

## The Kenyan dairy sector: stakeholder roles and relationships, and their impact on milk quality

Simon Nyokabi<sup>a</sup>, Simon Oosting<sup>b</sup>, Bockline Bebe<sup>c</sup>, Lisette Phelan<sup>d</sup>, Bernard Bett<sup>e</sup>, Johanna Lindahl<sup>f</sup>, Imke de Boer<sup>g</sup>

a Wageningen University

[simon.nyokabi@wur.nl](mailto:simon.nyokabi@wur.nl)

b Wageningen University

[simon.oosting@wur.nl](mailto:simon.oosting@wur.nl)

c Egerton University

[obebeb@yahoo.com](mailto:obebeb@yahoo.com)

d De Montfort University

[lisette.phelan@gmail.com](mailto:lisette.phelan@gmail.com)

e International Livestock Research Institute (ILRI) [b.bett@cgiar.org](mailto:b.bett@cgiar.org)

f International Livestock Research Institute (ILRI) & Swedish University of Agricultural Sciences (SLU)

[j.lindahl@cgiar.org](mailto:j.lindahl@cgiar.org)

g Wageningen University [imke.deboer@wur.nl](mailto:imke.deboer@wur.nl)

**Abstract:** *The dairy sector in Kenya is an economically important sector providing employment and a source of income value chain actors. Although demand for milk and dairy products is high and increasing, sector growth is constrained by milk quality issues stemming from physical-chemical composition, microbial contamination and adulteration which pose a risk to human health.*

*The objectives of this research were to identify which stakeholders in the Kenyan dairy sector play a role in determining milk quality, and to explore whether roles are affected by power relationships between stakeholders. The study used Social Network Analysis (SNA), and employed process Netmap, to examine the roles of, and relationships between dairy sector stakeholders, and the impact of actual and perceived power on the quality of milk and dairy products traded in formal and informal dairy value chains in Nakuru county Kenya.*

*Results show that the dairy sector in Nakuru county is a multi-layered network of stakeholders, encompassing stakeholders from both the formal and informal dairy value chains. Farmers, cooperatives and processors play a key role in determining the quality of milk and dairy products, while cooperatives, processors, government agencies exert influence over milk quality as the most powerful stakeholders in the network. Stakeholder relationships in the formal value chain are more conducive to the enforcement of regulation and standards, and thus the production of high quality milk and dairy products, than those in the informal value chain.*

**Keywords:** *Milk quality, Dairy value chain, Kenya dairy sector, Social network analysis, Multi-stakeholder analysis, Net-Map, Value chain integration*

## Introduction

The dairy sector contributes to 40% of the total livestock gross domestic product (GDP) and to 3.5% of national GDP in Kenya (SNV 2013; Wambugu et al. 2011). It is a multi-layered network of stakeholders, comprising actors along the dairy value chain that are involved in the production, handling, transportation, storage, packaging and marketing of milk and dairy products (Yami et al., 2012; Msaddak et al., 2017). Smallholder farmers, input suppliers, service providers (extension services, feed suppliers, breeding organisations, and veterinary services), and processing and marketing actors (milk collection centres, transporters and private processors) can be categorised as either formal or informal value chain stakeholders, based on their business arrangements with each other (Omore and Baker, 2009; Beyene, 2015).

Although formal dairy value chain stakeholders operate within a well-defined legal framework (Mamo, 2013), research has shown that milk traded in the formal dairy value chain in Kenya is not always of high quality (Roesel and Grace, 2014), and that milk traded in the informal dairy value chain is not necessarily of poor quality (Roesel and Grace, 2014). Informal value chain stakeholders have been accused of poor adherence to food safety and quality standards. Despite increased provision of training and increased certification (Kaitibie et al., 2010), the informal dairy value chain continues to provide a market channel for the trade of low quality milk which does not meet food safety and quality standards and poses a risk to human health due to its high bacterial count, aflatoxin and antibiotic residues, and the presence of zoonotic pathogens (Kaitibie et al., 2008; Kabui, 2012).

Taking Nakuru county as a case study, this research adopts Social Network Analysis (SNA), to studying value chain structures and stakeholder relationships. Process Net-Map was used to examine the roles of, and relationships between stakeholders in the Kenyan dairy sector (Birner et al., 2010; Schiffer et al., 2010). Recognising that stakeholders have complementary and competing interests (Wambugu, 2000; Hooton et al., 2004; Smallholder Dairy Project, 2004), and exert power to increase individual advantage and realise desired outcomes (Olsen et al., 2014; Vermeulen, 2005), this research explores and deconstructs the power relationships which exist, to determine the impact of stakeholders' actual and perceived power on the quality of milk and dairy products produced and traded in formal and informal dairy value chains in Kenya.

