from the Kenya Bureau of Standards (KEBS), the EAC and the international Codex Alimentarius each have their own use. The summary below shows key parameters that KEBS and harmonized EAC standards align on.

1.4 Background to the Quality-Based Milk Payment System pilot project

1.4.1 SNV's Kenya Market-led Dairy Programme and QBMPS

When SNV's Kenya Market-led Dairy Program (see section 1.5.1) started in July 2012, it found there is no harmonized and systematically applied government strategy or sector self-regulation mechanism (e.g. by processors) to enhance milk quality and enforce the dairy industry standards of KEBS. Legislation to curb the raw milk market was (and is) not enforced, but this is a prerequisite for minimizing the possibilities of side-selling by farmers and collection and bulking enterprises (CBEs) that fail – or are not willing – to comply with minimum quality standards (Table 1).

The KDB had been calling upon the sector for some time to self-regulate the industry and to pilot a QBMPS. However, under the current regulatory framework and market dynamics, no processor had yet embarked on this as a tool to enhance milk quality in the smallholder supply chain.

Piloting of a QBMPS by a first mover with smallholder suppliers was considered highly innovative for Kenya and was expected to provide important lessons for the sector at large. As in other dairy economies, this first mover was likely to be a processor that focuses on value added products such as cheese and yoghurt. In Kenya, only Bio Foods Ltd has a system in place that pays a premium on quality parameters. However, at the time (2012–13), Bio Foods sourced only 5,000 litres of milk per day from four large-scale dairy farmers, which was deemed to have limited relevance to systems sourcing from smallholders.

Hence, KMDP decided to enter in this space and, in cooperation with the KDB, commissioned a study in 2013 on the feasibility of piloting and implementing a QBMPS in Kenya, benchmarked against countries with similar smallholder-dominated dairy economies (e.g. in Asia). The report from the study (Foreman and De Leeuw 2013) was presented at a multi-stakeholder workshop organized by SNV and KDB on 6 August 2013.

In the following months, KMDP received requests from four processors to advise upon a road map and to assess in more depth the feasibility, required investments and costs of piloting a QBMPS within their milk catchments. This resulted in recommendations to each processor. The scope of the recommended pilot was limited to a single collection area with relatively small groups of farmers who either deliver raw milk directly to the processor's bulking point or deliver milk to a dairy society that bulks and chills milk from its members and then sells to the processor. In all the proposed pilots, KMDP advised the processors to start implementing a zero setting for a milk quality tracking and tracing system (MQT&T system) on critical parameters, which would be the first steps towards implementing a QBMPS. HC was the only processor that followed up with the zero-setting assessment (Ndungu 2015).

1.4.2 Application from Happy Cow Ltd

As a follow-up to the studies referred to above, in September 2014 KMDP received an application from Happy Cow Ltd in Nakuru (HC) to support implementation of a QBMPS, through KMDP's Innovation Fund. The application involved a large number of steps and investments in the milk collection chain, of which the first was to design and implement an MQT&T system as the basis of the QBMPS. In addition,

investments were proposed in laboratories, milk-testing equipment, cold chain and other basic infrastructure in the HC milk collection chain.

With this proposal, HC would be the first processor in Kenya to pilot introduction of a payment system for a smallholder supply chain that would be based on quality grades (or "bands") of milk. Hence, KMDP decided to support the introduction of a QBMPS as suggested and desired by HC. The HC project had two phases:

- Phase 1: November 2014 – December 2016; total budget €459,000 (KMDP grant: €311,000; own contribution from HC/CBEs: €148,000)
- Phase 2: January 2017 – February 2019; total budget €282,540 (KMDP grant: €128,650; own contribution from HC/CBEs: €153,890).

1.5 Project partners

1.5.1 SNV Netherlands Development Organisation

SNV is an international not-for-profit development organization founded in the Netherlands in 1965. It provides capacity development services to nearly 2,500 organizations in 36 countries worldwide. SNV helps to alleviate poverty, to spur inclusive development in agricultural value chains and to improve access to basic services, including water and sanitation and renewable energy. In East and Southern Africa, SNV implements dairy programmes in Ethiopia, Kenya, Tanzania, Uganda, Zambia and Zimbabwe. In Kenya, SNV was incorporated in 1966 and currently runs programmes in dairy, horticulture, climate-smart agriculture, water, sanitation and renewable energy, with a portfolio of €60 million worth of projects in 2018.

1.5.2 SNV's Kenya Market-led Dairy Programme

SNV implements the KMDP, which is funded by the Embassy of the Kingdom of the Netherlands in Nairobi. KMDP (Phases I and II) runs from July 2012 to July 2019 with a combined budget of €9.5 million. KMDP works across the dairy value chain with smallholder dairy entrepreneurs; MSFs and LSFs; dairy cooperatives and farmer organizations; milk processor input suppliers and service providers, including for dairy training and advisory; industry associations; and policy and regulatory bodies (notably the Kenya Dairy Processors Association, the KDB and the Ministry of Agriculture, Livestock, Fisheries and Irrigation). See Appendix 1 for more detail on KMDP activities.

Figure 1 *Happy Cow's main products are various types of cheese and yoghurt (photos HC)*

1.5.3 Happy Cow and CBE partners

HC is a milk processor from Nakuru that started operations in 1996. HC produces cheeses and fermented dairy products such as yoghurts and mala. The company has 125 staff and sells its products all over Kenya through the main retail outlets; some of its products are also exported and sold within the EAC. Its daily raw milk intake is about 15,000 litres, which is sourced from (among others) Olenguruone Dairy Farmers Cooperative Society (Olenguruone for short) and New Ngorika Milk Producers Ltd (a public company by shareholding; New Ngorika, for short). Both are dairy societies that collect and bulk milk from smallholders; that is, they are CBEs.

1.6 Project design overview

The proposal for a pilot project, or "proof of concept", to track and trace milk quality and to develop and implement a payment system based on quality of raw milk delivered to HC was initiated by the project partners HC and its CBEs Olenguruone and New Ngorika. HC and the CBEs were supported through the network and the financial support of SNV-KMDP with an international consultant from the Netherlands to develop the project proposal (Dirk Harting of The Friesian Agri Consultancy, now called Bles Dairies Consultancy). Harting had previously developed and implemented a similar project in Vietnam for a large international dairy processor sourcing milk from smallholders.

The project design concerned the introduction of an MQT&T system and a QBMPS, the two being closely connected and supported by a large number of interventions and investments in the raw milk collection chain, from farmer to factory. The project (Phase 1 and Phase 2) covers a period of a little more than four years (2014–2019). The project proposals for these two phases contain detailed information about the organization, systems, management, roles and functionalities of the project and the project partners. This section presents a summary of the project design.

At the start of the project (November 2014), New Ngorika had 600 members, of whom the active suppliers delivered approximately 3,500 litres of milk daily; while Olenguruone had 2,000 members, of whom the active suppliers delivered 7,000 litres of milk daily. Each CBE collected milk from different routes in their catchment area from the farm gate, where transporters were responsible for milk grading. Basic infrastructure and practices for hygienic milk collection and handling were lacking; for example, use of non-food grade plastic containers to deliver unstrained milk, no separation of morning and evening milk, dysfunctional cold chain, lack of clean water. Apart from supplying HC, the two CBEs also delivered milk to other processors, a situation not uncommon in Kenya among the smallholder-owned dairy societies.

Historical data from HC suggested major challenges in total bacterial count (TBC), coliform count, milk adulteration (with water and preservatives) and antibiotics residues, significantly above KEBS standards. This was confirmed during the zero setting at the start of the project. Apart from the inability to comply with the industry standards, this caused major challenges for HC's production of cheeses and fermented products (yoghurts, mala), leading to poor fermentation that caused product spoilage, low product yield and shortened product shelf life.

1.6.1 Raw milk–testing regime

The only quality analysis carried out by the CBEs before the start of the project were acceptance tests, including organoleptic, alcohol and density tests. This testing was done at the point of the farmer handing over raw milk to the transporter (or to the CBE's platform). The tests by transporters were carried out at the farm gate. Milk payment to farmers was based on volume only.

This testing expanded in the project, so that milk accepted by the CBEs was tested on a number of parameters, mostly related to food safety and composition. Some of these tests were already performed at HC's main lab in Nakuru (e.g. antibiotics tests, freshness), but for all tests more accurate testing equipment was purchased. A comprehensive milk sampling and testing regime was put in place for getting a better insight into the quality of the milk in the raw milk supply chain and for introducing a milk bonus payment system. Table 2 gives a detailed overview of the testing regime developed during implementation of the project. For this purpose, the (main) HC laboratory in Nakuru was expanded, and mini-labs were built and equipped at the two CBEs.

This MQT&T system analyses a number of parameters at different points in the milk collection chain and at different frequencies as depicted in Table 2. Analysing milk for each parameter and each individual supplier at every delivery is not financially sustainable due to the large costs involved. Hence, farmers' milk quality is controlled per group of farmers instead and tested periodically, thereby significantly reducing the number of samples and tests needed.

In the project, the collection of milk is organized through milk collection points (MCPs), which are simple sheds in the milk collection routes. Nearby farmers deliver their milk once a day to the MCP, where in fixed groups of five or six they deposit the milk into the same 50-l milk can with a unique number/code. One farmer delivering milk to the MCP is appointed as Prefect to carry out the acceptance test and to hand over the milk to the transporter.

Further to the summary in Table 2, a more detailed description of the MQT&T system is provided in Bles Dairies East Africa and SNV-KMDP (2019), including the costs and type of testing equipment purchased and costs per sample (consumables).

Table 2 *Raw milk–testing and sampling regime (MQT&T system) as planned by the project.*

#	Parameter	Milk sample point	Frequency	Point of analysis	Tests	Testing equipment / consumables
			2015–2018			
a	Acceptance test: - Freshness - Coagulate - Adulteration	HC platform CBE platform MCP (route)	Each milk delivery	HC platform CBE platform MCP (route)	- Organoleptic test - Alcohol test - Density test	- Human sensing - Salut tester - Density meter
b	Freshness (Titratable acidity)	HC CBE / MCP	Each milk delivery	HC main lab CBE mini-lab	Acidity test	Auto burette / pipette (NaOH)
c	Freshness (pH)	HC CBE / MCP	Each milk delivery	HC main lab CBE mini-lab	pH test	pH meter
d	Total plate count coliform and *E. coli* count (cfu/ml)	HC CBE / MCP	2/month*	HC main lab	Microbacterial test	Various lab equipment (3M Petrifilm)
e	Antibiotics residues	HC CBE / MCP	2/month* Each delivery	HC main lab CBE mini-lab	Test kit Yoghurt test	Ampuls/incubator (Delvo test) Yoghurt/incubator
f	Total solids (Fat/Protein/ Lactose)	HC CBE / MCP	2/month*	HC main lab	Composition test	LactoScope
g	Adulteration (water, preservatives)	HC CBE / MCP	2/month*	HC main lab	Freezing point	(a) LactoScope (calculated FP) (b) Cryostar (calibrated FP)
			From 2018 onward			
h	Aflatoxins	HC CBE / MCP	At random	HC main lab CBE mini-lab	M1 rapid test	Strip kit
i	Somatic cells	HC CBE / MCP	At random	HC main lab CBE mini-lab	Cell count	Cell counter DeLaval Eko scanner

* = Tests d, e, f and g are carried out twice per payment period (payment is made once per month).

1.6.2 Quality-based milk payment system

To store and analyse the data generated in the main laboratory at HC Nakuru and the mini-labs at the CBEs and to use them for the QBMPS, a tailor-made computer software program was developed. This software integrated three Excel sheets derived from the results of the milk testing to develop quality reports shared with the CBEs. The CBEs also implemented some changes in their initial software to accommodate the quality-based reports and enhance faster/automatic bonus allocation to the qualified farmers. Bonus payments are made monthly.

The bonus system was designed to capture parameters d–g in Table 2. However, HC and the CBEs developed their own standard for each parameter, which were more lenient than the KEBS industry standards, but considered more realistic and attainable by smallholder farmers and the dairy societies. The bonus system was tied to the "milk can level", that is, the small groups of five or six farmers. To determine the bonus payment, the milk cans are sampled at the CBE platform.

The scores in Table 3 are then used to determine if a certain milk can would qualify for bonus payment or penalty, and how much. The penalty was set at zero so as not to discourage and upset the payment system that had been in place at the start of project. The payment system is shown in Table 4 below.

Following the project design, the bonuses are paid by HC through the CBE. For New Ngorika, it is paid to the farmers who had delivered milk in a certain can. For Olenguruone, the bonus is shared between the farmers (80%) and the transporters (20%). The base milk price paid by HC (before the bonus) varies; it is similar to the prices paid by other processors collecting milk from the CBEs, but is usually KES 1–2 higher.

Table 3 *QBMPS and KEBS standards.*

Parameter	Grade	QBMPS standard [a]	KEBS standards	Premium / penalty score [b]
Total plate count (units in cfu/ml)	**A**	0–2,000,000	< 200,000	50
	B	2,000,001–10,000,000	200,000–1,000,000	0
	C	> 10,000,001	> 2,000,000	-50
Antibiotic residues	All	Negative	Negative	15 [c]
Adulteration (freezing point)	All	-0.500	-0.525 to -0.565	20 [d]
Total solids	All	> 11.75%	> 11.75%	15 [d]

[a] Developed by HC
[b] Premium or penalty score given to milk of the corresponding QBMPS standard (column 3)
[c] Antibiotic-positive milk is discarded
[d] Failure to meet standard results in a 0 score for this parameter.

Table 4 *Bonus payment module employed.*

Grade	Total score [a]	Payment	Amount per litre (KES)
A	70–100	Premium	+2
B	40–69	Standard	+1
C	<40	Penalty	0

[a] Calculated by summing the scores from Table 3

1.6.3 Interventions and investments in the raw milk collection chain

To be able to implement the systems described above, a number of interventions and investments were required. These can be summarized as follows:

(a) Reorganization of milk collection and milk sampling:

- training of farmers on clean milking
- sensitization of the CBEs to collect milk twice a day in order to assure/promote separation of morning and evening milk
- establishment of MCPs (sheds) on the milk collection routes that are walking distance from the farmers (> 30 for each CBE)
- appointing and training of prefects (farmers) to grade milk for their peers at the MCPs
- forming of farmer groups around 50-litre aluminium can(s) with a unique code (to instil can attachment and ownership)
- training of milk collectors and milk reception staff on hygienic milk handling
- appointing and training MCCs (overseeing milk collection, sampling and testing on the milk collection routes)
- training of lab technicians at the CBEs and at HC
- promotion of faster milk collection
- proposal of a clocking system to monitor milk transportation systems and collect milk within a set time frame (although it was not embraced by the CBEs).

(b) Setting up and equipping of laboratories:

- milk-testing equipment, fridge, desks, computer and consumables for raw milk–testing at the CBEs and at the main HC laboratory
- development of a software system for data processing and analysis
- management of the laboratories – both the CBE mini-labs and the main lab – by lab technicians employed by HC
- milk testing at the mini-labs includes acceptance testing, testing on freshness and testing on the presence of antibiotic residues (yoghurt test), with random testing of aflatoxin and somatic cell count added in 2018
- bulk milk–testing at the main lab at HC, carried out on bulk milk received from the CBEs: total plate count, antibiotic residues, composition and freezing point tests for total solids, adulteration and freshness, with testing for aflatoxins and somatic cells since 2018 (see Table 2 above)
- accreditation under the Kenya Accreditation Service (KENAS) in December 2018 for the main laboratory at HC in Nakuru, after participating in proficiency tests organized by KEBS in Kenya and Qlip in the Netherlands and a pre-audit in September 2018.

Figure 2 *HC's suppliers mostly are smallholder CBE members*

(c) Hardware investments that were planned and made in the milk collection chain from farm-to-factory concerned:

- construction and equipping of three laboratories (see above)
- erection of MCPs equipped with milk grading and weighing tools
- purchase of aluminium milk cans (9, 20 and 50 litres) or MazziCans to replace the plastic non-food grade containers used
- motorbikes for the MCCs and milk racks to use on the motorbikes to collect milk
- improvements in milk reception and can-washing facilities at the CBE milk reception platforms
- improved access to potable water
- installation of milk coolers and pre-cooling units or ice banks to assure fast cooling of milk
- separation of HC "project milk" and milk delivered to other suppliers, including installation of calibrated weighing equipment
- purchase of a milk tanker and a project vehicle (HC).

(d) Project management and organization:

- employment of a project manager and two lab technicians at the satellite laboratories (by HC)
- appointment of prefects to operate the MCPs and employment of a MCC to oversee milk collection and sampling
- appointment of one complementary HC extension staff member for sensitizing and training the farmers and transporters on the new systems (in addition, KMDP deployed one extension staff member to support farmers on good dairy management and forage preservation practices to increase milk production)
- formation of an MQT&T project team that would include all new functions created plus the Manager of the CBEs, who would report to the Board. For these new functions – on a case-by-case basis – job descriptions and work instructions were developed
- development of a project manual encompassing all the job description information, processes, systems, workflows, functions, standard operating procedures and work instructions of the project, which was to be used for management and training
- development of a sensitization and training programme for the various actors in the milk production, collection and processing chain, which provided for clear reporting and communication structures between the project partners and with KMDP.
- provision of a budget for "technical backstopping" by local and international experts if external advice was needed during implementation.

(e) Project budget and oversight SNV-KMDP:

- acknowledgement that SNV-KMDP is not implementing the project; rather, it monitors progress of the project for due implementation of the project proposal (and where required adjustment of the design), the quality of interventions, the deliverables, the timelines and financial management
- understanding that the project budget is €740,000, of which it is expected that by the end of the project the project partners will have used €700,000, €425,000 of which will have been contributed by KMDP and €275,000 contributed by the project partners.

2 Assessment of Happy Cow's project investments and interventions

2.1 Multidimensional analytical framework to assess the pilot project

To assess this complex project, we developed an analytical framework that adapted the Scaling Scan framework developed by the PPPLab (https://ppplab.org/2017/11/3223/). This framework outlines 10 key "ingredients" that are deemed useful for assessing the multidimensional outcomes of innovative interventions in the agricultural sector and for reflecting on the lessons learned and potential for scaling. The 10 scaling ingredients and the specific variables used in the assessment are outlined in Figure 3 (which is an adaptation of the original version). We then used a mixed-method approach to assess the multiple dimensions of the pilot project using various data sources: review of project documents, project partners' primary data, stakeholder interviews and discussions with project stakeholders and SNV-KMDP as fund manager.

The mixed approach enabled us to collect a wide variety of data and conduct a rich analysis of the pilot. However, there were some challenges with the data that we note as a limitation to the study. First, we encountered bottlenecks in the retrieval of data from HC databases (described later in the results) and from the CBEs. At the time of data collection, information from the HC database was not easily accessible and needed an expert to extract and clean. Data quality for some parameters (especially TPC) was poor. At the CBE level, record keeping was inadequate due to limited data management systems and capacities. Some data from the CBEs (e.g. milk intake) did not completely match with HC data. Data did arrive in time though to use the January Milk Quality Seminar organized by 3R Kenya, SNV-KMDP and V4C projects and KDB for dissemination of findings and to collect input for finalization of the report.

Secondly, there were difficulties in separating what was considered "project milk" and "non-project milk" at the point of bulking for dispatch to HC. About 30% of the HC daily intake was collected as project milk and went through the QBMPS. This made it difficult to separate and analyse data that would distinguish between some of the quality test results of project and non-project milk, as some samples were collected after all milk had been bulked. Relatedly, some of the practices in handling milk in the field, such as topping up project cans with non-project milk, compromised the quality of what would have been considered project milk and therefore affected the quality test results. To an extent, these factors therefore limit the validity of some results.

Box 2.1 *Assessment methodology.*

The six-step methodology for the assessment was:

a) expounding the analytical framework, building on the Scaling Scan tool and complementing it with other impact assessment approaches. The analysis was guided by the adapted methodology
b) review of various project documents and data and other information sources, including studies that have been conducted on the QBMPS that provide key insights on the lessons learned
c) a one-day guided workshop with representative actors involved in the various stages of implementation of the QBMPS for a self-assessment process. The workshop was to enable the project owners/partners to collectively assess the different dimensions of the pilot and score what worked well or not
d) in-depth interviews with selected key informants involved in the implementation of the project
e) meetings with relevant actors on next steps in or after the project
f) one-day dissemination workshop for sector stakeholders.

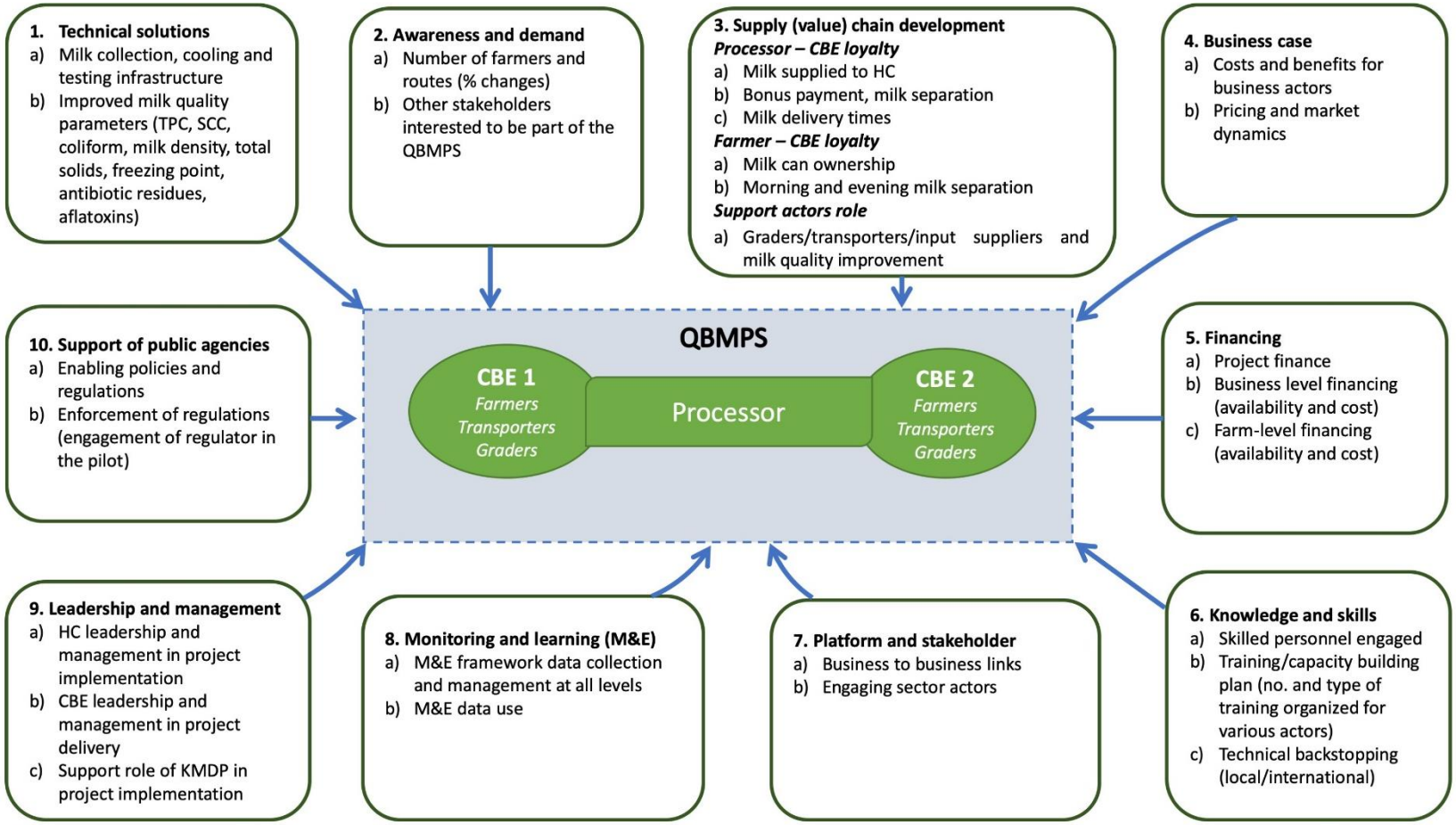

Figure 3 Analytical framework – A multidimensional approach for assessing the QBMPS pilot.

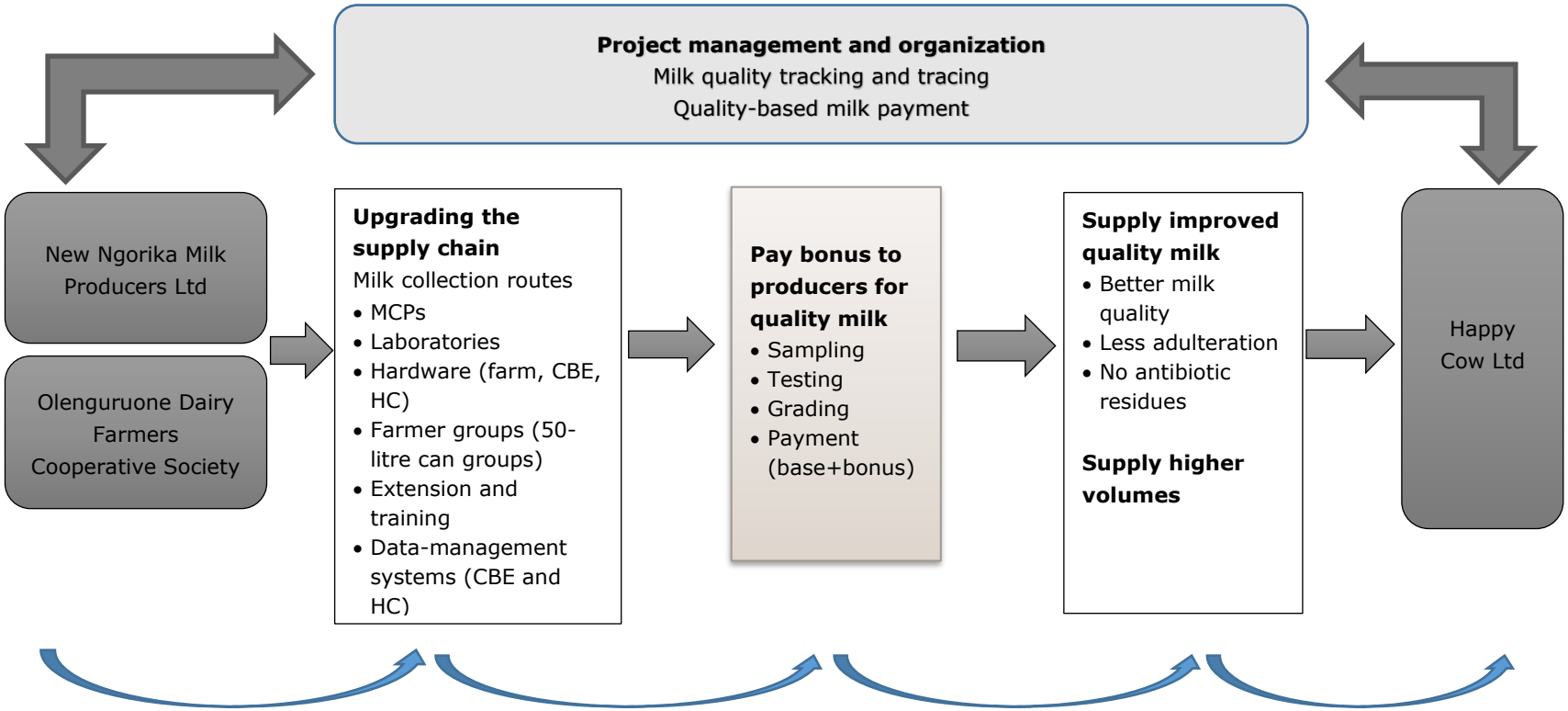

Figure 4 *The business model (theory of business) for the QBMPS.*

The research process provided a logical order for the six steps outlined by the ToR (Appendix 2), which are also listed in Box 2.1.

To kick off the assessment, a workshop was organized in Nakuru involving 32 stakeholders of the HC QBMPS pilot (farmers, CBEs, input providers, project staff and researchers from 3R Kenya). The 3R Kenya researchers who facilitated the workshop administered an adapted version of the Scaling Scan tool to assess perceptions of the project partners on the scaling potential of the QBMPS. The results of the assessment are described in section 2.2.

Participants were briefed on the Scaling Scan approach and discussed all its 10 ingredients in small working groups and then scored them individually on a Likert scale (of 1–5) in terms of their potential for upscaling, 5 indicating the highest potential for upscaling. The participants were asked to individually rate the 10 ingredients in relation to the potential for scaling the QBMPS (see section 2.3 and Figure 22).

2.1.1 Theory of business – intended change pathway

The project was intended to be a proof of concept that would introduce a QBMPS in a smallholder supply chain in the Kenya dairy development context, which is fraught with many challenges. These challenges contribute to low levels of compliance with milk safety and quality standards, be they national, regional or international. Therefore, from the onset the pilot was an ambitious endeavour. This is especially true since the starting point was to incentivize producers and other actors in the supply chain to adhere to basic safety standards in milk handling, in addition to what are considered quality parameters. The QBMPS can be characterized as a sociotechnical innovation that entails a series of change processes, including behavioural, technological and organizational. The developed work plans were intended to consider these change processes so the project could meet its targets.

Figure 4 summarizes the thinking behind the project:

- Happy Cow (HC) implements the project in close collaboration with its two supplying CBEs.
- HC's supply chain is upgraded, starting from routes in which "project milk" is being collected; MCPs are constructed; laboratories at the CBEs and HC are upgraded; farmer "can groups" are formed; a range of hardware investments are made; collection and milk-handling routines are adjusted; farmers, CBE staff, transporters and graders are trained; and farm advice is conducted.
- To first track and trace the quality of milk and then pay for milk based on quality, milk sampling is organized at reception by transporters in the routes, at CBE platform and at HC platform level; testing is organized as per a predetermined milk sampling and testing regime; a bonus payment system is developed based on the scores of milk tested for a set of parameters; payment is made by HC to CBEs and by CBE to farmers.
- The intended result of the changes is that the quality of milk supplied to HC is improved and that volumes increase.

The next section enumerates the various project investments, interventions and achievements and reflects on the success factors, challenges, shortcomings and preconditions required for scalability. It examines the project design in relation to, among other things, the local settings; internal organization and management; dynamics of project partners; economic, social and cultural factors; and the enabling environment. Where possible, the assessment distinguishes between project outcomes at farm, collection, CBE and processor levels.

2.2 Project outcomes on 10 dimensions: successes and shortcomings

This section presents an in-depth analysis of the project outcomes and limitations to date, using the dimensions in the 10 scaling ingredients as outlined in the analytical framework (Figure 3).

2.2.1 Technical solutions

Milk quality improvement was the major goal of the QBMPS project. A zero-setting study (Ndungu 2015) established that various quality parameters of the milk supplied to HC by the CBEs were far out of the acceptable ranges and national standards. Funded by the project and HC's own financing, a number of technical and technological investments were undertaken to monitor and improve the milk quality. These are:

1. expanding the laboratory and systems at HC to enhance testing at processor level and seeking accreditation
2. constructing mini-labs at the CBEs and providing the personnel, equipment and consumables for conducting basic acceptance tests and grading at the farm and CBE platform
3. setting up and operating an MQT&T system
4. promoting the use of hygienic milk containers
5. installing improved milk-cooling systems at the CBEs.

Below, we expound the details of the investments and enumerate the achievements of these investments and interventions and the related results in milk quality changes.

2.2.1.1 Upgrading and construction of laboratories and a milk quality tracking and tracing system

Three laboratories were constructed and/or equipped (see Figure 5) and new sampling and testing protocols introduced at HC and CBE level as outlined in the project design (section 1.6). This was a critical part of the MQT&T, which is the basis of the QBMPS. The existing laboratory at HC was upgraded with state-of-the-art equipment (e.g. Delvo scan and incubator, Delta Instruments Lactoscan, DeLaval Somatic Cell Counter, Ekomilk Somatic Cell scanner, 3M reader and Petrifilm, Cryoscope), most of which was sourced internationally. In addition to upgrading the laboratory, the HC team also developed a Hazard Analysis Critical Control Point management system. With these investments in laboratories, milk-testing equipment and training of staff, HC set up an MQT&T system involving a number of parameters and tests to be carried out at established periodic intervals (daily, twice-monthly, monthly). The QBMPS parameters that were analysed at the HC lab included total plate count (TPC, aka TBC, total bacterial count), total solids, freezing point and antibiotic residues and (later) somatic cell count and aflatoxins.

In 2016, mini-labs were constructed at the CBEs to facilitate acceptance tests of the raw milk received at the platform (Figure 5). The CBE laboratories were kitted out with key testing equipment (including a milk analyser, other hardware and consumables) and were to be operated by qualified personnel seconded from HC. Having such a reasonably sophisticated lab at the CBEs was a major step in bringing milk-quality testing closer to the farms. Introducing such testing in a smallholder supply chain was a major milestone for the project. The tests conducted at the mini-labs were organoleptic, alcohol, density and antibiotic tests. The milk graders, who in some cases (in Olenguruone) were also the transporters, were also kitted out with basic equipment (lactometer, scoop) to carry out initial acceptance tests.

Figure 5 *CBE (left) and Happy Cow laboratories (right) (photos HC).*

The laboratories and the testing equipment were to enable a detailed sampling and testing regime at various points along the chain as part of the MQT&T system. Part of the system entailed integrating a computer data management system to ensure consistent and accurate data capture that is critical to a QBMPS. Some setbacks were encountered in developing computer software to store and analyse these data, such as the ability to have real-time interface between the central lab at HC and the mini-labs at CBE level. Overall, the interconnectedness of these testing regimes was not sufficiently streamlined to ensure a seamless MQT&T system.

Furthermore, challenges emerged that impacted on effective use of the laboratories, due to a number of organizational issues. At HC, challenges included issues of calibration of some equipment that was sourced internationally, which also affected servicing and access to spare parts. At the CBE labs, the main limitation related to the high costs of consumables and expectations that some of the costs were to be covered solely by HC or the project. For some graders, the issue was that they had not been kitted out with the right equipment. While some of these issues have been resolved, more support is needed to ensure a more streamlined approach to such a system.

These challenges notwithstanding, HC has generated a wealth of data from these efforts that will be very informative to guiding the sector to actualize a move towards a QBMPS. Additionally, the upgrading of the laboratories and installation of an MQT&T enabled HC to acquire KENAS certification in December 2018. This shows that its infrastructure is reasonably sophisticated, matching international standards. This opens up the opportunity for offering accredited laboratory testing

services. More training of Happy Cow staff and investments in the laboratory are foreseen in 2019 in readiness for their transition from ISO/IEC 17025:2005 to ISO/IEC 17025:2017. HC will be assessed by KENAS based on the new standard in May 2019 as an initiative towards transition.

2.2.1.2 Use of hygienic milk containers

The project aimed to completely stop the use of unhygienic plastic cans for delivery and transportation of milk within the CBE catchment areas and to introduce more hygiene options. This was a key effort of the MQT&T system. The CBEs aimed to make available aluminium cans and improved plastic MazziCans through their input stores. Nine-litre cans were targeted at individual farmers. For bulking and transporting milk from a group of farmers, 50-litre aluminium milk cans were promoted. For the pilot, cans along project routes were to be computer-registered and linked to the corresponding farmers and transporters. While the computer registration was not achieved and no precise data on uptake of the cans is available, the CBE management estimates that less than 5% of farmers delivering milk to them and less than 20% of transporters are still using unhygienic plastic containers to deliver milk. However, more specific results from demonstration routes (section 2.2.2.1) indicate that there was about 55% reduction in the use of plastic cans in New Ngorika (Chamuka and Ndothua) and 51% in Olenguruone (Seger, Kitoben, Sinendet, Cheptuech and Oromoit areas). While this shows progress, the uptake of this relatively simple low-cost technology is slow, which indicates the difficulties of achieving behavioural change. In Olenguruone, the transporters initially resisted using aluminium cans and racks, saying they were bulky and more likely to cause accidents, especially during the rainy season. Nevertheless, buy-in increased slowly. During a training session of transporters in Olenguruone, we observed the participants expressing their willingness to support the improvement of milk quality along their collection routes. The CBEs were not able to fully enforce a ban on plastic containers, as they were apprehensive about losing the milk volumes to other buyers.

Figure 6 *Milk collection, transportation and delivery at the CBE platform by transporters using motorbikes with can racks (photos authors (top), HC (bottom) and Dick Harting (right)*

2.2.1.3 Improving the milk-cooling system

At the zero-setting stage, it was found that the bulk cooling tanks of both CBEs were slow in chilling milk to the required temperature of 4°C, hence the tanks were acting as incubators for microbial multiplication. This led to high rates of milk rejection at the processor's platform (average 1.5% of total monthly intake) (Ndungu 2015). In the second phase of the pilot, the CBEs were co-financed (30% of the hardware costs) to augment the cooling of tanks. The CBEs bought 10,000-litre Aviva ice-bank plate exchange chillers that were deemed better due to their rapidity in chilling the milk and would therefore reduce microbial contamination.

While installation of the Aviva instant chilling plants was completed in 2017 for both CBEs, a number of challenges delayed their use. In New Ngorika, the main issue was lack of access to a clean water supply; in Olenguruone, the chilling tanks needed some repairs, which were only completed in June 2018. The delay in the use of this technical solution was partly due to poor planning by the CBEs and may have been due to some financial issues at the CBEs, as discussed under Finance (section 2.2.5).

2.2.1.4 Improvements in milk quality parameters

The investments outlined above were meant to result in improvement in a number of milk quality and safety parameters. Below, we present results as at June or December 2018 (depending on when the data was collected) of the quality parameter testing that was part of the MQT&T system and the QBMPS. These are TPC, antibiotic residues and adulteration (total solids, freezing point and total density).

Microbial quality

To improve the microbial quality of milk, the project aimed to reduce TPC in bulk milk to 10,000,000 cfu/ml. The KEBS standard is 2,000,000 cfu/ml. These targets, shown in Figure 7, were based on the zero-setting report, which also projected what was considered feasible (Ndungu 2015).

The TPC did not show a consistent trend through the project duration, as shown in Figure 7. TPC recordings were highest in the months of May–June and October–November. Despite apparent errors in TPC readings identified by an expert, it is evident that the high TPC levels remain a concern. This relates to the challenge of the upgraded chilling equipment at the CBEs not being used.

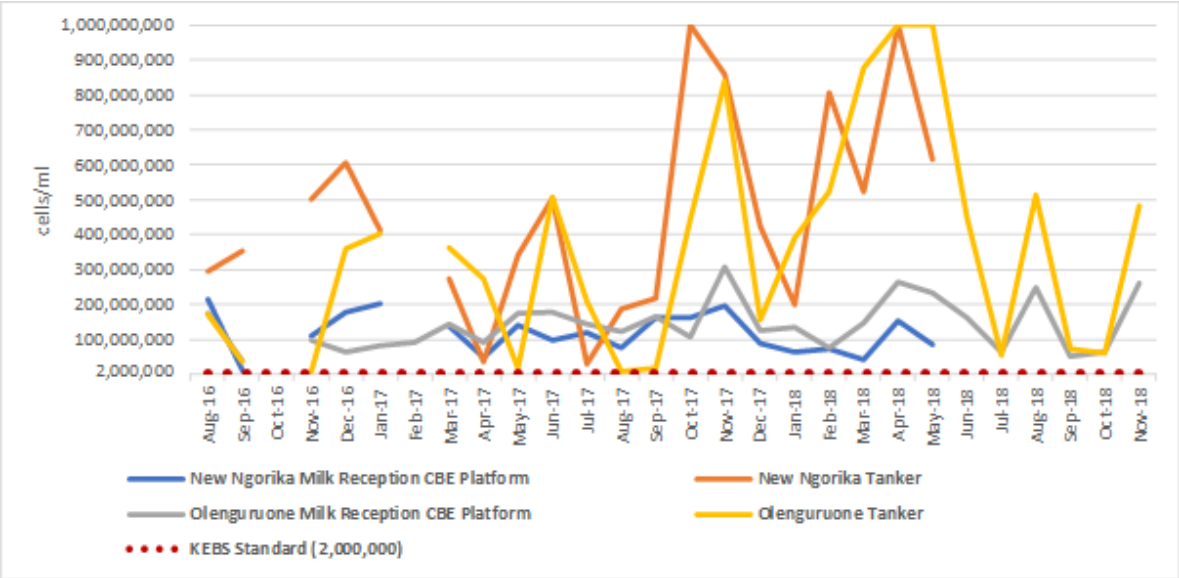

Figure 7 *Average monthly TPC from August 2016 until December 2018 (Source: HC).*

Antibiotic residues

Antibiotic residues in milk (ABR) pose a serious problem in dairy value addition, as they inhibit useful microbes in starter cultures for yoghurt, cheese and other fermented dairy products. HC, being a producer of cheese and yoghurt only, aims to completely eliminate ABR in its raw milk. Hence it maintains zero tolerance for ABR.

Comparison of tests from the zero-setting study (Ndungu 2015) against 2018 tests shows mixed results. At zero setting, the proportion of ABR-positive milk samples was 55% in New Ngorika and about 35% in Olenguruone. By January 2018, when testing for antibiotics for the QBMPS commenced,

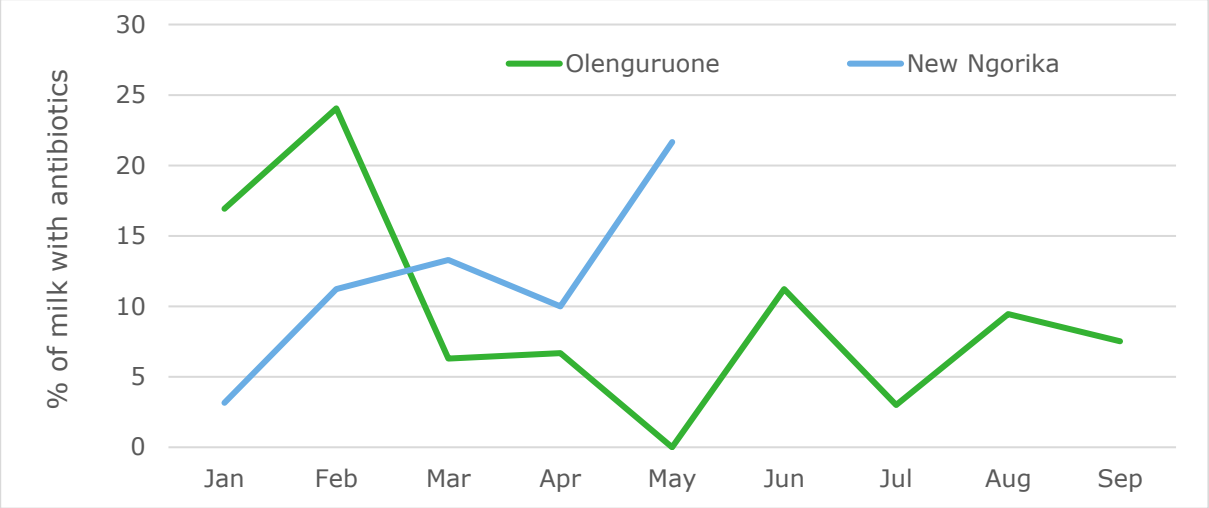

Figure 8 *Monthly proportion of milk delivered at HC containing antibiotic residues in 2018 (Source: HC).*

there had been a sharp decline in New Ngorika to less than 5%. However, the gains were reversed and, by the end of May, the proportion increased again to about 20% (Figure 8). Olenguruone, on the other hand, managed to reduce the proportion of ABR-positive milk to less than 10% by September, when data was collected. It was later reported that by December 2018, the proportion had dropped to zero.

The increased proportion of ABR in delivered milk was of concern to HC, which introduced a rule of suspending milk collection from the CBE if the bulk milk tested positive for ABR on two consecutive days. Because of the increasing trend in ABR and other challenges in doing business with New Ngorika, HC terminated milk collection from New Ngorika in May 2018.

The challenge with ABR exposed a weakness in the MQT&T system, as initially it was not able to effectively trace the source of the antibiotics. This is because at the CBE platform both project and non-project milk were bulked together and the ABR could have come from non-project milk. ABR testing at the CBE mini-labs was expensive, so it was not carried out – as proposed in Table 2 – at the MCPs or even often at the CBE level. Instead, it was done after the milk had been bulked at HC, which resulted in blanket rejection of full daily batches that penalized all farmers. This was a source of tension between HC and the CBEs. While introduction of testing in relation to ABR had initial positive results, its shortcoming was that it was not effectively applied closer to the farmers. The CBEs felt that it was not fair for them to bear the rather costly testing for antibiotics; they expected more support from the processor to solve the problem. HC, on the other hand, felt that it should not bear the costs for ABR testing, as they were not the source of the contamination.

Reduction of adulteration: freezing point, total solids and milk density
Adulteration is a malpractice that includes addition of various substances to preserve the quality (such as hydrogen peroxide) or to increase the volume of milk (such as water) and attempt to still pass quality checks. Adulteration with water raises the freezing point and lowers milk density. Freezing point, total solids and milk density are parameters that detect common forms of milk adulteration. Cases of adulteration were rampant at the start of the project, with 36.8% and 23.8% of samples showing adulteration with water in Olenguruone and New Ngorika respectively.

The **freezing point** target was -0.525 °C to -0.565 °C. Based on the HC data, the average monthly freezing point (Figure 9) did not reach this target.

For **total solids**, the aim was to reach the KEBS standards of 11.75%. On average, samples from both New Ngorika and Olenguruone had less than 11.75% total solids in January 2016 (Figure 10). However, they increased to over 11.75% by November 2016, thereby meeting the KEBS requirements. From then they stayed close to this KEBS standard, with an exception occurring in November 2017 when both CBEs recorded lower total solids. Low milk solids can usually be attributed to poor feeding practices rather than to adulteration. This was addressed in farmer training.

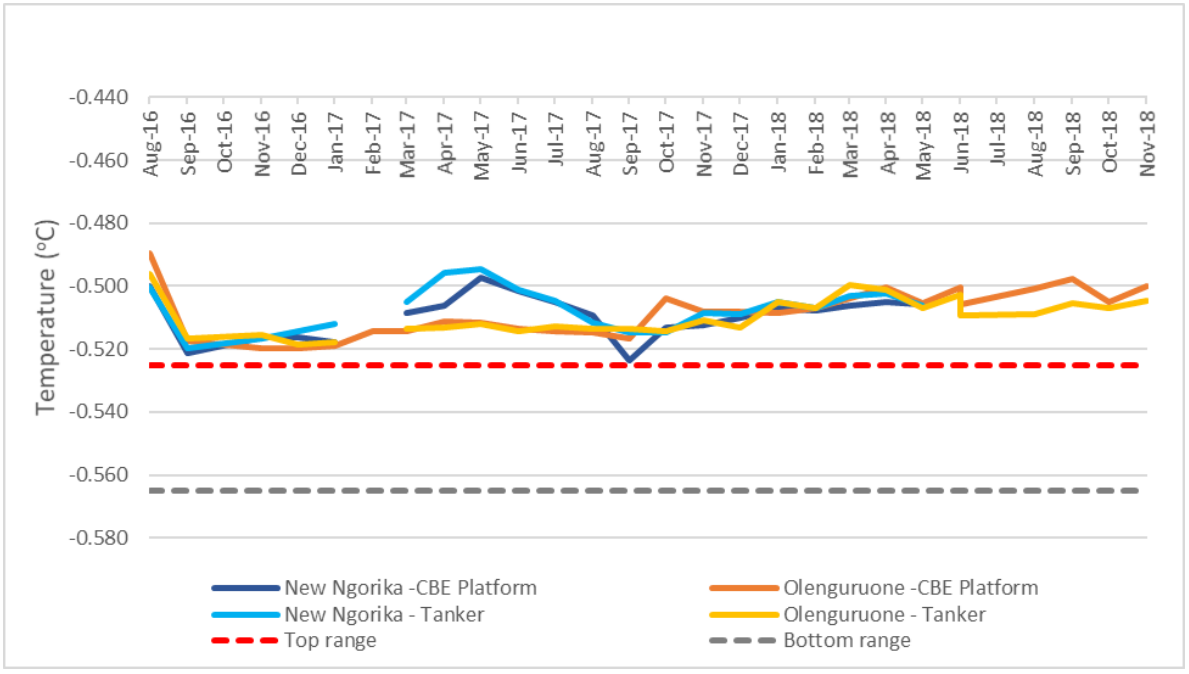

Figure 9 *Average monthly freezing point (Source: HC).*

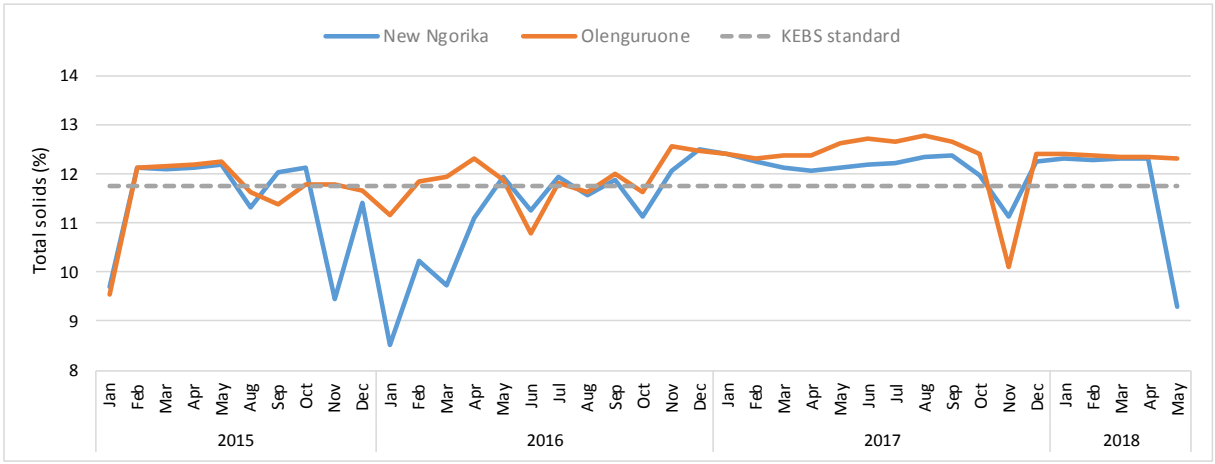

Figure 10 *Monthly trends in total milk solids of milk from New Ngorika and Olenguruone (Source: HC).*

The project targeted **milk density at 20°C** to fall within the range of 1.028–1.036 g/ml, as per KEBS standards. Results of the zero-setting in the second quarter of 2015 indicated bulk milk densities of 1.0281 for Olenguruone and 1.0284 for New Ngorika, only just meeting the KEBS standard. A marked improvement was observed from mid-2016 onwards, when the milk density went up and remained within the acceptable range for both CBEs, with the exception of June 2017 when it dropped slightly below the minimum in New Ngorika (Figure 11).

The results from the total solids and milk density tests point to a general reduction in adulteration of milk delivered by the two CBEs since the inception of the project. Introduction of a financial penalty for adulterated milk in New Ngorika further supported the combating of adulteration.

The findings reveal that, overall, the objective of improving milk quality in the HC and the CBE supply chain fell short of the targets. Lack of adequate data, especially in relation to what was considered project and non-project milk, makes it difficult to be conclusive about the effect of the technical solutions on improving milk quality for HC. The bottom line is that it was impossible for HC to market their brand as premium products.

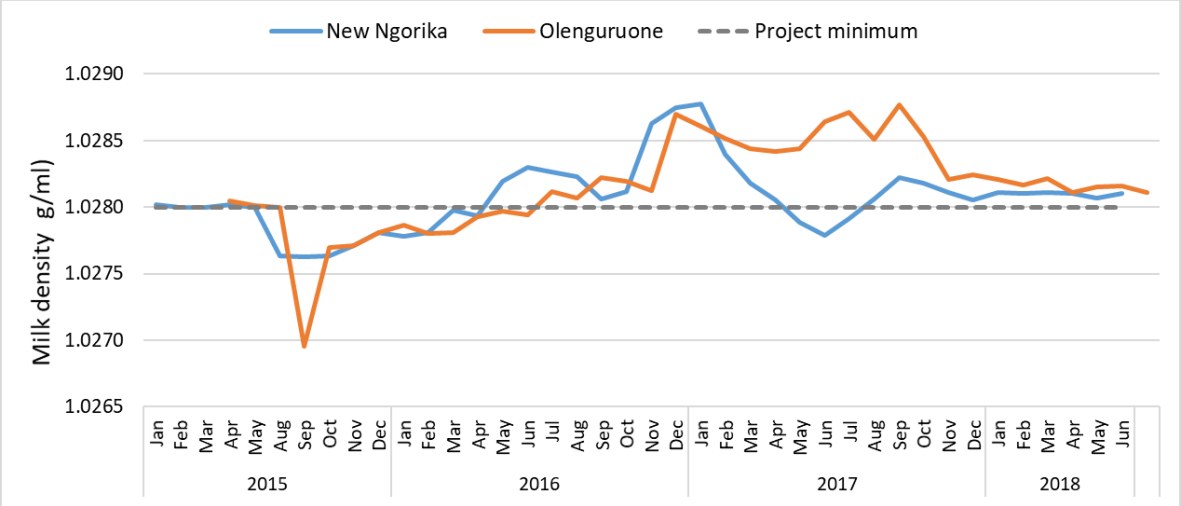

Figure 11 *Average monthly milk density in New Ngorika and Olenguruone (Source: HC).*

2.2.2 Awareness and demand

This section assesses the wish and readiness of the different users to use the proposed solution. We checked the extent to which individuals, groups and the community as a whole were aware of the QBMPS and how this affected their acceptance and adoption of the system.

2.2.2.1 Number of routes and farmers involved in the pilot

There was a lot of sensitization about the project and its objectives over the duration of its implementation. At the project's inception, the business partners had many meetings to understand its scope and ambition and to agree to be involved in implementation.

The project started implementation in a few select CBE milk collection routes, with the ambition to have all the routes included by the end of the project. In both Olenguruone and New Ngorika, six routes were selected to begin with. The plan to increase the number of routes over the project duration was, however, not implemented. As the project progressed and its complexity slowed the implementation of various activities, it even became necessary to concentrate on a reduced selection from the initial 12 routes to achieve better quality of milk.

For this reason, in 2017, the project selected three demonstration routes in Olenguruone and two in New Ngorika. This enabled project management to get a better focus on the quality of operations and to concentrate resources on fewer milk collection routes. These demonstration routes were introduced after the project experienced little improvement of milk quality, especially in the operations directly under the control of the CBEs. The project mobilized students from Egerton University and assigned them to farmers to explain the project objectives and operations. They also monitored the milk collection operations.

Figure 12 shows the number of active farmers in Olenguruone in the period 2015–2018. Unfortunately, it was not possible to differentiate between farmers on project routes and those on non-project routes, because the records were not differentiated. According to this data, the number of active farmers supplying milk to Olenguruone fell over the period. In New Ngorika, the data on active farmers was not provided. However, discussions with management revealed that here, too, the number of suppliers fell across the project period. The increasing competition for milk between actors in the formal sector and between actors in the formal and informal (with less stringent quality demands) sectors makes it more attractive for farmers to supply their milk to the less regulated market, especially because they can avoid extra expense and time input required to guarantee better milk quality.

The proportion of farmers qualifying for bonus payments grew very slowly and remained below 8% over the first three years of the project.

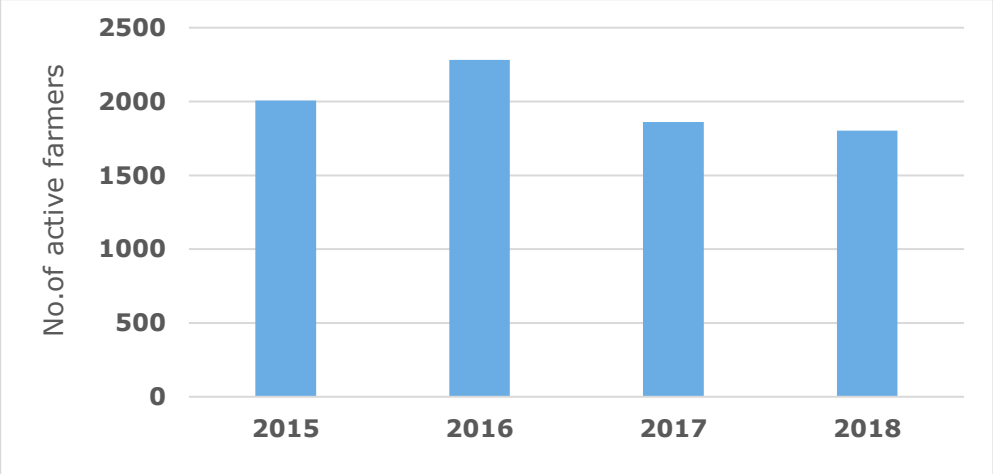

Figure 12 *Average number of active farmers in Olenguruone, January 2015 to June 2018 (Source: Olenguruone).*

2.2.2.2 General perceptions of the QBMPS model

At farm level, farmers cited lower milk rejection due to hygienic milk handling as an attractive proposition of the QBMPS. They also noted that the QBMPS introduced transparency in milk collection and payment method. The milk is now weighed instead of estimated, which formerly could leave the farmers feeling cheated. Productivity has increased as a result of training and extension activities, especially for the farmers who practise feed conservation and feeding protein-rich feed such as lucerne.

The market is driven by volumes, not by quality. Because farmers and CBEs are able to sell their milk even if they do not invest in the QBMPS, some of them would rather continue with their current farm practices and sell their milk to buyers who are not as concerned about quality.

Because the final decision to accept or reject milk and the grading for bonus payment is only made at the level of the processor, it was challenging for farmers to understand how the bonus amount was determined. Also, because the test results – and therefore payment – were provided to farmers more than a month after milk collection, it was difficult for them to attribute the payment to their change in practices affecting milk quality changes at farm level. It would have been easier if the grading for payment could have been quicker and more directly visible to the farmer, so they could be expected to more easily improve hygiene practices.

2.2.3 Supply (value) chain development

The QBMPS is built on the objective of streamlining the milk supply chain by ensuring that the chain actors are well-coordinated and sufficiently linked to improve collection of safe and quality milk. In this section, we analyse changes in the coordination and relationships between the HC supply chain actors. We focus on loyalty and trust along the chain, and on adherence to agreements between the different actors. Actors include the farmers supplying milk, the CBEs bulking and cooling the milk and the processor buying it. There are also providers of supporting services who play a key role in attaining the set objectives: for example, graders and transporters; quality control personnel; extension, AI and veterinary service providers; input suppliers.

Figure 13 *Farmer training on hygienic production and milk handling is an important part of the system (photo KMDP)*

2.2.3.1 milk collection

A major intervention of the QBMPS was the construction of MCPs. The majority of farmers were used to having their milk collected at the farm gate by transporters linked to the CBE. The MCPs were introduced as platforms to coordinate collection of raw milk and to enable fast grading at the point of acceptance. Graders in New Ngorika and prefects (farmer volunteers) in Olenguruone were responsible for conducting basic acceptance tests at the MCPs (see Figure 14). The MCPs were also intended to enable farmers to apply peer pressure, encouraging each contributor to conform to delivering quality milk, especially as they were clustered in 50-litre-can groups.

Overall, 24 MCPs were constructed in New Ngorika and 43 in Olenguruone. However, only about 70% of MCPs in Olenguruone are currently in use, while none of the MCPs in Ngorika were ever used. While the site selection, design and agreements on access were supposedly negotiated with farmers in a participatory manner, there seem to be other underlying socioeconomic issues that were not considered that affected MCP use. Some farmers complained that the MCPs were too far away and that it was a strange expectation of the project to have them walk to the MCP when the transporter's route to that MCP went past their homes. Due to perceived security reasons, some farmers did not feel comfortable walking to the MCPs very early in the morning and leaving their milk in another farmer's compound.

Figure 14 *Milk grading at a milk collection point.*

In Olenguruone, the transporter businesses were independent from the CBE, and some bypassed the grading at collection. This resulted in inconsistent grading. In New Ngorika, grading of milk did not take place at the MCPs, as these were not used. However, there was a grader in charge of milk collected by the CBE tractor. Additionally, in New Ngorika the high competition for milk by both formal and informal sectors made some traders more aggressive in milk collection at the farm gate, thus diverting milk that would have been collected by the CBE.

To enhance effective use of MCPs, in the second phase the project manager proposed having two demonstration routes in New Ngorika and three in Olenguruone where farmers, graders and transporters would be closely monitored and supported to improve their milk collection practices. However, this only worked in Olenguruone, where there were the farmer prefects to monitor progress. In New Ngorika, this did not work as farmers who were approached to be prefects demanded compensation for the work. The results from the demonstrations indicate some improvements, such as increased use of aluminium cans for milk transportation, decreased milk rejections and increased numbers of farmers qualifying for bonuses (Ndungu 2018).

2.2.3.2 Grouping farmers around a milk can

Enhancing farmer-to-farmer loyalty is an underlying factor for success of a QBMPS in a smallholder supply chain. In this context where individual producers have low milk volumes, an important structure of the tracking and tracing system is grouping of farmers and allocating them specific milk cans (typically of 50 litres) to bulk their milk. Farmers were to be **clustered into groups** (of 5–7 members) to fill a 50-litre milk can. In reality, the farmer groups that were formed ranged from 2 to 19 members, depending on how many could fill the can. Each can was engraved with its allocated number, and the farmers were then issued with a number linked to the can. The initial idea was to

have computerized can labelling, but this was not achieved. The clustering and bulking point was where basic acceptance tests were conducted for each individual farmer before bulking. Each can was expected to belong to a consistent group of farmers. The **sampling plan** required taking a sample from each can twice a month for testing against the QBMPS grading. Platform tests at the CBE were also performed for each can. Milk-can group membership was therefore important for ensuring that the group maintained the quality of the milk. This determined whether they qualified for bonus payment or whether their milk was rejected.

Some farmers took the initiative to get to know other farmers in the same can group, and they jointly aimed to receive the bonus payment. Others did not know the other farmers in their can group. From the interviews, we note that the concept of can groups was not always adhered to during collection. Sometimes one milk can is filled at different collection points due to limited supply volumes. Because these farmers did not meet each other at the MCPs, it became hard to achieve peer-to-peer cohesion and monitoring. In addition, the interviews revealed that in some instances where the assigned farmers did not deliver enough milk to fill the 50-litre can, the transporters would add milk from other farmers, thus increasing the risk of contamination and further inhibiting traceability.

2.2.3.3 Separation of evening and morning milk

Separation of morning and evening milk was an important way to reduce the high load of bacteria, since most farmers did not have adequate cooling storage for overnight milk and collection was only done once a day. There are no records to show the extent to which this was achieved in both CBEs. New Ngorika started to collect evening milk separately but stopped because the transaction costs were high compared to the volume of milk collected. Some farmers said they were still mixing morning and evening milk, because it would be hard to carry two containers. Although New Ngorika invested in an additional 30 cans to help in milk collection, there was still mixing of morning and evening milk. It was also noted that the recording system did not allow for separate recordings of morning and evening milk for each farmer, which actually meant farmers could be paid bonuses for non-project evening milk. These difficulties in separating collection and recording of morning and evening milk resulted in the low number of farmers qualifying for bonus payments.

2.2.3.4 Separation of project and non-project milk

One of the project interventions was to organize separation of project and non-project milk through installation of parallel reception lines and coolers, coupled with installation of Aviva instant chilling plants at both CBEs. Installation of the chilling plants was completed in 2017, but parallel lines and the separation of project and non-project milk had not been achieved at the time of data collection in 2018 for reasons outlined in section 2.2.1.3. This hindered the ability to separate project from non-project milk. However, it also emerged from the interviews that the CBEs were reluctant to separate the milk, as it would amount to discrimination against some of their members. This is another sociocultural barrier that impeded the full testing of the QBMPS proof of concept.

2.2.3.5 Integrating a clocking system to improve milk delivery

A manual recording system for milk delivery times was in place at the CBE cooling centres, which also noted the volume of milk each supplier delivered. The project intended to introduce an automated clocking system to record milk delivery times and ensure timeliness of milk collection. In June 2016, the need for a clocking system was discussed in the Olenguruone cooperative meeting. This was also mentioned in other meetings, and a deadline was set for putting the system in place by December 2017. This deadline then shifted to March 2018. In neither of the CBEs had the automated system been implemented at the time of the data collection for the assessment.

Despite these challenges, a look at some of the milk delivery records and discussions with management during visits to both CBEs indicated some improvements in delivery of what was considered project milk. In New Ngorika, it was observed that project milk arrived at the CBE cooling tank between 7 am and 10 am. This was seen as a great improvement compared to before the project, when milk was often collected until 2 pm. Figure 15 shows the earliest and latest time of milk delivery to Olenguruone over the project duration. The chart shows that there was no visible reduction in the collection intervals; the earliest and latest milk collection times were similar over the project's duration. It was not possible to differentiate the timing for project milk and non-project milk, as the data recording system did not separate them. Therefore, we cannot conclude that there was a better trend for project milk, though the milk quality controllers stated that project milk usually came in earlier.

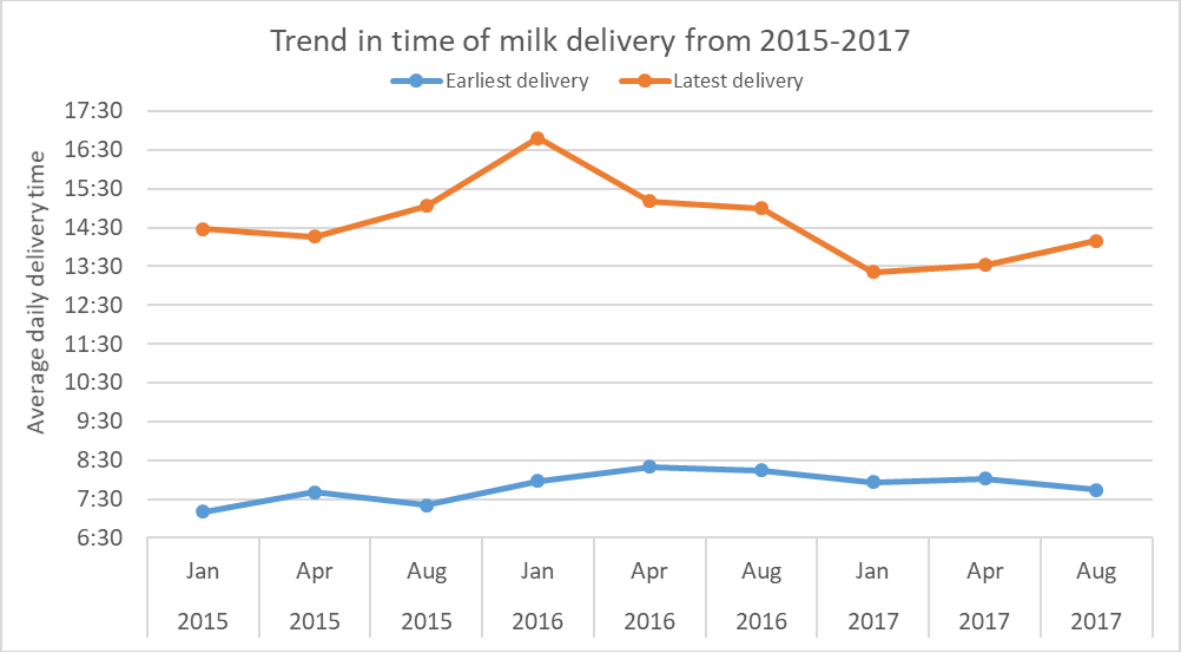

Figure 15 *Average monthly earliest and latest time of milk delivery at Olenguruone, 2015–2017 (Source: Olenguruone).*

2.2.3.6 Buyer–supplier loyalty and changes in milk volumes

Two levels of buyer–supplier loyalty are relevant in relation to the QBMPS: the farmer's loyalty to the CBE and the CBE's loyalty to the processor. Farmer–CBE loyalty can be understood as the extent to which farmers who were part of the project remained as suppliers to that CBE over time. In Olenguruone, all farmers were shareholders. In New Ngorika, which is characterized as a private company but is open to shareholding, only about 2% of farmers were shareholders. The majority of farmers interviewed in New Ngorika considered themselves merely suppliers, thus had little loyalty to the company.

In lieu of accurate numbers of milk suppliers, the overall milk volumes that the CBE collected from their farmers provides a good indication of this loyalty. CBE loyalty to the processor looks at the volumes the CBE supplies to the processor over time, compared to what it supplies to competing buyers.

According to the interim project evaluation (Harting and Katothya 2016), HC collected an average 9,000 kg of milk daily from the two CBEs, of which about 4,000 kg was project milk, that is, milk collected from the project routes. The ambition was that this milk would increase in both volume and in quality and ultimately qualify for a quality bonus. Our analysis indicates a lower average of daily intake from the two CBEs (about 6,500 kg). The data on project milk volumes was not made available, because the separation was not achieved as noted in section 2.2.3.4. This data would have been able to show the extent to which the QBMPS was effective in assuring premium quality to the processor.

What the results do show is that the processor and the two CBEs engage in significant business with each other, and that a significant level of CBE supply loyalty to HC exists, compared to other buyers. However, the results also indicate significant fluctuation in the volumes of milk supplied, causing adverse effects on business between the two parties. As Figure 16 shows, the volumes collected by New Ngorika increased by about 14% in 2016 and significantly dropped by 40% in 2017. While the drop in volume was linked to drought in that year, interviews also revealed that many farmers had opted out of supplying to New Ngorika. The major reason for this was price and the options they had to sell to other buyers. Despite a significant reduction in milk collection in 2017, New Ngorika increased the proportion of milk delivered to HC from 48% in 2016 to 81% of total supplies in 2017 (Figure 16). Olenguruone kept the average daily milk supply to HC constant at about 3,200 kg per day over the four-year period, despite fluctuations in total milk intake. The 2017 drop in volumes was mainly linked to the severe drought that was experienced in the country. As Figure 16 shows, the drop in total daily collection by the CBEs continued in 2018, indicating decline in supply. While bearing in mind that the weather affects the dynamics of supply volumes, supplier loyalty remains an important issue for both CBEs and processors in building resilient supply chains.

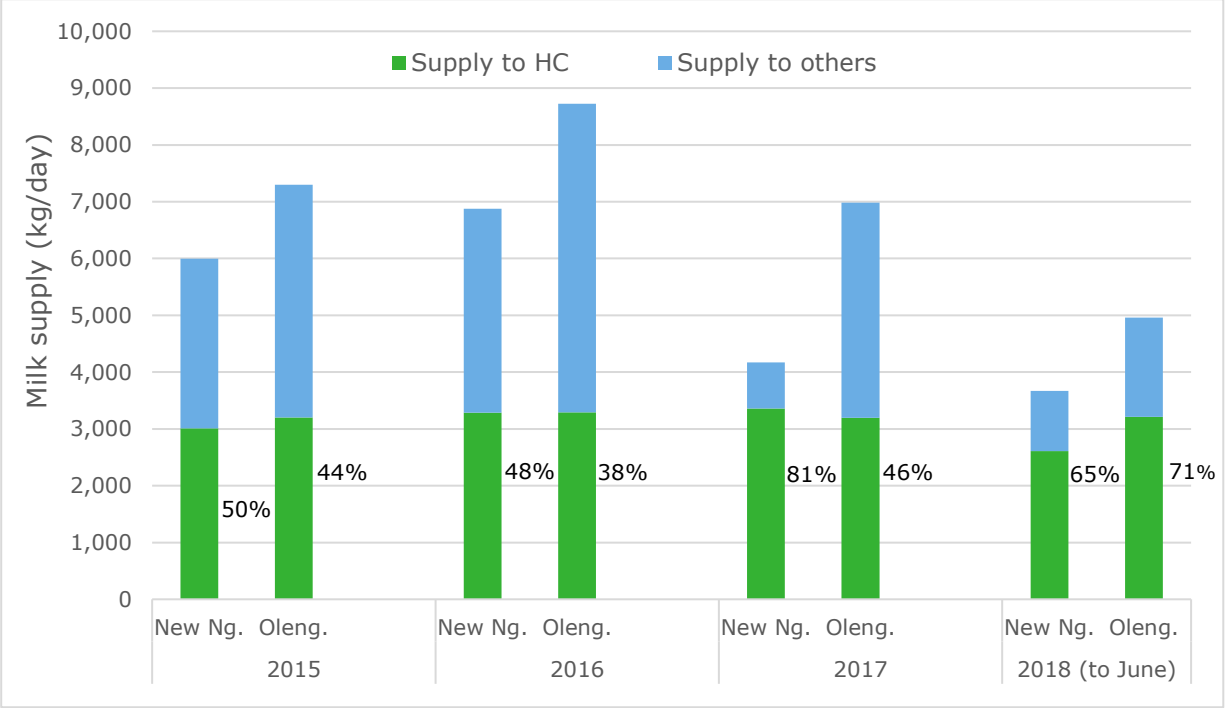

Figure 16 *Trends in daily milk volumes supplied to HC by the two CBEs (Source: New Ngorika and Olenguruone).*

2.2.3.7 Role of graders/prefects and transporters in improving milk quality

The milk graders are key actors in ensuring that the MQT&T system works well. In the initial project design, the graders and transporters were not factored in to the business model and did not receive any bonus payment for assuring quality. In Olenguruone, some transporters who operate independently as businesses were accused of mixing milk from farmers that were not part of the same milk-can group and, in some cases, were also a source of adulteration. Allocation of part of the bonuses to them would probably increase their commitment, since they would also have a direct benefit from assuring quality. Recently, Olenguruone started offering the transporters an extra KES 0.20/kg for standard milk and KES 0.4/kg for premium milk, which is deducted from the farmers' bonus. The effect of this will need to be assessed after some time.

During the second phase, milk prefects were introduced to grade milk at MCPs in the demonstration routes. The prefects were chosen from among the farmers in the area and trained on hygienic production and milk testing. Olenguruone decided to reward the prefects through transport refunds and telephone airtime allowances. It is likely that this will not be sufficient in the end, as prefects invest time and forgo other duties in favour of milk grading. In New Ngorika, the idea of prefects did not work, since they wanted payment for their time. Debates also emerged about who would cover the costs of the graders, with the CBE saying that it would not be sustainable for them to cover it. The lesson here is that in such a complex supply chain, these transaction costs need to be factored in to make the QBMPS model attractive to each actor.

2.2.4 Business case

This section looks at the economic attractiveness of the QBMPS for participating actors, which will affect how they adopt project technologies. It also considers the direct and indirect costs and benefits for all actor types involved, how they changed over the project time frame and how they would change when scaling up.

2.2.4.1 Costs and benefits for the different actors

A cost–benefit analysis study of the QBMPS pilot (Ndambi et al. 2018) shows variations in the net profit of the different business actors. Actors had to make different investments towards the objective of improving milk safety and quality, and they differed in the benefits they obtained.

Private sector benefits

Farmers participating in the pilot needed to build a milking shed, buy the necessary milking equipment (additional towels, wide aluminium containers, cleaning reagents, aluminium cans) and, in order to attract bonuses, spend more time cleaning equipment and attending training. The cost of these investments was about KES 1.55/kg of Grade A milk (Figure 17). In return, the total benefit – realized from the bonus payment and a reduction in rejected milk – was about KES 3.86/kg of Grade A milk. Farmers also benefited from training in milk hygiene, good feeding, fodder management and conservation. Thus, producing Grade A milk results in a net profit of KES 2.31/kg of Grade A milk to farmers through the QBMPS piloted.

For the **CBEs**, the costs incurred included those for construction of a mini-lab and MCPs; purchase of equipment, laboratory tests, software, transportation racks, aluminium milk cans and the engraving of these; project staff time; and training of farmers, milk graders, transporters and technicians. These costs were KES 0.56/kg of Grade A milk, compared to a benefit of KES 0.32/kg, which results from the reduced milk rejection by the processor (Figure 17). This leaves the CBEs with a net loss of KES 0.24/kg of Grade A milk. This shows the limited incentive for CBEs to engage in a QBMPS, unless they are compensated somehow.

The **processor** incurs costs for constructing a laboratory; purchasing equipment and laboratory tests; project staffing; software development; training of farmers, milk graders, transporters and technicians; bonus payments; and external advisory services. This cost KES 3.05/kg of Grade A milk. In return, the processor benefits from increased product yield, reduced production failures and reduced product returns. This amounts to a benefit of KES 0.93/kg of Grade A milk (Figure 17).

For example, HC saw increased cheese yield, obtaining 1 kg of cheese from 9–10 kg of cheese milk, compared to 1 kg cheese from 13–14 kg milk at the onset of the project. However, the net loss for the processor is KES 2.12/kg of Grade A milk.

The additional costs and benefits for **transporters**, in terms of time and changed behaviour, were not calculated. These could be a factor in the unwillingness of transporters to follow milk-handling procedures.

Public sector benefits

The **public health sector** also benefits from the QBMPS through reduced incidence of milk-related illnesses and other hazards. To determine the burden of various milk-borne diseases on public health, disability-adjusted life years (DALYs) were calculated from the incidence of the diseases and the average productive time lost due to the diseases (Ndambi et al. 2018). This was a total annual loss of 53,000 DALYs. Considering the average lifespan of 62.13 years in Kenya, this equals an average annual loss of 855 full lives due to milk-related infectious diseases. This number would be even higher if the effects of antibiotic residues, hydrogen peroxide and cancer from aflatoxins were considered.

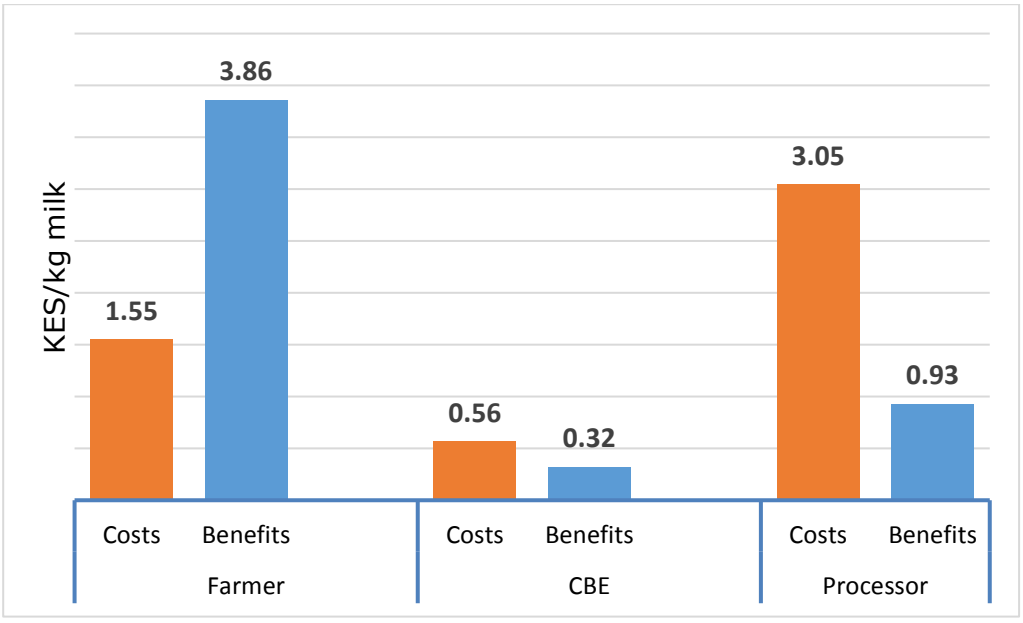

Figure 17 *Total additional costs and benefits of QBMPS for various actors (Source: Ndambi et al. 2018).*

We also looked at the health-care costs for milk-related illnesses, which comprise direct costs (showing the value of goods, services and other resources consumed in providing care due to an illness) and indirect costs (loss in output because of reduced productivity due to illness). These costs amounted to KES 436 billion per year. These direct and indirect costs would be significantly reduced if milk produced in Kenya went through a QBMPS.

2.2.4.2 Pricing and market dynamics

We looked into milk-pricing dynamics and the bonus payments made over the project period, reflecting how the trend of milk pricing over the three-year period confirms that HC generally offered a competitive base price to CBEs. As the **value proposition** of the QBMPS is that the various supply chain actors can be incentivized to assure milk quality through premium bonus payments and a competitive base market price, pricing was an important factor to consider in the QBMPS pilot. Discussions with various key informants indicate that the effects of pricing dynamics were not well considered at the start of the project but affected its progress.

Base price

In New Ngorika, across the period January 2015 to June 2018, HC base milk prices stayed on average about KES 2/l above that of New KCC, the main competitor. This gave HC an advantage in securing milk from the CBE. In June 2018, Brookside started collecting milk from New Ngorika and offered about KES 2/l more than HC. Over the same period, HC's milk prices in Olenguruone stayed above competitor New KCC's prices by an average of about KES 3/l of milk. Olenguruone further received an extra KES 1/l for milk chilling, giving a total price advantage of KES 4/l from HC compared to New KCC. HC collects its milk from the CBEs itself and thus does not have to pay the CBE for transportation. However, because Olenguruone transports New KCC milk to the New KCC factory, it receives an additional KES 2/l. The net position is that the CBE still benefits more from HC prices than from New KCC prices.

Other market players compete for a share of the milk by matching or offering a better price, be they local traders buying directly from farmers, or other processors buying from farmers and CBEs. New Ngorika also delivers milk occasionally to other processors, including Bahati, Countryside and Farm Solutions. These processors only collect milk irregularly, for a few months a year, usually offering the same price as HC, sometimes KES 1–2/l more. Their purchases were only 8% of the total volume supplied by New Ngorika between January 2015 and June 2018.

Bonus payments

The project was designed with the understanding that the impetus for change would be the introduction of a financial incentive for the producers. While the base price offered by HC to the CBEs was competitive, bonuses were only awarded to the few farmers who met the quality parameters of standard and premium milk. As stated above, the proportion of farmers qualifying for bonus payments grew very slowly and remained below 8% over the first three years of the project (Figure 18).

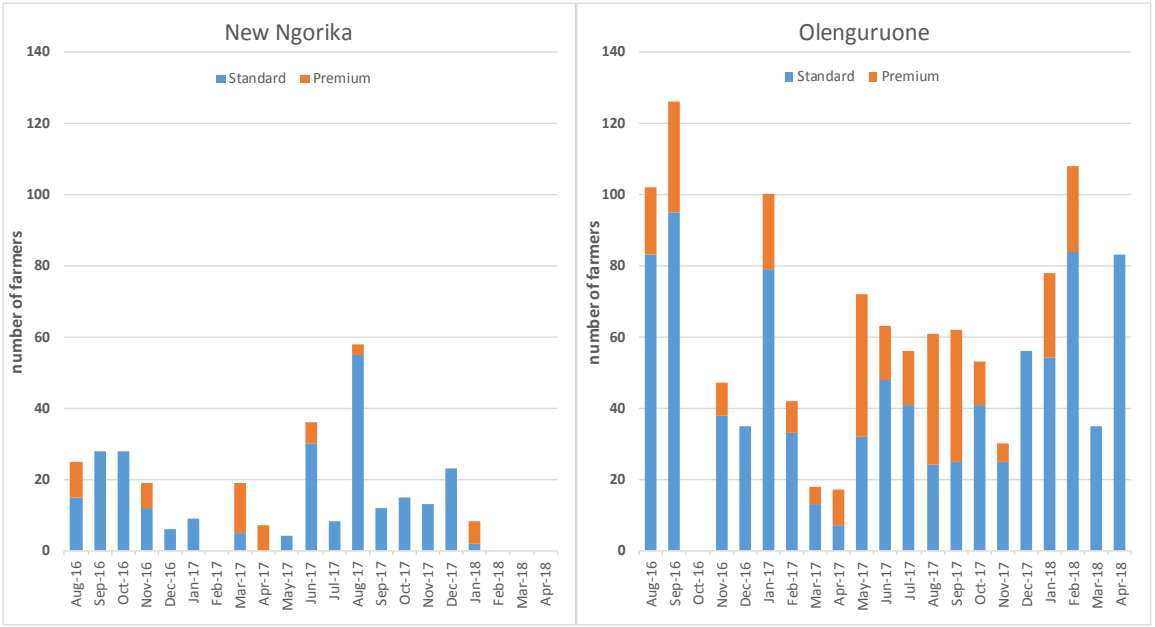

Figure 18 *Total number of farmers who qualified for bonuses, Aug. 2016 – April 2018 (Source: HC).*

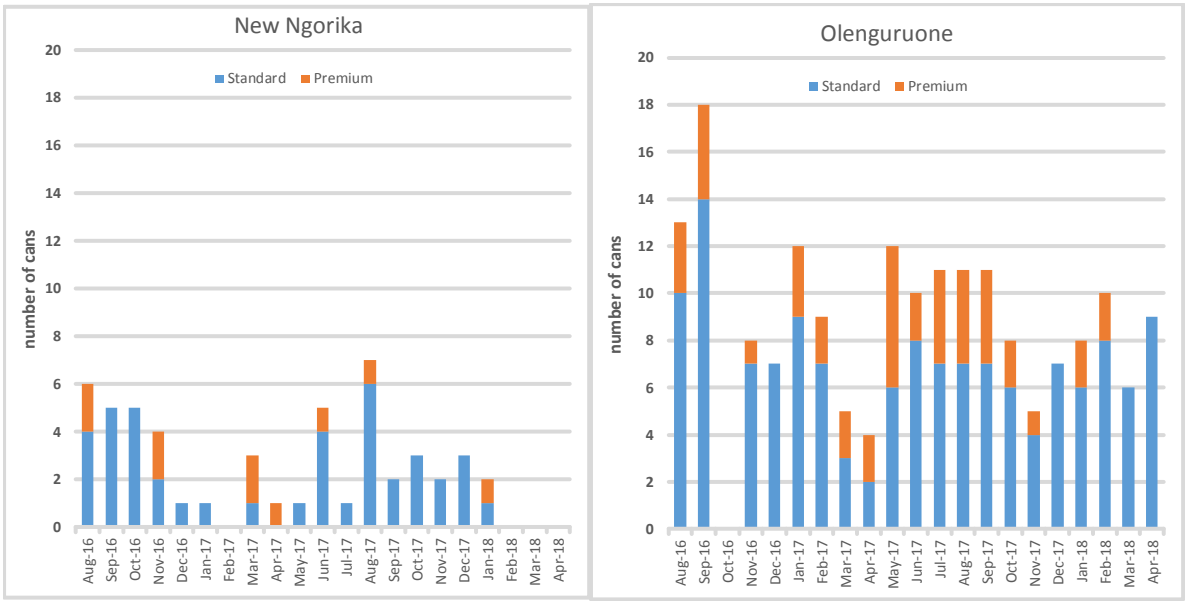

Figure 19 *Total number of cans that qualified for bonuses, August 2016 – April 2018 (Source: HC).*

As Figure 19 shows, in Olenguruone more cans qualified for bonuses than in New Ngorika. This may be related to the corresponding differences in investment and promotion of improved practices observed between the two CBEs. These differences can (partly) be explained by the market context of New Ngorika, where the competition for milk is fierce. According to various actors, the informal market actors have the advantage of lower transaction costs (e.g. licence fees), so they can offer better prices to farmers. They divert much milk away from the formal chain. While their terms seem attractive to farmers, such as daily or weekly cash payments and farm gate milk collection, they have also been an unreliable market to many farmers.

Reduction in milk rejection levels
The integration of milk tracking and tracing in the HC supply chain was not only intended to increase the volume of quality milk, but equally to reduce the loss of milk along the chain. The installation of laboratories and the improvement of quality testing at collection points is reported to have resulted in a decrease in milk rejection. As Figure 20 shows, the rejected milk volumes in New Ngorika went down by about 70% from 2015 to 2017, although the numbers were going up again in 2018.

2.2.5 Finance

This section assesses the effectiveness of the financing options for value chain actors. It examines the availability and affordability of finances during the project and the effect of finance on implementing and scaling the QBMPS model. The financing options available included project (innovation) funds, private financing of the various actors and commercial finance.

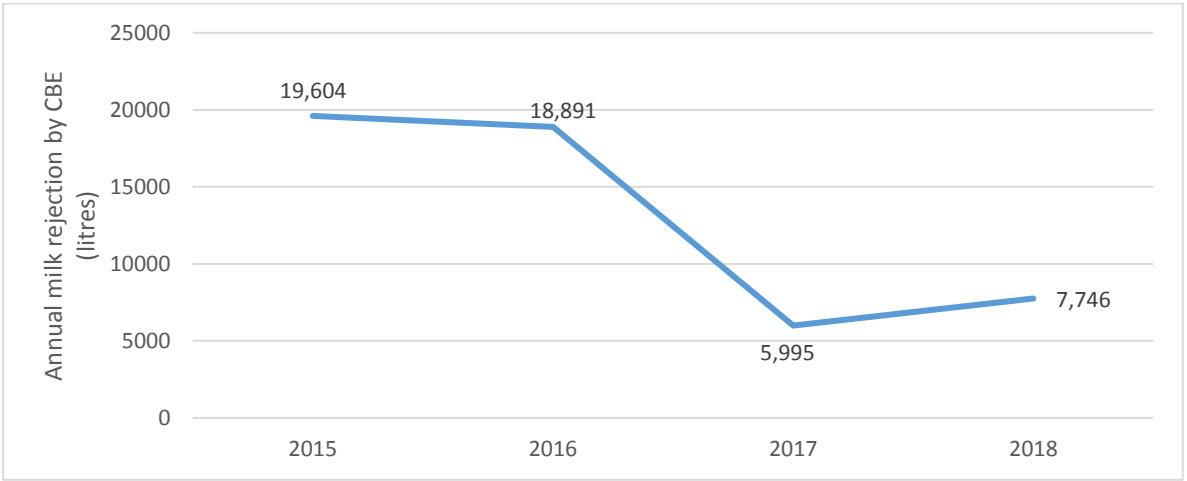

Figure 20 *Milk rejection volumes in New Ngorika 2015–2108 (Source: New Ngorika).*

2.2.5.1 Innovation financing: project investment

The project was financed by the Embassy of the Kingdom of the Netherlands in Nairobi through SNV-KMDP, with co-funding from HC, New Ngorika and Olenguruone. By the close of the project (May 2019), the actual donor contribution for the project is expected to reach €425,000 (70% of which was for Phase I and 30% for Phase II). Co-financing by HC and the two CBEs will reach €275,000, amounting to 39% of total investment.

While the fund manager was flexible with the budget, some financial challenges emerged. In Phase 1, HC, as project lead, made most purchases on behalf of the CBEs and deducted the costs from CBE milk. To settle these expenses, HC needed the CBEs to account for their project expenses by providing receipts and invoices. As the CBEs delayed submitting the required documentation, HC could not reimburse costs from the funder. This issue prompted a change in cost recovery modality in Phase 2, with the CBEs having to paying up-front for their own purchases and to have receipts, invoices and payment vouchers available for reporting and auditing purposes. This caused cash flow challenges for the CBEs. Financial stress became more pronounced when Phase 2 started during the prolonged drought of 2017. Volumes collected by the CBEs were down by 50% or more over many months, not only because of lower production by the farmers but also due to increased competition with traders/hawkers. Because CBEs' ability to meet these substantive commitments depended on their business performance, they delayed purchases. In short, while the financial procedures were designed to enable fast project implementation, it was nevertheless delayed because control over cash flow and sourcing of equipment at competitive prices was more important for the CBEs.

2.2.5.2 Business financing

The project partners – processor, CBEs and farmers – required commercial finance in addition to project investments. The business partnership was used to leverage some of this commercial finance. HC facilitated additional credit support to the CBEs from the Rabobank Foundation for Phase 2, to fund 40% and 20% of CBE consumables and hardware expenses respectively. The latter included ice banks (instant coolers with plate heat exchangers) and technical assistance. Other additional investments included construction of MCPs and KENAS accreditation of the HC laboratory. HC acted as guarantor in acquiring this CBE finance.

Interestingly, while the CBEs agreed to take out the loan, they indicated that they felt pressured to make the new investment because of the project. It was not clear to us how the CBEs' ability to take on debt, in light of their business risks, was evaluated. At New Ngorika, the leadership pointed out that having taken a loan at a time when their milk volumes were dropping affected their cash flow and put them at risk of a high credit burden. This may be seen against the backdrop of the worsening business relationship between HC and New Ngorika due to milk quality issues, culminating in HC discontinuing milk collection from New Ngorika in June 2018. HC had foreseen this possibility and reduced outstanding advances to prevent defaulting. This hiked New Ngorika's cost of servicing its loans, which increased by about 70%.

Olenguruone showed that the monthly laboratory analysis costs were KES 137,000. New Ngorika said that due to the QBMPS project, the cost of servicing debt increased from KES 350,000 to KES 600,000 per month, at a time when milk prices fell and competition from other processors and brokers increased.

HC also faced business challenges at a time when they were making large investments in the QBMPS, notably the lower milk intake during the prolonged 2017 drought and the collapse of Nakumatt Supermarkets, which is said to have left the dairy sector – in particular the processors – with a total debt of KES 1 billion.

Farmers' investments related to improving milk quality included purchase of aluminium cans, inputs such as veterinary drugs and better feeds, construction of milking sheds and spending time attending training. Costs and benefits for these investments have been outlined above in section 2.2.4.

2.2.6 Knowledge and skills

This section looks at the issues of skills and capacities at individual and institutional level to use, adapt and promote the QBMPS innovation.

2.2.6.1 Staffing

At the beginning of the project, a team was competitively recruited to promote and drive the implementation of the QBMPS innovation. This core team comprised a project manager, milk quality controllers, MCCs and extension officers. These personnel were stationed at different points in the

supply chain (Figure 21). The project manager hired by HC had training in dairy technology and experience in the sector. During Phase 1, she acquired a master's degree, having conducted research on the project. Three milk quality controllers were stationed at HC, Olenguruone and New Ngorika. Two MCCs were to be recruited to oversee the milk quality at the CBE collection points/routes – milk collection, handling, sampling, testing procedures and equipment – and to be in charge of organizing training for the farmers on an as-needs basis. Only Olenguruone managed to hire an MCC. The lack of MCC in New Ngorika affected the overall delivery of project activities, and it did not become clear why this position was not filled. Two extension officers were hired to raise awareness about project issues and deliver training to farmers to enhance good dairy practices and improve milk quality. In addition to these project staff, New Ngorika hired transporters and graders, while Olenguruone hired independent transporters to collect and deliver milk to the CBE.

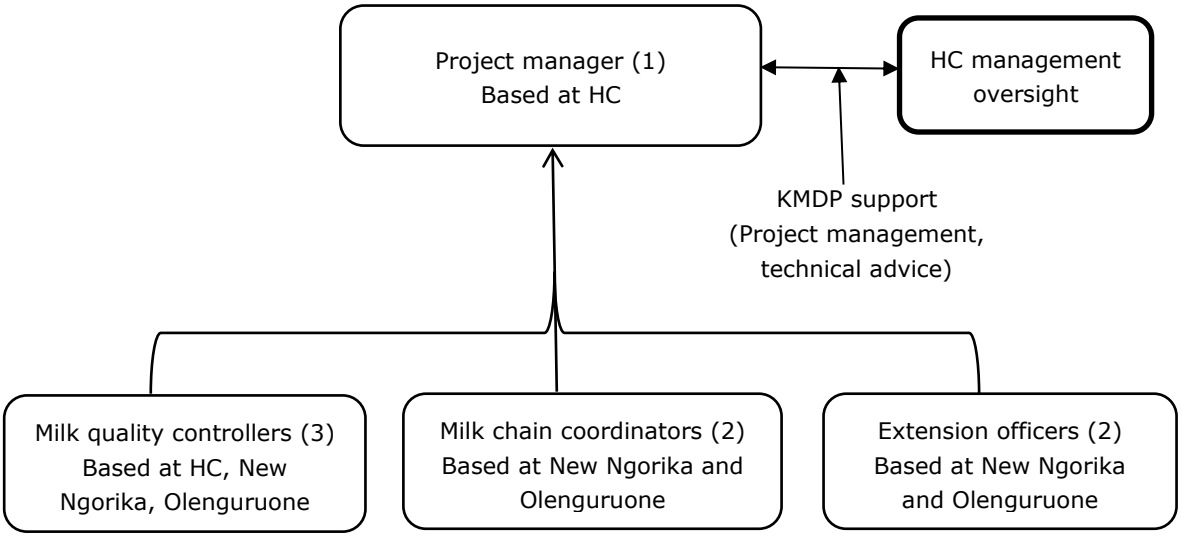

Figure 21 *Structure of project staffing.*

All these staff were expected to coordinate their efforts. While this was achieved to some level in Olenguruone, it was not so in Ngorika. The lack of an MCC affected the overall organization of milk collection and coordination of interventions at Ngorika. Moreover, staff turnover greatly affected project implementation. For example, the absence of an MCC in Ngorika affected extension service provision to the farmers. The high turnover of CBE milk graders affected project progress. New personnel who joined the project were not fully inducted into the QBMPS. According to some of the interviewees, there should have been more emphasis in providing the CBEs with managerial and governance support.

2.2.6.2 Organization of the extension and training system of the QBMPS

A central aspect of implementing the MQT&T system and QBMPS was to enhance extension services in order to increase milk productivity and quality at farm level. The project proposal and midterm review both articulated that extension was the key to the success of the pilot. The project invested considerably in training of staff, farmers and other supply chain actors on various aspects related to improving milk quality and quantity. As part of extension, a training plan was to be developed targeting farmers and the supply chain actors (e.g. graders, transporters). The project manager was in charge of developing and overseeing the implementation of the extension and training plans. At each of the CBEs, a board extension committee was charged with providing leadership on extension delivery to its members and suppliers.

Training and extension were organized through various approaches. The CBE employed dedicated extension staff who were given a motorbike so they could reach the different collection routes. KMDP seconded local capacity builders who also offered training and extension services. In addition, various input suppliers were invited to offer training, which also served as a platform to promote their products. The project manager brought on board Egerton University students through an internship arrangement; they were also used to provide some extension support to selected demonstration routes. It was expected that with more dedicated support, such demonstration routes would accelerate improvement in milk quality. Training for transporters started in 2016; from January 2017 on, there was usually one training session for transporters per month. The project organized several

trips for staff and CBE leaders within Kenya (e.g. to Kiambaa cooperative) and to India (Amul Dairy), after which the CBEs each purchased a plate heat exchanger and ice banks to enable faster cooling of milk to 4°C. Additionally, both CBEs committed to procure Aviva testing equipment.

Extension staff were supposed to visit farmers whose milk had been rejected and make a diagnosis of the source of the problem, sometimes in collaboration with the MCC. After diagnosis, the farmer would then be given advice to correct it. In Olenguruone, the MCC and extension staff did work collaboratively to provide such support. In New Ngorika, where no MCC was hired and there was high turnover of extension staff, there was not the support necessary to achieve more positive results with milk quality and adherence to the new practices (e.g. use of MCPs, separation of evening and morning milk). The reasons for the high turnover were linked to lack of support in conducting their activities (e.g. the motorbike intended for extension was diverted to other uses; when it broke down it was not quickly repaired). This points to gaps in management support to the pilot.

Interviews confirmed that training covering a wide range of topics was offered to farmers. The topics included milking procedures, cleanliness and hygiene, feed and fodder preservation, calf rearing and breeding, and antibiotics withdrawal periods. Some standard operating procedures were developed with farmers during this training. Many farmers did receive training, but many more did not. Records from Olenguruone indicated that the number of training sessions increased over the years of the project and that the average attendance rose from 20 farmers per session in 2015 to 25 in 2017, showing that more farmers were developing interest in the training on offer.

While considerable effort was put in to the above activities and will have contributed to the changes described, especially in relation to milk hygiene, the overall milk quality objectives were not attained. The anticipated behavioural change was not achieved within the proposed project duration. For example, some farmers were still using unhygienic plastic containers, despite the training they had received in this regard. This raises questions about the effectiveness of the training and advisory support offered. The numerous approaches described do give the impression that the project was constantly searching for an effective extension strategy, but that the capacity of the extension system was still insufficient and lacked integration with the MQT&T system and QBMPS. Project partners may want to critically assess their training and extension methods and staff capacity, as well as the more fundamental question whether lack of awareness and skills is the actual bottleneck preventing behaviour change.

2.2.6.3 Technical backstopping

Local and international consultants were hired to support the project with technical assistance (backstopping) in two fields: i) project design, implementation and review, and ii) technical support for the various training activities described above. Experts included the local capacity builders engaged through KMDP to support the training of farmers, and international and local experts engaged to support the processor. These included an international consultant with experience in QBMPS who was hired by KMDP to provide backstopping to the project and experts from Egerton University who were expected to also guide particular aspects of project implementation. This pool of various expertise was appreciated by various actors and played an important role in getting some aspects of the interventions streamlined. However, some moments in the backstopping efforts became a source of tension between the experts and the project partners. It was sensed that advice from external experts did not sufficiently appreciate the complex socioeconomic and cultural context where the pilot was operating.

2.2.7 Collaboration with other stakeholders

This section looks at the extent to which the project stimulated strategic collaboration and partnerships in the sector. It examines the project's engagement with other stakeholders, as well as relevance, contribution and benefits of these collaborations and partnerships to the project.

2.2.7.1 Business-to-business partnerships

By design, the project was aimed at strengthening collaboration among stakeholders at various levels. The first was at the level of forging business linkages. Beyond the linkages between the main project partners, other business relations were stimulated because of the pilot, both local and international. This included various equipment manufacturers and distributors (Delta Instruments, Aviva). A notable partnership was the link between CBEs and the Rabobank Foundation, which provided affordable financing to the CBEs to purchase the improved ice banks. The arrangement was possible because HC was able to stand as guarantor for the CBEs. Olenguruone reported several other linkages that came about due to the project. KCB bank offered to partner with the CBE in providing training to farmers. The Micro-Enterprise Support Programme Trust financed the construction of an improved cooperative

building. The Smallholder Dairy Commercialization Programme, a project supported through the International Fund for Agricultural Development, supported acquisition of equipment. Other linkages were those with farm input providers as training partners, for example, Oshwal, Twiga, Syngenta, Vital and Coopers. Olenguruone is also talking with the County government about provision of artificial insemination kits and a cooler and with KDB about training. In New Ngorika, some of the training was done in line with farmers' welfare group meetings (*Chama*). Some welfare group members were not members of the CBE, so the knowledge imparted may have led to improvement in milk handling beyond project routes.

2.2.7.2 Sector engagement

The success of the project was also hinging on engaging a wide range of stakeholders in the sector and industry around the experience with the MQT&T system and QBMPS. Other cooperatives visited the partner CBEs to learn about the MQT&T system, with the intention of applying it to their own operations. Githunguri Dairies also visited HC with the same intention. Following an appeal from HC to New KCC and Brookside, asking them to stop receiving raw milk in unhygienic plastic containers from the two milk-sourcing areas in order to create a level playing field, Brookside has introduced a ban on these containers.

HC proactively sought to engage with sector actors, with the intention to share and learn lessons, inform them about the project and influence peers and public sectors agencies; these included the Kenyan Dairy Processors Association, KDB, Eastern and Southern Africa Dairy Association, and international research and policy institutes (e.g. European Centre for Development Policy Management, Wageningen University & Research). It sought to persuade these actors to put the issues of milk quality on national and international agendas, mainly in the context of food safety. Since the project began, the HC team has made over 30 presentations about the QBMPS to various forums and audiences (Appendix 4). Moreover, it has had newspaper articles and scientific publications published.

The effect of these engagement efforts is that addressing the issue of milk quality and safety – an important threat to public health as well as to sector development and competitiveness – is firmly on the industry agenda, both for private and public sector actors. The extent to which these engagements and presentations led to a change coalition is worth additional study. More needs to be done to increase momentum. Additionally, it was noted in several interviews and project review meetings that engaging the KDB as the regulatory agency more structurally in the implementation of the pilot might have contributed to some of the intended changes (e.g. banning of unhygienic plastic cans, curbing diversion of contaminated and rejected milk to other markets). Further reflection on the effect of this gap on project outcomes is found under the public sector governance section below (section 2.2.10).

2.2.8 Monitoring and learning

The QBMPS pilot was designed as a proof-of-concept project with the objective of generating evidence and learning on the innovative implementation of a QBMPS in a smallholder-dominated milk supply chain. The insights of the implementation process and the results were to be shared broadly with dairy sector stakeholders in Kenya and beyond. The project had an elaborate results-based M&E framework with four major results areas and key performance indicators with deliverables and means of verification.

This section looks at how data and evidence were generated to support the successful implementation of the project. We scrutinized the monitoring and evaluation (M&E) system on how data was collected and used in decision-making and how this was transparent between actors. The focus is on the data management systems and the results framework.

2.2.8.1 Data management systems

A major assumption at the start of the project was that it would be easy to acquire software programs that could incorporate an MQT&T system and QBMPS for Happy Cow. The project hired a software development firm to design, develop and implement a web-based QBMPS data aggregation system that would store the huge volumes of data collected at various sampling points. There were major setbacks in the development and smooth operations of this software, which were addressed to some extent by late 2018.

In addition, most of the CBEs already had software in place, albeit without quality parameters. The CBEs also hired their own developers to design systems integrating the quality parameters. However, these systems were not put into use, as was confirmed during interviews with CBE management. Currently the CBEs are entering the milk quality payments into their systems manually. This has made

the data capture and management laborious and has limited robust analysis. Besides, we found that the CBEs lack the capacity to conduct the continuous analytics required to guide their business decision-making. Furthermore, the software used by the two CBEs was not interoperable and not integrated with the HC software, making it difficult to share information about the best-performing farmers in terms of quality.

2.2.8.2 Results framework enabling learning?

At the onset, the project developed a comprehensive results framework to monitor progress and guide learning and adjustment. A system was developed for the project manager, the milk quality controllers and the MCCs to submit progress reports on project achievements. Though these internal monthly reports were prepared, they were not linked to a systematic M&E system among the business partners that would have allowed cumulative tracking of progress to guide project implementation and determine focus areas for the next work plan. The systematic tracking of project progress was carried out on a six-monthly basis, as per the contract between KMDP and HC.

Regular meetings were held quarterly between HC, KMDP and the CBEs to discuss progress and to address the problems faced during implementation. These meetings were informed and guided by the M&E results framework. During the course of implementation, the M&E results framework was adjusted; however, this was primarily with regards to the timelines for achieving specific deliverables. During Phase 1 of the project, the focus on deliverables and means of verification did not inspire dynamic feedback loops in improving project delivery. The design involved a huge number of interventions that required (behavioural) change and investments at all levels in the organization of milk collection, handling, testing and payment, in an environment that was not very conducive to change. It resulted in a heavy load of organizational and financial stress on the partners involved, who also had to fight vested interests from, for example, transporters. The design relied heavily on the experiences of the international consultant, who had implemented a similar system in Vietnam for a large international dairy processor. That project, however, had superior financial and organizational "muscle" and operated in an environment with much better infrastructure, as well as the milk being collected and bought by the processor directly from the farmers, without CBEs as intermediaries.

At the end of 2016, an interim evaluation was carried out and, based on its recommendations, a proposal for Phase 2 was developed that was approved in February 2017.

In February 2018, KMDP and HC (and partners) decided to not strictly follow the results framework anymore but to concentrate on key deliverables for the remainder of the project. These were:

1. KENAS accreditation for HC laboratory
2. Consolidation of satellite labs at the two CBEs
3. ensuring that the CBEs had reliable access to clean water, used Aviva fast-cooling equipment, separated project and non-project milk, and used good practices in the milk collection chain (aluminium cans, racks, early delivery at platform)
4. building a robust database for all milk quality parameters in the project (including somatic cells and aflatoxins), with milk being tested across the chain at all critical control points: farmer → can → CBE platform cooler → tanker truck (loading from chilling tank CBE) → tanker truck (arrival at HC Nakuru)
5. putting together a project handbook that includes flow charts, standard operating procedures (SOPs), work instructions and procedures
6. conducting a study to document and assess the QBMPS pilot for learning and sharing with sector stakeholders
7. outlining a strategy for continuation and upscaling, to be in place by the end of the pilot project. The contours of the upscaling trajectory are described in the report *Happy Cow Ltd Milk Quality Tracking & Tracing System* (see Appendix 5 for graphical summary).

In relation to systematically generating evidence from the pilot and documenting lessons to guide policy and the sector stakeholders, KMDP and HC partnered with 3R Kenya, an applied research and learning project also funded by the EKN. One study analysed the private and public costs and benefits of implementing a QMBPS in Kenya. The results of this study, to which both KMDP and HC made important contributions, provide important policy insights that have been widely shared and well received by policymakers such as KDB and industry players. By refocusing the results framework, starting the process of review and drawing lessons about the future of the initiative, a major conclusion is that the project design was ambitious and technocratic. The project partners, the international backstopping support and the fund manager (KMDP) perhaps tried too long to stay with

the initial design, hoping that given enough time all the hurdles (technical, financial, skills, organizational, project management and enabling environment) could be overcome and the plan could be implemented as designed, without major review or overhaul. According to HC and KMDP, the implementation of this current assessment and lessons learned from other experiences with QBMPS pilots (by SNV-TIDE in Uganda and in India, through ongoing contacts with Aviva) have in hindsight brought new perspective on the value of a learning-oriented results framework to guide adaptation of such a complex and innovative pilot project.

2.2.9 Leadership and management

This section reflects on how leadership and management of the project affected implementation and results.

2.2.9.1 Leadership and management dynamics

The success of the project was dependent on how well the leadership of the project at different levels effectively guided coordination and implementation. The leadership was at three levels: at KMDP as the fund manager, at HC as the project lead and at the CBEs as executing partners. People in top leadership positions from all the stakeholders were involved in all steps of project inception and implementation of both phases. During the inception phase, time was spent to ensure that project partners were well informed of project objectives. This was followed by signing of project agreements to formalize the partnerships and commitment of all partners. Both CBEs signed letters of commitment to ensure effective coordination and management of the novel and complex innovative pilot project. HC and the CBEs also signed suppliers' contracts, stating the quality requirements, price/kg and expected volumes to be supplied.

HC was to oversee the entire project design and implementation and to ensure good communication between all stakeholders. This function was delegated to the project manager and a team of staff with different roles as outlined in section 2.2.6. The project manager, under supervision of the HC management, was responsible for monitoring the MQT&T system and the QBMPS; the project budget; the financial records, including the financial commitments of each party; and the cost-sharing arrangements; and was also the custodian of project hardware during implementation.

The KMDP project leader, representing the fund manager, was to provide overall oversight of the project to ensure that milestones and deliverables were attained, following the elaborate M&E results framework that was part of the project proposal. KMDP's role was to ensure that resources were well utilized and to provide guidance and support to the project team. While KMDP leadership was hands-on in engaging with the project management process, it allowed the project owners (HC and the CBEs) significant flexibility and independence in leading implementation.

Interviews with various stakeholders revealed that some of the issues encountered in project implementation reflect on leadership and management dimensions of the project. Ideally, a company director and an experienced project manager, familiar with a QBMPS, would manage a project such as this. The absence of such experience coupled with the fact that the project manager had to juggle implementation of activities (such as conducting training) with master's studies stretched project management capacity and affected delivery. Capacity gaps appeared in the project management team in setting up robust systems to guide implementation, including the M&E system which was data heavy and required periodic systematic analysis and feedback (section 2.2.8). In hindsight, it might have been useful if HC had appointed an experienced assistant project manager to support the project manager in carrying out the many tasks in this project. In addition, HC and KMDP could have been more vigilant in assuring that the project manager had enough external backstopping – including in management of data and monitoring, evaluation and learning. The need for technical backstopping (internationally and locally) was foreseen in the project proposal and budget but was not fully utilized by the project, and the parties who were engaged could not meet expectations.

In Phase 2 of the project, a solution was sought by KMDP to contract an international consultant for technical backstopping of HC and to advise the KMDP team leader. This consultant was the same person who was involved in project design. Although this decision was understandable in the expertise-constrained context, this did not bring in a fresh and critical look at the design and ambitious targets of the project.

2.2.9.2 Dynamics between business partners

The project was initiated with the understanding that enhancing milk quality through MQT&T and a QBMPS was a win–win for all the business partners. The leadership of HC and the CBEs expressed this commitment at the beginning. However, in the course of implementation, various tensions emerged

between the partners. Some of these related to the issue of cost sharing in financing investments that were necessary to implement the QBMPS (section 2.2.5). In some instances, the CBEs wanted more flexibility in purchasing equipment and consumables. Because HC and KMDP felt unable to be flexible and deviate from project design, this caused some friction. A related issue that caused contention between the business partners was the question of who should bear the costs for some of the quality tests (section 2.2.1.4).

One of the CBEs noted the tension caused by the expectation that they take on debt to implement the project, while HC management was not willing to consider their demand for higher milk prices. This was also tied to the fact that there was a lot of fluctuation in the volumes of milk they collected, which affected their cash flow and their ability to meet various obligations, including servicing debt. Furthermore, the small proportion of farmers receiving bonuses put CBE management in a difficult position when trying to show the value proposition of enhancing milk quality. This resulted in some members dropping out and the CBE losing volumes they could collect, making it even more challenging to make their business viable. This raises the question of the extent to which a financial risk assessment was carried out as part of the project design and in guiding project management.

2.2.10 Support by public agencies

This section examines the public support for reaching the scaling ambition. It looks at how support from the Kenyan regulator authorities (KDB, KEBS, etc.) contributed in promoting the QBMPS and in enabling fair competition along a quality-driven dairy value chain.

Regulatory authorities were not directly involved in this project. The challenges in policy and regulatory implementation and enforcement related to milk quality standards indicate a weakness of public support for the efforts of MQT&T and the QBMPS. The pilot exposes how far the regulatory agencies have enabled a quantity- rather than quality-driven sector to thrive.

The success of a QBMPS is premised on the expectation that if milk is not meeting safety standards – as set by KEBS and which KDB is mandated to enforce – and is rejected by the processor, it will not be sold to other buyers. However, the pilot exposed that this does happen regularly – even usually. HC experienced unfair competition from other formal and informal milk buyers along the same routes. Competitors with lower quality standards accepted the milk rejected by HC. This highlighted the missing role of the regulator, as these competitors did not meet the standards for fresh milk.

Yet HC also found that the KEBS standards for fresh milk are too stringent for the smallholder farmers and decided to set its own, lower, standards. This raises questions about how best to set standards that are realistic but still meet the basic safety parameters so consumer safety is not jeopardized and ensure processors can receive the volumes they need to run their business.

In discussions with several interviewees it was noted that, considering that this innovation was being tried for the first time in the Kenyan context and seeing the ambition to scale up the QBMPS, it would have been advisable to include KDB as a partner from the start. Engaging the regulators more throughout the project duration might have contributed to other outcomes, including identifying areas for capacity-building of regulators so they could set a level playing field for the various actors of the chain. This is particularly important at this point where the sector and industry actors have recognized that unless everyone moves towards safety and quality, the sector's development and competitiveness is threatened. On the other hand, enforcement of regulations, basic infrastructure and good housekeeping, all aimed at protecting the consumer, should not depend on a pilot project, as this concerns a sectoral problem of national concern. In addition, HC called upon the regulator, county governments and peer processors several times to ban use of non-food grade plastic containers, but this was in vain.

2.3 Scalability of the model: assessing preconditions

The pilot was a proof of concept, and the results demonstrate that the QBMPS as designed was not fully feasible. As such, a number of changes envisaged were not realized. During a workshop with the QBMPS pilot stakeholders in Nakuru, an adapted Scaling Scan (PPPLab 2018) was conducted to understand how the different dimensions of the pilot had performed and to give an indication of areas that would need further attention in scaling such a system. The participants were asked to individually rate the 10 ingredients in relation to the potential for scaling the QBMPS.

As Figure 22 shows, some aspects of the pilot were perceived to have fared well, such as the technical solutions that were offered. Nevertheless, the ultimate result of improved milk quality was largely not attained. Three ingredients – value chain development, monitoring and learning, and public support – were rated by less than 60% of the respondents as completely or partly well addressed by the project, making them the least rated ingredients. These ratings correspond with the findings of the assessment described above, which shows major shortcomings in these aspects.

Further development in these areas should be considered essential for making the concept scalable within Kenya. An important caveat is that this scaling self-assessment was a perception exercise undertaken by the project partners under the guidance of the workshop facilitation team. We note that there was a tendency to rate external factors more critically than internal dimensions, notably leadership & management and knowledge & skills. The findings of the broader assessment, however, were that weaknesses in these two internal dimensions also contributed significantly to the challenges faced during implementation of the project.

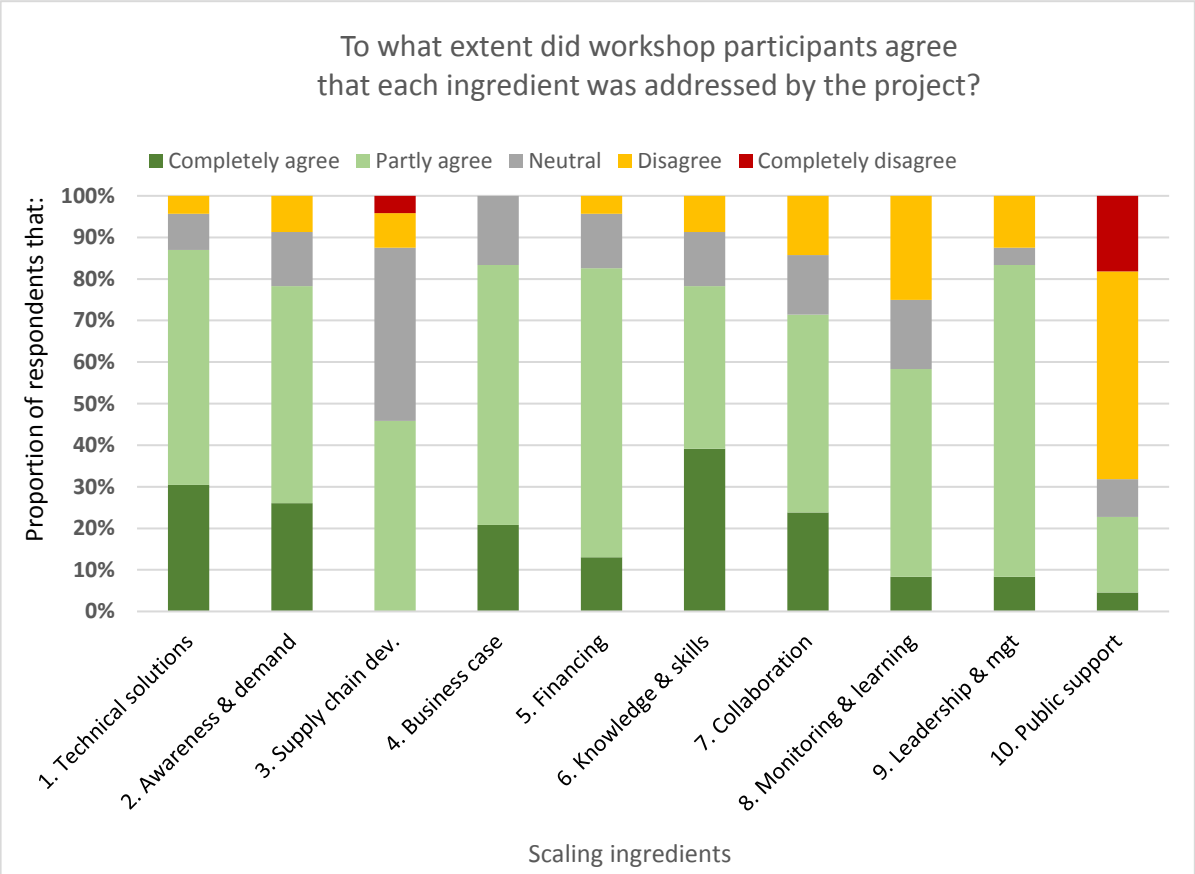

Figure 22 *Rating of the ingredients related to the QBMPS (Source: Stakeholder workshop, Nakuru).*

A mid-term evaluation of the QBMPS pilot (Harting and Katothya 2016) characterized the pilot as a systemic and radical innovation and provided some initial reflections on its scaling potential. As a systemic innovation, the pilot needs to engage a wide range of different actors in dairy to address a widely recognized fundamental challenge (the poor state of milk quality) in the sector and entails introducing comprehensive technological, organizational and institutional changes. The pilot is a radical innovation in the sense that it requires a comprehensive (rather than incremental) adoption of good dairy practices, by a critical mass of farmers. Also, it competes with a dominant volume-based payment system, in a very unfavourable regulatory environment.

The evaluation notes that to confront the challenge of poor milk quality affecting the sector, the QBMPS pilot would be able to reach a point of scaling if it developed and adapted solutions for the most critical issues. This would result in three outcomes: 1) an enhanced shared vision and values between the business partners that would influence other industry actors to address the issues at hand, 2) reduced risk and uncertainties in using a system that works given the prevailing context (especially among farmers and CBEs), and 3) a consolidated and sustained innovation process and related outcomes through distribution of benefits among all actors. The results enumerated from this current assessment indicate a mixed level of success towards the noted outcomes. Thus, we can conclude that scaling of the QBMPS can only be considered possible when these outcomes are clearer.

3 Conclusion: lessons learned and recommendations

The project was intended to be a proof of concept to introduce QBMPS in a smallholder supply chain in the Kenyan dairy development context, which has low levels of compliance with milk safety and quality standards. Therefore, from the onset the pilot was an ambitious endeavour.

This section summarizes the findings from the assessment of the proof of concept based on interactions with various actors in the pilot project. The authors have combined these findings with their own experiences of the Kenyan dairy sector to come up with recommendations on the scaling potential of the QBMPS in the Kenyan context.

3.1 Lessons learned

A. Intermediate level of success: The hard work of project partners in this experiment resulted in progress in a number of fields

a. Adoption of some of the good practices by all actors (processor, farmers, CBEs, transporters) in the supply chain resulted in a level of improvement in the safety and quality of milk, which was the major goal of the project. Improved milk-handling practices by farmers and, to some extent, by transporters and CBEs is evidenced by earlier milk delivery by project farmers, high adoption of use of aluminium containers and reduced use of unhygienic plastic containers. Rejection rates were reduced, and a number of milk quality parameters improved. The introduction of testing at various critical control points including at reception (farm level), CBE level and HC level is a contributing factor to these changes. However, software problems and gaps in the data, which was collected at different points and over time, limited analysis and conclusive evidence of these critical results.

b. Investments in key infrastructure, such as construction of laboratories and improved chilling technology and facilities in the CBEs, are a visible positive result of the project. These investments formed a major step in bringing milk testing closer to the farmers and in better handling of bulked milk.

c. Upgrading of HC's laboratory and integration of good operational procedures and standards are major milestones that the project enabled. This culminated in KENAS accreditation of the HC laboratory for a range of milk quality parameters in December 2018. This KENAS accreditation offers new business opportunities for HC and is increasing the availability of accredited testing capacity in the sector.

d. Farmers can clearly benefit from the QBMPS. Those who received a bonus for quality milk have a net profit after deducting their additional investments. Farmers also claimed improved productivity, especially as a result of training and extension activities.

e. The effect of the project partners' engagement efforts in sharing their experiences with other sector stakeholders has put milk quality and safety firmly on the industry agenda as an issue that threatens public health as well as the sector's development and competitiveness. The pilot has attracted attention from KDB and other processors and has stimulated a rethink of practices in the sector. Sector actors, both private and public, are openly discussing milk quality now, after initial resistance. Consumers are increasingly becoming concerned with quality and safety of milk and dairy products. The project has also drawn interest from other actors, including development and research partners such as Danida, Heifer International, European Centre for Development Policy Management, SNV-Voice4Change project and WUR-3R Kenya project. These partnerships can go a long way in extending results beyond the project.

f. Public co-funding of the project was deemed necessary for testing QBMPS as a proof of concept innovation that was being tried out for the first time in Kenya in the context of a smallholder supply chain. Funding from the Embassy of the Kingdom of the Netherlands permitted execution of the project. The study by Ndambi et al. (2018) clearly showed that

public funding is justified, especially by the public good benefits that can result from entrenching such a system in the sector.

B. A number of circumstances were beyond what project partners could influence; these concern difficulties in the operating climate in the Kenyan dairy sector

a. The QBMPS can be expensive and complicated if **basic, necessary assets and institutions** are not already in place, such as mandatory use of aluminium cans for milk handling and transportation, clean water, milk-cooling facilities, milk-testing equipment and milk grading. This is further exacerbated in the current system, where the set standards are not being enforced and competitors are still paying based on volume. It is the mandate of the public agencies to ensure that a level playing field is created for all sector actors and that the dairy sector is streamlined towards a formal system with proper quality assurance in place.

b. **Behaviour change** is complex and takes time. It requires deliberate strategies that are not only about economic incentives. There is need to continuously develop capacity-building plans that will help to changing mindsets. The CBEs need more knowledge about and awareness of their supply chain arrangements and the gaps related to milk quality assurance. Both CBEs have different arrangements for how the milk gets to the CBE; both systems have faced various challenges and unethical practices. There is only so much a project can do in achieving behaviour change at CBE and farm level; the effect of a QBMPS is contingent on proper practices along the chain.

c. Other **context factors affecting execution** of the project included the general disregard for quality in the sector; the competition for milk volumes in the market is at the expense of quality, especially where CBEs are operating near major cities and towns. This affects business relationships, including the ability to form long-term, trusting and loyalty-based supply chains. Furthermore, the insufficient servicing capacity and lack of spare-part supply lines for internationally sourced laboratory equipment, as well as extreme weather events such as the 2017 drought, adversely affect ambitions to move towards a safe and quality-driven industry.

C. Reflections on what could have been done differently to achieve more success

The implementation of this complex project faced many challenges, with some milestones not being achieved. This assessment has found that non-achievement of intended results and outcomes can primarily be attributed to:

Weaknesses in the design

a. Findings reveal that the objective of improving milk quality in the supply chain fell short of a number of targets. In hindsight, the project had overambitious targets, trying to address too many quality parameters at once (bacterial quality, adulteration, antibiotic residues, somatic cell counts and aflatoxins).

b. The bonus payment system should have been simpler and transparent enough for all actors. Discussions with many actors revealed that they did not understand how the system works and did not trust the results transmission process. For example, the farmers did not understand how they did not qualify for bonus payments, despite making the required changes to improve milk quality on their farms. Keeping it simpler would make it clearer to farmers; for example, paying them for good practices – such as compliance in use of aluminium cans – would be an initial step towards paying for improved quality. Additionally, the test results should be made available to farmers immediately.

c. The interconnected milk-testing regimes and bonus payment system were not well streamlined to ensure a seamless MQT&T system and prompt bonus payment. Some of the tests could only be conducted at the HC lab, and the time frame for relaying results was not factored in to the design.

d. The design of the bonus payment did not factor in incentives for other critical actors in the supply chain, including the transporters and CBEs. These actors received insufficient compensation to motivate their compliance and investment in the system.

e. The milk collection system, including the use of a 50-litre can as the initial point of bulking milk, did not carefully consider the effort required to make the MQT&T system work, including how the grouping of farmers would work and the cost of monitoring and testing the cans.

f. Socioeconomic issues were insufficiently considered, as was evident in underutilization of MCPs.

Implementation issues

The system was not always well implemented as designed. Ultimately, this resulted in HC not being able to market its brand as premium products. Implementation issues included:

a. There was suboptimal implementation of a number of project interventions. The formation of milk-can groups was illogical, with insufficient social cohesion for peer pressure to work effectively; some graders were not supplied with the right equipment; proper can labelling took a long time; project and non-project milk were not kept separate. In Olenguruone, the contractual arrangements with the transporters should be with the CBE, not with the farmers, as is currently the case. This will enable the CBE to effectively monitor and enforce the milk quality. In New Ngorika, there was need to find faster ways of delivering milk to the CBE as the current set-up of tractor routes results in late deliveries.

b. Partners appeared to have insufficient management capacity and backstopping support to adjust the project design in a timely manner, prioritize the key interventions and be consistent in following up on priority issues in the pilot. This resulted in many implementation gaps that affected the results.

c. Bonus payments were late because test results were communicated to farmers more than a month after milk collection. This made it difficult for farmers to attribute the payment to their change in milk-handling practices at farm level. Grading for payment should have been quicker and more directly visible to the farmer, so they could be expected to more easily improve hygiene practices.

d. The proportion of farmers qualifying for bonus payments grew very slowly and remained below 8% over the first three years of the project. Based on expert estimates, at least 60% of farmers must qualify for a bonus payment to motivate them to invest in quality improvement if a QBMPS is to work well.

e. The QBMPS is a highly data-driven system, which is central to monitoring progress, enabling learning and adjusting the business strategy. Data-driven monitoring of progress and learning in the pilot was insufficient. This resulted in a number of data gaps, especially in relation to what was considered project and non-project milk. This made it difficult to adjust interventions and to be conclusive about the effect of the technical solutions on improving milk quality for HC.

f. Insufficient CBE motivation and capacity resulted in insufficient staffing (not hired, not replaced, not competent), transporters not being well managed (mixing of project and non-project milk), and slow behaviour change (e.g. collection speed, ban of plastic containers). This was insufficiently corrected.

g. The many different approaches to extension and training give the impression that the project was constantly searching for an effective extension strategy. Yet the capacity of the extension system was still insufficient and lacked integration with the MQT&T system and QBMPS. Project partners may want to critically assess their training and extension approaches and staff capacity, as well as the more fundamental question whether lack of awareness and skills is the actual bottleneck preventing behaviour change.

h. Co-investment between the partners and the innovation financiers was built in to the project design and was assumed to be important for getting the necessary buy-in for the system. In practice, this revealed that there was insufficient analysis of the risks underlying the business models of the various partners and how they affected their ability to acquire finances to invest in the QBMPS. The CBEs, for example, took on additional loans, which made them vulnerable, especially when faced with huge drops in milk volumes that they relied on for revenue. In some cases, this made it difficult to service loans.

Strategy issues

a. Misunderstandings and conflicts of interest between HC and the CBEs led to many partnership issues, including purchasing disagreements; ultimately, this resulted in HC stopping collection of milk from one of the CBEs, which later withdrew from the project.

b. In hindsight, partners have noted that engaging the KDB as the regulatory agency more structurally in the implementation might have favoured some of the intended changes (e.g. removal of unhygienic plastic cans, curbing diversion of contaminated and rejected milk to other markets). It should be noted that this is not a given, as KDB's track record in coordinating such processes is lacklustre.

D. Thus, the following lessons can be drawn from this pilot project

- **Designing a QBMPS:** The proposed model was borrowed from a smallholder milk supply chain in another context. At the start it was insufficiently adapted to Kenyan circumstances. The scope was too ambitious, with too many parameters and interventions that the project was not able to implement properly within the short time frame. It would have been better to start with fewer milk quality parameters for bonus payment. During that period, other parameters could have been tested and tracked in order to gain better insight into milk quality and safety aspects in the supply chain. As changes in entrenched practices and behaviour do take time, such changes should be more intentionally prioritized and addressed, as well as be more limited in number. The design of the M&E results framework should be focused on progress on key changes, rather than on key performance indicators and means of verification that are more linked to activity implementation.
- **Management of pilot:** Despite the rather detailed results framework, the pilot was designed to be adaptive. This requires strong data collection and management, which can then be used to adjust management. Sufficient capacity should be built in the lead and partner companies for this type of monitoring, evaluation and learning style.
- **Importance of a champion:** There was strong commitment by HC management to use their long experience in the sector and insights from the pilot to flag milk quality and safety as a critical issue that could threaten the sustainable and competitive development of the entire industry in Kenya. The company has taken a risk by being vocal about milk quality, being willing to share its data and agreeing to test the innovation of a QBMPS in a smallholder context. While the initial response in the sector was resistance, the persistence of HC has won support and engagement from peers.
- **Technology options:** The current testing system is expensive, considering that it is testing the milk of smallholder farmers who market less than 10 kg of milk per day. At the project level, there is a need to continuously search for new testing technology and equipment that is more cost-effective and to design an optimum sampling and testing regime (scope, frequency, sampling points).
- **Farmer behaviour change:** A proper mix of instruments is needed to motivate farmers to change milk-handling practices, considering their socioeconomic and cultural contexts. Introduction of a QBMPS project needs to be accompanied by a combination of training and extension support along with financial incentives and penalties. The project's strong emphasis on sensitization of farmers assumes that knowledge and skills were the bottleneck, and improvements of these would result in farmer investments and behaviour change. Quick rewards for behaviour change coupled with rejection of poor milk may have been more effective, but only if there was actually a level playing field and the rejected milk could not find another market.
- **Business case:** What does it take to invest in a QBMPS? What is the business case? Who benefits and who loses? Is win–win possible? What business relationships are assumed to catalyse? Some actors felt that they incurred a financial cost from the project, and the data confirm this. CBEs felt forced to increase costs significantly, which – especially in a drought year – they were unable to sustain. The project design and its implementation would have benefited from business-case thinking for each stakeholder, linked to stronger risk assessment and risk management plans. The system should also make financial sense to all the actors involved and not just be implemented based on its appeal. There is need for a pre-project financial feasibility study, preferably using the worst-case scenario with the lowest expected milk volume. In addition, milk pricing remains a thorny issue that requires policy and market interventions to ensure fairness.
- **Public–private partnerships:** Donors who are promoting and supporting these arrangements need to take into account the fragility of existing business relationships and development interventions and the capacity of the private sector to implement such arrangements. We observe that at the conceptualization of the project this was not sufficiently taken into account by all parties, including KMDP as fund manager and EKN as donor. During implementation both KMDP and HC recognized these fragile relationships, the market dynamics at work and the behavioural change required, and made several adjustments to the implementation strategy. The lesson here is that development actors and private sector actors need to avoid undue stress on business partnerships, overly optimistic assumptions about what it takes to make public–private partnerships successful in complex contexts (agri-food sector) and unrealistic impact expectations.

3.2 Recommendations

The investments made in this pilot have laid an important base for continuing to support the ambition to reorient HC's smallholder-dominated supply chain towards quality and safety. We make several recommendations to ensure the huge investments of the pilot are leveraged in fine-tuning a QBMPS that would work better and can be adopted and scaled up by multiple actors. These recommendations have been shared with HC at an earlier stage, after which HC started to implement them (see Box 3.1).

Recommendations for Happy Cow Ltd (and other processors)

- **Investment in an integrated management system for a data-driven business model:** The QBMPS is a heavily data-driven business model. It requires investment in integrated systems that enable seamless data capture, storage and analytics at different critical testing points at both CBE and processor level. It also requires managerial capacity to continuously use the analytics to guide business decision-making. This was a key gap in the QBMPS pilot for all the business actors. HC will need to focus more on this aspect of the business and to make the necessary technical and managerial investments if it is to further integrate the system in its business.
- **Business partnership management:** The dairy sector structure in Kenya has developed in a manner that has promoted mistrust, unethical behaviour, battle for milk volumes rather than quality, and limited loyalty among business partners. To continue with the QBMPS, HC and other processors that want to invest in such a system will need to carefully and deliberately build strong and mutually beneficial (win–win) business partnerships with suppliers and other actors in the chain.
- **Leveraging the KENAS accredited laboratory services:** The accreditation of the HC laboratory offers opportunities to grow a new business line. This has to be strategically developed. The HC KENAS accreditation also provides opportunities to share data and experience within the Kenyan dairy industry. This can be done through peer networks that HC is part of (Kenya Dairy Processors Association) and through opportunities to contribute its experiences to stakeholder platforms where the agenda for milk quality and safety has gained momentum.
- **Business case:** The business case of the QBMPS would really be proven if (when) HC moves towards premium dairy products. This would not only increase returns on investments, but also demonstrate QBMPS as a means to an end.

Recommendations for the sector/industry

- **Transferability:** Industry actors should lead the efforts in entrenching QBMPS in their supply chain, drawing lessons from the HC pilot. Wider application should make the system leaner and more cost-effective, yielding results at scale.
- **Scalability:** More needs to be done to increase momentum in scaling the QBMPS. As an industry-wide agenda, it will be important to support stakeholder engagement that enables exchange and learning among the different actors, to fine-tune a system that will be workable nationwide. The forms of such stakeholder engagement can vary, but with devolution in place, county-level platforms might provide an entry point. This can build on some ongoing efforts, supported through public–private partnerships.
- **Widespread improvements:** Efforts by all industry actors to improve milk volumes and quality should be concurrent. The investments needed for QBMPS need to be recovered through increased milk intake levels, with attention for benefits by all actors.
- **Technology:** The sector needs to embrace technologies that enable on-time testing and transmission of results. Some of this technology is already available in the market; other technology may need to be co-developed through innovation partnerships.

Recommendations for the public sector

- **Public investment:** Assessment of the public health costs and benefits of a QBMPS in Kenya (Ndambi et al. 2018) demonstrated the huge benefits in ensuring milk safety to consumers. This makes a good case for public agencies (KDB; Ministry of Health; Ministry of Agriculture, Livestock, Fisheries and Irrigation) to push for necessary public investments to entrench such a system in the sector.
- **Cooling technology:** The experience of HC revealed that attention is required for appropriate (faster) cooling technology. Current efforts by government agencies in procuring milk-cooling tanks may not have paid sufficient attention to this and should look to remedy this situation if milk quality assurance is to be successful at large scale.

Recommendations for development partners and donors

- **Roles of supporting agencies:** SNV-KMDP's multiple roles in providing external support – financing, management advice and technical advice – requires some attention. How can an innovation like this best be financed? Should the fund manager be co-implementing or take more of a monitoring role? International technical support was important for the project, but did not always match the needs of HC, the CBEs and the context. HC was sometimes hesitant to involve external expertise, as they felt experts had insufficient knowledge of the local context. More clarity of roles might have helped in managing expectations within the CBEs, HC and KMDP.
- **Synergy to help scaling up:** Momentum has been created to drive the dairy sector in Kenya towards quality and safety through this QBMPS pilot. Many development programmes are now supporting this critical issue. Development programmes should create synergy, rather than duplicate efforts, in their contribution to the scaling-up of such a system in the country.
- **Public–private partnerships:** Supporting public–private partnerships as a modality for fast-tracking innovative solutions in dairy (agro-) sector development is important. However, in general more attention should be paid to understanding the workings of such partnerships and the challenges that emerge. It is critical to build learning and partnership management support in, including through action-oriented research to accompany such processes. Additionally, the time required to build partnerships is often not well catered for, as projects are expected to be rolled out and results achieved in short timespans. This calls for new approaches for project design in complex environments.

Box 3.1 *Post-assessment project developments.*

Improving QBMPS design

- HC has already planned to address a number of the lessons learned on design weaknesses from section 3.1.C (notably b, c, d and e). It is revising the bonus payment system (see Appendix 5 for graphical summary).

Enhancing quality testing

- Over the course of 2018/19, further analysis by an expert showed that TPC test outliers above 100,000,000 cfu/ml should be deemed unreliable due to errors resulting from 'level 6' measurements with the 3M reader. Nevertheless, average TPC levels remained high and of concern during the entire project period, also because the instant cooling equipment from Aviva was still not fully operational by the end of 2018.
- In 2019, Olenguruone started testing ABR in individual milk cans in batches of eight (composite sample). If a result is positive, they work back to find the problem milk can(s). This helps to trace and follow up with the farmers who are the source of the ABR. This new approach is partly financed through the project. After the project ends, Olenguruone needs to decide whether it will continue with this procedure.
- According to HC, in December 2018 the proportion of ABR-positive samples dropped to zero. This has remained so over the first quarter of 2019 due to stringent testing (fast testing kit) of 50-litre milk cans (composite samples).

Improving the data management system

- HC is making concerted efforts to solve data processing and utilization issues. It continues to work on the data management software. More reliable results are expected before the close of the project, when the database software problems have been tackled.

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APPENDICES

Appendix 1 KMDP Intervention Areas

The overall goal of KMDP is to contribute to the development of a competitive, market-driven and private sector-led Kenyan dairy sector, with beneficiaries across the value chain. Enhanced competitiveness is defined as being the result of the combination of cost price of raw milk (productivity), efficient milk collection, processing and marketing, quality of milk and dairy products, level playing field and effective competition in the market.

The project contributes to an improved business and investment climate of the Kenyan dairy sector. It promotes and facilitates business-led networks and collaborations between Kenyan and Dutch dairy sector stakeholders for enhanced trade, exchange of knowledge, skills development and innovation. The Dutch dairy sector has valuable knowledge and technology to offer provided these are adapted to local needs and are affordable. The transitioning from aid to trade relations in the dairy sector, is used by the project as a strategy for increased sector growth and competitiveness, and for achieving food security and food safety.

a. Practical Skills and Farm Management

To address the skills gap in the dairy sector, KMDP facilitates linkages between Kenyan dairy advisors and international experts and trainers. These local dairy advisors are also linked to Dutch input suppliers and service providers who have set up business in Kenya. Dairy Advisory focuses on smallholder lead farmers and medium and large-scale farmers and is being professionalized by equipping and training the dairy advisors with tools for benchmarking farm performance, advising on the most optimal feed ration for different categories of cows and monitoring herd fertility and key performance indicators in the farm. In the dairy value chain, KMDP supports dairy cooperative societies and milk processors with setting up their own training & extension units. As a third intervention in the field of practical skills development, KMDP promotes and supports the PDTC concept where a local dairy training company collaborates with host or training farms (Practical Dairy Training Centers) and offers 1-week structured training for various target groups. Lastly, KMDP-II supports initiatives and partnerships between Kenyan and Dutch institutes for dairy education and training, with emphasis on E-Learning and other structured training and education materials and concepts, that are contextualized to the Kenyan situation and needs.

b. Feed and Fodder

KMDP has built up rich knowledge and experience as regards good practice forage production and preservation for smallholder, medium and large scale dairy farms (from seed to feed). Besides, KMDP has successfully piloted commercialization of quality forages and of forage contracting services. This was achieved through the SPEN model in the smallholder supply chain and the concept of "maize train" for medium and large scale farmers (i.e. mechanized agricultural contracting services for maize production, harvesting and silage making), and by facilitating introduction of innovative machinery for making baled silages. Through replication and upscaling, this will ensure enhanced access of quality forages for small medium and large-scale dairy farms. In 2018 KMDP-II also started a pilot on introduction of feed rationing software to help optimizing total rations and margin above feed costs. In addition KMDP collaborates with CIAT on piloting of various brachiaria varieties and it participates in forage sector platforms.

c. Milk Quality

KMDP Phase I and II worked with 35 dairy cooperative societies and 3 milk processors Meru Dairy Cooperative Union, Happy Cow Ltd and Bio Foods Ltd, on a number of issues related to milk production, collection, bulking and marketing, service provision and governance & management. The interventions on milk quality ranges from more generic to specific in terms of piloting innovations and policy influencing. On the generic level milk collectors, transporters and graders of dairy cooperatives are trained and milk quality policies are being developed and implemented on 17 cooperatives. Next to this KMDP has a targeted approach where it supports Happy Cow Ltd from Nakuru and two of the cooperatives that supply the processor with milk, with implementing a milk quality tracking & tracing system and a quality-based milk payment system. At policy level KMDP-II works with Kenya Dairy Board (KDB) and the Kenya Dairy Processors Association (KDPA), where it supports the milk campaign and development of a strategic plan.

d. Functional Dairy Value Chains

KMDP supports within the partnerships it has with processors and dairy societies so-called functional dairy value chains, characterized by formal and inclusive relationships between farmers, dairy societies and processors with inclusion of youth and women. Important drivers for such relationships are trust and loyalty, timely payment, fair and stable prices and provision of quality services from the processor to the dairy society to the farmer. These services should be geared towards enhancing productivity at the farm level, and efficiency and quality in raw milk collection and marketing, as this will contribute to enhanced profitability and sustainability of the dairy enterprise and the industry as a whole. Functional dairy value chains are also characterized by a stable and conducive relationship of dairy value chain actors and input/service providers with policy makers and regulators, with a common vision on how to address systemic bottlenecks for sector growth and competitiveness. At this level KMDP supports Kenya Dairy Board and Kenya Dairy Processors Association, the latter with strategic plan development. KMDP also participates in national forums for feed and fodder, milk quality and TVET (practical skills development).

e. International Linkages

KMDP promotes and facilitates international knowledge exchange, business linkages and other partnerships for learning and sharing of information. This is an important condition for fast-tracking adoption of good agricultural practices and innovations that are necessary to enhance the competitiveness of the sector, its long-term sustainability and its attractiveness for investors. KMDP-II supports investors' forums, dairy trade fairs and exhibitions, market studies/ scans, international study tours and trainings, and most importantly business-to-business linkages (B2B). B2B linkages and partnerships are considered as a more sustainable way of promoting change, innovations and best practices than aid relationships, as they are market-led and will prevail as long as there is demand for the products and services. KMDP has been successful in forging B2B linkages between Kenyan and international input suppliers and service providers, and assisted others with setting up base in Kenya and investing in the sector. This is partly facilitated through KMDP's Innovation Fund where private investors receive co-funding for innovative business cases, demos and pilots to address sector systemic issues.

Appendix 2 Terms of Reference

SNV/KENYA – KENYA MARKET-LED DAIRY PROGRAMME (KMDP)

TERMS OF REFERENCE FOR ASSESSMENT AND DOCUMENTATION OF THE MILK QUALITY TRACKING & TRACING AND QUALITY-BASED MILK PAYMENT PILOT PROJECT OF HAPPY COW LTD

1. Preamble

SNV Netherlands Development Organisation (SNV) is an international not-for-profit development organization that provides capacity development services to nearly 2,500 organizations in over 36 countries worldwide. In Eastern & Southern Africa SNV operates in 9 countries: Ethiopia, Kenya, South Sudan, Uganda, Tanzania, Rwanda, Zambia, Zimbabwe and Mozambique. In Kenya, SNV focuses on horticulture, dairy, extensive livestock, water and sanitation and renewable energy (biogas). In the dairy sector SNV Kenya is implementing the Kenya Market-led Dairy Programme that is now in its second Phase (KMDP-II, 1 Oct 2016–30 June 2019). Under KMDP-I (1 July 2012–31 December 2016), one of the core interventions was a pilot project—or proof of concept—to introduce a Quality Based Milk Payment System (QBMPS) by Happy Cow Ltd, in collaboration with two dairy societies supplying raw milk to this processor in Nakuru.

2. Happy Cow Project (MQT&T and QBMP pilot)

Phase 1: 1 November 2014–31 December 2016

In October 2014, SNV/KMDP signed an agreement with Happy Cow Ltd for the implementation of a Milk Quality Tracking & Tracing and Quality Based Milk payment pilot project, as is the full name of the project. Happy Cow is a medium-size—ISO 22000 certified—manufacturer of cheeses and fermented milk (yoghurts, Maziwa Lala and Kefir) mainly for the domestic market and some for export to neighbouring countries. Average processing volume is 15,000 litres per day.

The project is the first of its kind in Kenya in the smallholder supply chain, where milk production, collection and marketing is driven by volumes, with minimal attention for milk quality. These factors result in raw milk that is of sub-standard quality and consequently (raw and) processed milk often does not comply with KEBS standards for the main food safety parameters. This is seen as a systemic bottleneck that hampers the sector to enhance competitiveness and keep abreast with growing consumer awareness and demand for safe and tasty products, and also to export milk and dairy products.

Funding of the project—that also entered into its second phase—was made available by the Netherlands Embassy in Nairobi through KMDP, which is entrusted with fund management and project monitoring. Happy Cow implements the project with two of its suppliers namely Olenguruone Dairy Society Cooperative (2,500 active suppliers and 9,400 litres per day: 2016 figures) and New Ngorika Milk Producers Ltd (1,000 active milk suppliers and 6,900 litres milk per day: 2016 figures).

The agreement between SNV/KMDP and Happy Cow for the first phase of the project, is based on a comprehensive project proposal and project design covering a period of 27 months. The proposal and the agreement identify a clear set of interventions or activities for 4 results areas, with deliverables and means of verification for each. This facilitates and informs monitoring of the project and release of funds by the fund manager (SNV). The total budget was € 459,177 with a grant from SNV of € 311,000, whilst own contribution from Happy Cow and the two dairy societies stood at € 148,177.

In November 2016 an Interim Evaluation of the project took place. Amongst others the report observed that implementation realities and complexities on the ground, resulted in delay of implementation and the need to adjust interventions and investments. Also, new areas of concern and important issues to address were identified during the first 2 years of project implementation. The report concluded that in spite of the delays caused by a hostile enabling environment and difficulties of all partners in the project to play their role as expected (farmers, transporters, dairy cooperatives and

the processor), the project did gain sufficient momentum internally but also at sector or policy level, to justify a phase 2 funding.

Phase 2: 1 February 2017–31 January 2019

This led to a joint decision by Happy Cow, SNV and the donor to end the project under KMDP-I (ending 31 December 2016) at Result 3 and to reformulate a new project proposal for Result 4 for financing under KMDP-II (KMDP runs from 1 October 2016 till 1 July 2019). Hence in February 2017 a project proposal for phase 2 of the project was completed and submitted to SNV for a period of 24 months with a budget of € 282,545 (grant SNV of € 128,653 and own contribution of € 153,892).

In the course of 2017, progress in the project stagnated, with the few farmers receiving bonus payments at the end of phase 1 stabilizing or even decreasing. Willingness and/or ability of the dairy societies to vigorously implement the project design and systems from the farm level to the collection points in the routes, up to the milk intake and cooling tanks at the society level, dropped or at least did not get to the expected. Reasons that attributed to this were the severe drought experienced in the year 2017 that affected the financial capability of the 2 dairy societies to invest in the project and the collapse of Nakumat Supermarkets, leaving processors including Happy Cow with huge debts. Other reasons mentioned were the need for behavioural change and a more conducive enabling environment (enforcement of standards, codes of conduct by processors, banning of hawkers, etc.).

The strategy to fast track the project in the second half of 2017 was to focus in each dairy society on 2-3 demo routes only. With the assumption that if all systems are in place in these routes many farmers would receive bonuses. This would set an example for the other routes which would then follow suit. In the first quarter of 2018 it became clear that this strategy had not yielded the expected results, and that efforts of the dairy societies to implement the work plan for 2018 and to scale-up the demo routes were mixed. Response was lowest in New Ngorika. This led SNV and Happy Cow to partly put the project on hold, which de facto was already the case as the dairy societies had not requested for any project funding since mid-2017.

However at Olenguruone, with the help of Egerton University students, some farmers in the demo routes volunteered to assist in manning the collection points and performing milk grading on behalf of other members. They are referred to as prefects. This was to facilitate milk collection, milk tracking & tracing as well as assuring more farmers being able to access the bonus. The group is still in existence up to date.

In Phase 1 Happy Cow introduced the following quality parameters for tracking and tracing and bonus payment:

- TPC or bacterial count
- Antibiotic residues
- Total solids
- Freezing Point (adulteration).

In Phase 2 of the project Happy Cow also started testing on somatic cells and aflatoxins. So far these 2 extra parameters have not been included in the bonus system.

After 3.5 years from the start, the project partners have not been able to collect milk that is of a significant higher quality, and to use this as an incentive to pay a bonus or an incentive to the majority of farmers. The system of milk collection, separation and cooling from the farmer to the dairy society, and interception of milk that does not comply with the standards, was never fully and vigorously implemented by the project partners. Yet it is system that drives the results.

In this respect the project did not perform and yield as expected, and as per today only a small percentage of farmers and milk delivered to Happy Cow Ltd qualifies for bonus payment. This has also been reported by SNV in KMDP's progress report for 2016-18 that was submitted to the Netherlands Embassy in April 2018 (reference is made to Annex 1 for an abstract of the section on Happy Cow Ltd in this progress report).

In March 2018 it was agreed by SNV and Happy Cow that focus for the next 6-9 months would be:

a. KENAS accreditation Happy Cow laboratory.
b. Establishment of satellite labs at the 2 dairy societies.

c. Dairy societies: assure reliable access to clean water, ensure completion and use of Aviva fast-cooling equipment, allow separation of project and non-project milk, and facilitate sample collection at the farm level for enrolment in the database.
d. Building a robust data base for all milk quality parameters in the project (incl. somatic cells and aflatoxins), with milk being tested across the chain at all critical control points: farmer–can–CBE platform cooler - tanker truck (loading from chilling tank CBE)–tanker truck (arrival at HC Nakuru). This would also include project versus non-project milk at the CBE platform and periodic testing of milk from the shops and milk dispensers or ATMs in Nakuru and environs.
e. Project Handbook, including flow charts, SOPs, work instructions and procedures.
f. Happy Cow project study: documentation for learning and sharing with sector stakeholders.

3. Project Assessment and Documentation

It is against this background that SNV KMDP and Happy Cow Ltd wish to initiate an independent project assessment and documentation, including the successes and failures of the project—and the underlying reasons—and its scalability.

The learning will be both for the project owners, the fund manager (SNV) and the donor (EKN), as well as for other stakeholders in the sector who are concerned with milk quality and ways and systems to enhance this (farmers, dairy cooperatives, milk processors, consumers, regulators and policy makers. This documentation gives Happy Cow Ltd and partners an opportunity to critically review past activities and consequently improve key elements of the QBMPS. It borrows also a leave from the recently completed 3R study that calculated the cost of implementing a QBMPS on 2.5 KES/kg milk; costs that CBEs/Coops/Processor are incurring and that needs to be reduced to make scaling-up attractive.

As a pilot, the project was designed with the ambition to demonstrate the potential for QBMPS for a smallholder supply chain in the Kenyan dairy sector. After 3.5 years of implementing the pilot, the partner organizations would like to:

a. Document the project background, design and implementation; the bottlenecks faced by the project partners and the project's successes and failures.
b. Systematically review the lessons learned in implementation of the systems—what worked well and what did not; this will include an assessment of:
   - costs and benefits of a QBMPS
   - prevailing practices in the smallholder milk collection chain and their drivers
   - the quality of raw milk supplied
   - pre-conditions to be met for successful implementation of QBMP system.
c. Advise Happy Cow Ltd on the next steps to be taken, taking into account the activities suggested by Happy Cow Management as documented in Annex 2.
d. Generate foresight on the scalability of such a system in the dairy sector in Kenya.

4. Scope of Project Review and Documentation

In reviewing and documenting the project and its deliverables for learning purposes, the consultants shall address/report on the following areas and elements:

I. Description

a. Introduction of/to the Kenyan dairy industry (size, structure, trends) and the regulatory and policy framework as regards milk quality, including KEBS standards for different parameters.
b. General outlook and status of milk quality and food safety in Kenya and perspectives from different stakeholders (processors, consumers, government agencies) on the gravity of the problem. Cost implications to society of unsafe milk and dairy products (public good: see 3R Kenya Project Research Brief).
c. Introduction to SNV and the Kenya Market-led Dairy Programme: key objectives, focus areas and work of KMDP on milk quality and QBMP.
d. Background to the Happy Cow Project: project justification and partnership with SNV KMDP and with New Ngorika and Olenguruone.
e. Project design: organization, systems, management, roles and functionalities (see also: Project proposal and Happy Cow QBMP-project Handbook).
f. Project progress general: implementation of project design and planned changes (by farmers, transporters, graders, tank attendants, Management and Board, etc.) in milk handling, collection, testing and cooling and bonus payments.

g. Specific deliverables: Project Handbook, MQT&T system, Milk Quality Data Base, Milk Quality Payment system, HC and satellite laboratories, innovative testing equipment.

II. Analysis

a. Project outcomes for Happy Cow, the two dairy societies, farmers, transporters and other supply chain operators (milk quality, services, economic and social benefits, supplier-buyer relationship, others).
b. Project outcomes at other levels, e.g. County, Government institutions, KDB, KDPA, development partners, international donors. For example to which extent the project has contributed to increased awareness and attention for milk quality at the meso- (other processors) and macro level (central and County government, KDB, KDPA, development partners, international donors, researchers and other interest groups.
c. Underlying causes of project successes and failures: i.e. project design versus local setting, internal organization and management project partners, economic, social and cultural factors, enabling environment, others.
d. Success factors and pre-conditions required for replication and scaling-up of the project or parts thereof; refer to economic costs versus benefits for HC and partners (see: Research Brief).

III. Discussion and recommendations

a. Lessons learned.
b. Recommendations related to scaling.

5. Methodology

Following discussions between KMDP and 3R Kenya Project, it was agreed that the Scaling Scan tool developed by PPPLab (https://ppplab.org/2017/11/3223/) seems to provide a useful starting point to for developing an analytical framework to guide the proposed assessment, especially as regards to the replicability or scalability of the project. The Scaling Scan outlines ten key ingredients that can be useful to reflect on the lessons from implementing innovative interventions in the agricultural sector and understanding the potential for scaling. The ten ingredients include:

- Technology /Innovation
- Awareness and demand
- Value chain development
- Business case
- Financing
- Knowledge and Skills
- Platforms and collaboration
- Data and ICT
- Leadership and management
- Public sector governance.

As shown in Fig. 1, the 10 ingredients can be classified under 4 broad categories: Business & Markets, Governance and Regulation, Empowerment and Transparency and Knowledge & Technology (PPPLab 2018).

Figure A Scaling scan (PPPLab, 2018)

As proposed and in principle, the ingredients of the scaling scan framework provide a wide range of aspects that can be used to assess the QBMPS-pilot and to draw lessons on the outcomes of its implementation. The assessment will expound and adapt the methodology developed for the scaling scan, complemented—if and as deemed relevant—by the use of other impact assessment tools and collection of different types of data (qualitative and quantitative) to ensure a robust assessment of the pilot.

A 6-step approach is proposed for the assessment:

a. Expound the methodology (scaling scan versus—or complemented by—other impact assessment tools).
b. Review of various project documents and other information sources including studies that have been conducted on the QBMPS that provide key insights on the lessons learned. The analysis will be guided by adapted methodology.

c. In-depth interviews with selected key individuals involved in the implementation of the project. The interviews will be conducted before we undertake the third step.
d. One day guided workshop with representative actors involved in the various stages of implementation of the QBMPS for a self-assessment process. The workshop will enable the project owners/partners to collectively assess the different dimensions of the pilot and score what worked well or not. If need be at the end of the assignment the draft report can be shared and presented in a one-day validation workshop.
e. Meetings with relevant actors on next steps in the project, or thereafter.
f. One day dissemination workshop for sector stakeholders.

6. Expected Outputs, Assessment Team and Time frame

KMDP in collaboration with Happy Cow Ltd is proposing 3R Kenya Project to undertake this assessment. Over the past few years the dairy team of 3R Kenya Project has gained deep knowledge of the dairy sector in Kenya, particular also as regards the issue of milk quality.

Not only in terms of technical issues on milk quality parameters, collection, handling, cooling and testing of raw milk in the dairy value chain, but also in terms of the enabling environment that includes market dynamics/players and consumer awareness, social and cultural perceptions and behaviour, and dairy sector regulation and policies. It is only with this holistic perspective in mind that "milk quality" can be fully understood in Kenya and relevant lessons from the Happy Cow project with sector recommendations can be drawn and communicated.

Apart from having the required expertise (including Kenyan researchers from relevant and respected institutions), 3R Project Kenya also has the mandate from the donor perspective to carry out this assignment. So far it has done a number of studies in the dairy sector, amongst other it published a Research Brief on the private and public good of QBMP systems with the Happy Cow project as example ("Private and Public Costs and Benefits of implementing a Quality Based Milk Payment System in Kenya, 3R Kenya Project, 2018).

However having noted this, 3R Project Kenya researchers will consult other experts if and as required, for example those involved and /or with knowledge of milk quality payment systems in other countries in East and Southern Africa or Asia, notably from The Friesian and DTC. Besides, relevant staff from Happy Cow, SNV and Bles Dairies East Africa will be resource persons and shall also make available sufficient time for consultation and (where applicable) contributions towards—and review—of the final document. SNV will facilitate the workshops and printing of documents.

Outputs

- A report as per the scope presented under section 6 above.
- Meeting with Happy Cow to advice on next steps to be taken.
- Dissemination workshop on the findings.

Assessment Team

Asaah Ndambi, Catherine Kilelu, Jan van der Lee and Ruth Njiru (as available).

Time frame (workplan)

Activity	June	July	Aug	Sept	Nov	Dec
Review of scaling scan tool and refine methodology for fit of purpose (for our study)	x					
Project actors joint review workshop	x					
Documents review	x	x				
Key informant interviews		x	x			
Analysis and write up			x			
Project actors validation workshop (optional)			x			
Meeting with Happy Cow Ltd and SNV to advise on next steps to be taken				x		
Multi-stakeholder dissemination workshop				x		
Final report writing				x		

Annexes

Annex 1 – SNV KMDP 2016-17 Progress Report to EKN (April/May 2018)
Annex 2 – Happy Cow Ltd self-reflection and aspirations

Appendix 3 List of interviews

Name	Organisation	Position
Wilson Mabwai	Olenguruone (Olenguruone Dairy Farmers Cooperative Society)	Chairman
Wesley Langat	Olenguruone	Manager
Peter Cheruiyot	Olenguruone	Secretary of the board
Peter Terer	Olenguruone	Board member
Wilson Saurei	Olenguruone	Extension staff
Sammy Ngeno (Kiptendetn)	Olenguruone	Farmer
Group Interview at MCP	Olenguruone	Farmers
John Kileges	Olenguruone	Lead farmer
Emily Kirui	Olenguruone	Milk chain coordinator
Daniel Rono	Olenguruone	Milk quality controller
Alice Langat (Segel)	Olenguruone	Prefect
Group Interview 1	Olenguruone	Farmers
Group Interview 2	Olenguruone	Transporters
Andrew Soi	Olenguruone	Prefect
Renny Chemutai	SNV consultant (Olenguruone)	Extension staff
John Ndegwa	New Ngorika	Operations director
Samuel Mugwe	New Ngorika	Finance director
Margaret Ndungu	New Ngorika	Manager
Gabriel Karume	New Ngorika	Farmer
Samuel Munyua	New Ngorika	Farmer
Peter Kamau	New Ngorika	Grader
Janet Chepkoech	New Ngorika	Milk chain coordinator
Daniel Njenga	New Ngorika	Farmer
Susan Njuguna	SNV consultant (New Ngorika)	Extension staff
Gerard Oosterwijk	Happy Cow Ltd	Director
Teresiah Ndungu	Happy Cow Ltd	Project manager
Anton Jansen	SNV	KMDP team leader
Cosmos Muchina	SNV	KMDP M&E officer
Dirk Harting	Bles Dairies	Managing director – East Africa

Appendix 4 Presentations made by Happy Cow to share experiences and advocate for change in the Kenyan dairy industry

	Forum	Date	Place	Presenters	Types of stakeholders reached
1.	National dairy quality and market access programme forum	8-9/04/15	Naivasha	Teresiah Ndungu and Reuben Koech	
2.	East Africa Dairy Development (EADD) workshop	14/04/15	Eldoret	Teresiah Ndungu	
3.	ESADA* 11th African Dairy conference and exhibition *Eastern and Southern Africa Dairy Association	24/09/15	Nairobi	Teresiah Ndungu, Gerard Oosterwijk and Anton Jansen	Private and public sector actors
4.	Standard and Market Access Program (SMAP)	16/12/15	Nakuru	Teresiah Ndungu	
5.	Githunguri visitors	14-15/01 /16	Happy Cow and Ngorika	Gerard & Catherine Oosterwijk, Teresiah Ndungu, Emily and Albert of Githunguri	Dairy coop
6.	ECDPM*—COMESA workshop *European Centre for Development Policy Management	29-30/03 /16	Nairobi	Teresiah Ndungu and Reuben Koech	Regional stakeholders
7.	Nuffic*—Alumni event, Ethiopia * Dutch organization for internationalization in education	19–21/05 /16	Addis Ababa, Ethiopia	Catherine Oosterwijk and Teresiah Ndungu	WUR Alumni
8.	WUR* Wageningen "Milking to Potential" * Wageningen University & Research	20/05/2016	Wageningen The Netherlands	Jan Ulfman	International course participants ()
9.	Kenya Dairy Processors Association (KDPA)	10/08/16	Nairobi	Gerard and Catherine Oosterwijk	Dairy processors
10.	Kenya Dairy Board (KDB)	18/08/16	Nairobi	Gerard Oosterwijk and Teresiah Ndungu	Dairy regulator
11.	Western-Kenya Dairy Project (Hindri Kuipers team-leader, GE-GIZ program)	15/09/16	Happy Cow	Gerard Oosterwijk and Teresiah Ndungu	
12.	Voice for change partnership (SNV, IFPRI*, ILRI* and CUTS*) * International Food Policy Research Institute * International Livestock Research Institute * Consumer Unity & Trust Society	03/10/16	Happy Cow and Ngorika	Gerard and Catherine Oosterwijk	Consumer advocacy, researchers, SNV (NGO)
	Forum	**Date**	**Place**	**Presenters**	**Types of stakeholders reached**
13.	DTI* Oenkerk, Dairy processing course *Dairy Training Institute	18/10/16	Oenkerk, The Netherlands	Jan Ulfman and Alex Oosterwijk	
14.	KMDP* workshop (Nakuru) * Kenya Market-led Dairy Program	05/12/16	Jarika hotel, Nakuru	Teresiah Ndungu	Project partners
15.	KMDP workshop (Meru)	14/12/16	Heritage hotel, Nkubu.	Teresiah Ndungu	Other dairy coops
16.	Nakuru Dairy B2B forum: Global communities	30/01/17	Waterbuck Hotel, Nakuru	Teresiah Ndungu/Gerard Oosterwijk	
17.	Meeting with Heifer International team	26/04/17	Happy Cow Ltd	Gerard Oosterwijk	
18.	Meeting Danish Visitors	27/04/17	Happy Cow Ltd	Gerard Oosterwijk	
19.	National Agricultural Value Chain Forum (NAVCF)	16/05/17	Egerton University	Gerard Oosterwijk	Various stakeholders
20.	Training at HC for Egerton students	03/07/17	Happy Cow Ltd	Teresiah Ndungu	

21.	MD and chairman KDB	05/07/17	Happy Cow Ltd	Gerard Oosterwijk	Dairy regulators
22.	Egerton University/3R* Kenya team * Resilient, Robust and Reliable WUR	16/08/17	Happy Cow Ltd	Teresiah Ndungu	
23.	Discussion Forum on Evidence-Based Policy Advocacy	18/09/17	ILRI	Teresiah Ndungu	
24.	Testing on Residues in Dairy. CHR Hansen Seminar	14/11/17	Eka Hotel, Nairobi	Gerard Oosterwijk	
25.	ESADA 13th Conference	17/11/17	Johannesburg, SA	Teresiah Ndungu	
26.	Nakuru Dairy Stakeholders Forum by KDB	01/03/18	Catholic diocese, Nakuru	Victor Nderitu	Dairy stakeholders
27.	Dairy Investors Forum	23/03/18	Eldoret	Gerard Oosterwijk	
27.	Regional harmonization meeting on milk and milk products (EASC/TC 017)	16–20/04 /18	Pride Inn Hotel, Kigali Rwanda	Victor Nderitu	
28.	Presentation during a forum on building alliances with consumer organizations on Food Safety Agenda in KENYA	13/06/2018	Hilton Hotel, Nairobi.	Teresiah Ndungu	
29.	3R Work Shop Progress QBMP project	28-29/ 06 /18	Tumaini, Nakuru	Gerard Oosterwijk	
30.	Heifer International Kenya – Danida proposal	April-Aug 18	Nairobi	Gerard Oosterwijk	
31.	Nakuru County Food Safety & Loss Reduction Multi-Stakeholder Forum	03/09/18	Milele Resort, Nakuru.	Teresiah Ndungu	
32.	National Milk Quality and Safety seminar , Azure Hotel Nairobi	29/01/019	Nairobi, 29 January 2019	Gerard Oosterwijk Teresia Ndungu	All stakeholders

Publications

	Publication	**Types of stakeholders reached**
1.	**Two publications in year 2016** by Teresiah Ndungu: a) **http://www.academicjournals.org/journal/AJFS/article-full-text-pdf/8FDAD6758626**—for the Quality control of raw milk in the smallholder collection and bulking enterprises in Nakuru and Nyandarua Counties, Kenya with ***African journal of Food Science, published.*** b) ***http://www.academicjournals.org/journal/AJFS/article-full-text-pdf/5CC7E9560924***—for Hygienic practices and critical control points along the milk collection chains in smallholder collection and bulking enterprises in Nakuru and Nyandarua Counties, Kenya with ***African Journal of Food Science, published.***	Research\Academia\sector
2.	**Newspaper article:** Seeds of gold Nation newspaper article; 31st December 2016. http://www.nation.co.ke/business/seedsofgold/New-milk-payment-model-takes-shape/2301238-3502304-yl2mmbz/index.html	General public
3.	**Thesis award at Egerton University, Msc. Food Science for Teresiah Ndungu on 16th June 2017.** **Title:** Evaluation of hygienic practices and establishment of critical control points and raw milk quality in the smallholder supply chain of Nakuru and Nyandarua county, Kenya.	

Appendix 5 Proposed sampling regime and protocol for QBMPS in upscaled situation

Upscaled Situation

The "Up-scaled situation" is the follow-up of the project. The parameters for testing remain the same and are given in the Table 8 below (i.e. the standard platform tests, Total Bacterial Count, Composition, Antibiotics residues, Somatic Cells, Aflatoxin M1). The sampling regime foreseen after the pilot is less intensive and less costly and can be summarised as follows:

a) A milk analyser is placed at the CBE reception platform to analyse milk on composition and adulteration. Samples are taken and analysed daily from all the milk cans delivered at the reception platform.
b) A composite sample for testing at the Happy Cow Laboratory is taken once per month and unannounced from the 2-3 50 litre milk cans carried by each of the motorbike transporters (currently 28). The composite samples (28) are analysed at Happy Cow laboratory for the standard tests, but especially for Total Bacterial Count. TBC can only be tested at Happy Cow and is the parameter for bonus payment to transporters.
c) Once a week (on different days) a milk sample will be taken from the CBE cooling tank and from the Happy Cow tanker truck, for analysis at Happy Cow laboratory for the food safety parameters listed in Table 8
d) Separate protocols will be made for early detection of antibiotic residue in consultation with the CBE.
e) The bonus system will be enhanced to also include the transporters and the cooperative, and not only the farmers. The responsibility to award the bonus shall be delegated to the cooperative.

Draft Protocol

This **draft protocol** is designed for implementing during the Up-scaled situation (after the end of the pilot project in May 2019).

1) Milk analyser

Happy Cow (HC) and Olenguruone (Ole) will procure together one milk analyser to be stationed at the Platform at Ole. The cost of the milk analyser is estimated at KSH 250,000 including software, reader/printer and digital weighing scale of 200kgs. Ole will repay their share to HC through milk payment deductions. The analyser will be sourced from AVIVA and has a measuring speed of 18 secs per sample. Maintenance and repair cost are for Ole. The milk analyser should be used at the platform as follows:

a) All milk meant for Happy Cow shall pass the milk analyser.
b) All individual milk cans brought by the transporters shall pass the milk analyser.
c) Appropriate records/evidence must be shared with HC, e.g. rejected milk does not enter into the HC-cooling tank and kilograms of such milk should be recorded.

2) Mobile app for transporters

The milk analyser can come additional with a Mobile App for transporters. This software can be down-loaded and used on an Android phone at a cost of around KES 3,000/year. The transporters can record all basic data from their farmers, as measured along the route, including daily deliveries and quality of milk. The Mobile App for transporters is an ideal situation but likely not practical for Ole because:

- The mobiles of the transporters are basic and not always Android based.
- The yearly software cost per transporter needs motivation for them to embrace.

A more cheaper and sustainable way forward is that Rejected Results of the milk analyser are relayed to the concerned transporters and his/her farmers by SMS. The milk analyser will also be connected to an audio devise that "bleeps" at the platform when Rejected Results are recorded.

3) Bonus awards

The bonus award scheme will be as follows:

a) Milk analyser award

At this micro-level, HC cannot be involved too much, but tangible evidence needs to be commuted to HC-IT platform in Nakuru that milk analysing is indeed happening: recording total intake, rejection rates, fat%, density rates, etc. All milk meant for HC needs to go through the milk analyser and will receive KES 1.00 bonus.

Example: Ole will receive: 4,000 Lt daily * 30 Days * 1 KES = **KES 120,000 additional monthly**.

b) Transporters bonus award

The composite sample from each transporter (e.g. one sample of its 3 cans) will be analysed once every month at random and at HC lab. At the HC lab several quality parameters will be analysed with main emphasis on **Total Bacteria Count**; a low count is an indication of good raw milk. If at Ole all 28 transporters would participate, HC will provide monthly the outcome of these 28 transporters on TBC and the 25% best transporters (7) will receive KES 2.00 bonus for all milk delivered to HC in that month. Conditional is that these transporters must perform also well consistently on all the parameters at the platform and its milk analyser, for them to qualify for this bonus award. Ole will arbitrate which amount goes to the transporters and what amount goes to the farmer.

Example, if the transporter and his farmers supply 150 litres of milk daily, in a month it will be: 30 days * 150 ltr * 2 KES = KES 9,000 additional monthly. If the amount is divided by two, the transporters will get KES 4,500 and the other KES 4,500 will be divided amongst the farmers. Or for 25% best transporter (7) this amounts monthly to **7* KES 9,000 = KES 63,000**

c) Society bonus award for improvement on Total Bacteria Count

Currently, over last four months (October 2018 to January 2019) the bacteria load averaged monthly well above 10,000,000 cfu/ml (KEBS standards is below 2,000,000 cfu/ml). Ole board needs to work on basic quality principles to bring Total Bacteria Counts soonest below 10,000,000 cfu/ml. Note that the 10,000,000 cfu/ml is still a factor 10 higher than KEBS standards. Ole's cooling tank will be analysed once a week (4 times in a month). It should never have antibiotic residues and the bacterial count should be seen to improve. If an improvement of 25% reduction in TBC is achieved over time, Ole will get KES 0.5 per litre for all milk delivered to HC.

Example: if an average of 4,000 litres per day is supplied to HC, this monthly bonus amounts to: **4,000 Lts *30days *KES 0.5 = KES 60,000**. This monthly bonus (only when average TPC has improved compared to previous month) will pay for efforts of the Board, trainings, AB strips, etc.

Note: the easiest way for Ole's Board to achieve this bonus is practicing Good Milk Handling Practices, such as: using the existing PHE combined with the Instant Cooler, use 100% alu/ss milk cans, in-time milk deliveries, availability potable water, etc. These are all factors known to improve instantly raw milk quality (or TBC). If, as we have agreed, there are no significant efforts to work on this quality improvement, Ole will not access the KES 0.50 bonus from HC.

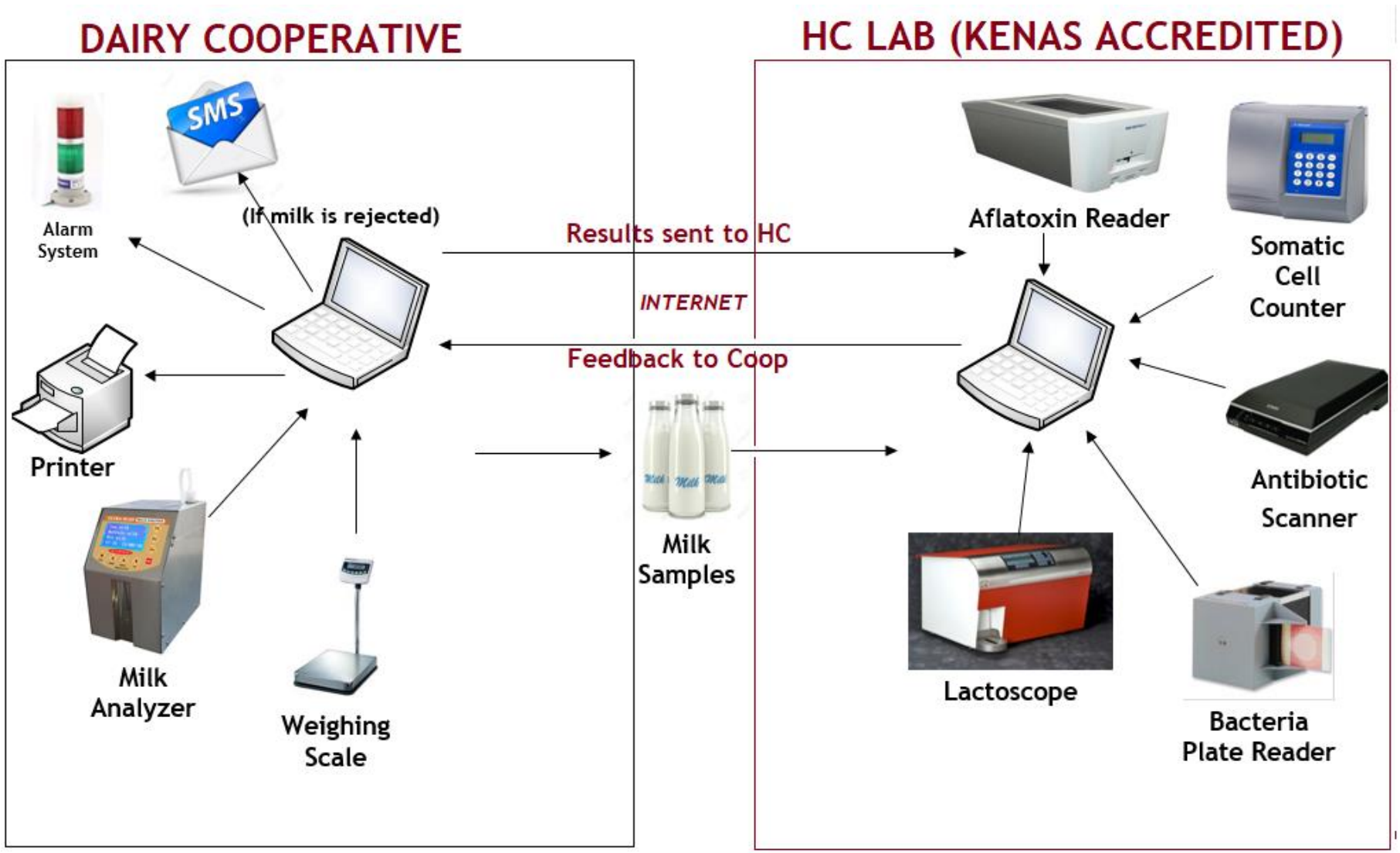
4) Sampling regime for samples to be tested at Happy Cow Laboratory

Happy Cow will take monthly samples from all transporters (once/transporter/month) and the cooling tanks samples. The table below shows how the samples will be taken per month.

Sampling analysis schedule			
	Where	**Who**	**Samples/month**
1	Milk reception platform CBE	All transporters composite samples	28
2	Milk cooling tank CBE	QC at CBE will take this sample	4
3	Milk tanker truck HC	The QC at HC will take this sample	4
	Total samples		**36**

For HC, the quality of the tanker sample is paramount; monthly improvement on tanker composite sample on TBC and milk free of antibiotic residues is required. HC will transfer the quality bonus amounts, as mentioned above, to a separate+ quality account of Olenguruone Society.

(derived from: Happy Cow Ltd - Milk Quality Tracking & Tracing report, March 2019)


DAIRY COOPERATIVE
HC LAB (KENAS ACCREDITED)
SMS
(If milk is rejected)
Alarm System
Results sent to HC
INTERNET
Feedback to Coop
Aflatoxin Reader
Somatic Cell Counter
Printer
Milk Samples
Antibiotic Scanner
Milk Analyzer
Weighing Scale
Lactoscope
Bacteria Plate Reader

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