## Conceptual framework

Power can be exerted by stakeholders in cooperation with others, or without the consent of others (Vermeulen, 2005). Stakeholders' relative power stems from their positions within a stakeholder network (measured using degrees of centrality), with core stakeholders having extensive relationships with other stakeholders, and peripheral actors having few relationships (measured using closeness of centrality) despite some playing an integral part in the network (Borgatti 2006; Aberman et al. 2015). The degree to which activities and processes in the sector are horizontally and vertically integrated, are therefore key indicators of the extent to which stakeholders are in a position to leverage and strategically manoeuvre in their interactions with other stakeholders (Olsen et al., 2014; Vermeulen, 2005).

Dairy sector stakeholders engage in horizontal integration (joint sales, marketing, joint input procurement and promotion) to mitigate the market-related consequences of small-scale production and heterogeneous product quality, and in vertical integration to control the supply or distribution of a product, thereby increasing its power in the marketplace, reducing costs and earning a higher income (Mutura, 2015). Stakeholders in dairy value chains operate in an institutional environment characterised by poor resource availability, infrastructure constraints, market access restrictions (Trienekens, 2011; Haggblade et al., 2012), challenges in coordination and governance structures, and institutional gaps (Sanga et al., 2013). The dynamics of relationships and positions relative to each other stem from flows of capital, information, advice and trust within a stakeholder network (Friedkin and Johnsen, 1997).

Social network analysis (SNA) enables researchers to identify the visible and invisible ties in a multi-layered network of stakeholders (Borgatti and Parker, 2002; Jatel, 2008). Process Net-Map takes into account all activities and processes along a formal and informal value chains, from input supply to production, processing, handling, transportation, storage, packaging and marketing of the final product or service offered to consumers (Haggblade et al., 2012). In the context of this study, SNA provides a framework within which to explore the roles of, and relationships between stakeholders in the Kenyan dairy sector, while Process Net-Map enables the impact of stakeholders' actual and perceived power on the quality of milk and dairy products produced and traded in the formal and informal dairy value chain in Kenya to be determined.

## Methodology

A stakeholder meeting was organised with the help of extension and veterinary offices in Molo town in Nakuru county. Dairy sector stakeholders invited for the meeting included farmers, transporters, processors, input/service providers, and representatives of dairy cooperatives, NGOs, financial institutions, Nakuru county extension and veterinary offices, Nakuru county government, the national government, the Kenya Dairy Board and researchers from Egerton university. In total, 20 individuals representing the different stakeholder groups mentioned above participated in the SNA meeting. The concepts behind SNA and the process Net-map tool as described by Schiffer and Peakes (2009), were explained to stakeholders prior to obtaining a signed (or a thumb print) consent. During the mapping exercise, meeting participants were asked to identify all stakeholders involved in the dairy sector (formal and informal value chains) and the activities these stakeholders were engaged in. The names of these identified stakeholders were written on small cards and placed on a big sheet of paper. Figurines (small figures) were then placed on these small cards to represent the different stakeholders identified in the sector. Lines were drawn to indicate the relationships stakeholders, with different colours used to denote the types of linkages (milk trade, information exchange, regulations and input and financial supplies). Next, stakeholders' perceptions of power and influence in the dairy sector and value chain activities were determined, with influence or power visualised by placing the figurines on so-called 'influence towers' (the stronger the influence, the higher the tower). Power to influence milk quality was defined as the ability of an actor to change or improve milk quality parameters in the final product mainly during the production, handling, transportation, storage, packaging and marketing. After the mapping exercise, a discussion was held with participants to identify each stakeholders' goals and objectives, the reasons behind the perceptions of power and influence, and the challenges and opportunities facing stakeholders in realising an improvement in milk quality. The researcher then conducted field visits to make observations (using a check-list) and to hold informal discussions with stakeholders to ascertain the truth on the ground and triangulate the information provided by the meeting participants especially regarding milk handling.

## Results

### Stakeholders' roles

A diverse group of stakeholders are involved in the dairy sector in Nakuru county (see Figure 1 and 2 and Table 1), from farmers to cooperatives, private sector actors (processors, input providers, extension providers, transporters, traders), public sector actors (extension providers, regulatory authorities), civil society stakeholders (non-governmental organisations and development agencies) and consumers. Centrality measures (degrees and closeness of centrality) revealed that the core actors in the dairy sector are farmers, cooperatives and processors as they had the most connections to the other stakeholders and occupied the most central roles in the formal and informal value chains. The formal value chain is dominated by few large processors and cooperatives which bulk and market milk on behalf of farmers, while the informal value chain involved farmers, transporters and traders selling raw milk and occasionally pasteurised milk directly to consumers, hotels and kiosks. There was

little or no value addition to the milk in the informal value chain, and the volume of milk traded was small and sold at a low prices.

Discussions revealed that, in both the formal and informal value chain, stakeholders were connected by milk trade, provision of information, inputs and services, training, enforcement of regulations and other value chain activities. The formal value chain had horizontal integration at the level of farmer groups and dairy cooperatives, and vertical integration between cooperatives, processors, service providers and financial institutions, and – to some extent – government agencies. The dairy cooperatives that bulked and marketed milk on behalf of farmers faced challenges in realising integration, and had to supply several processors to avoid becoming dependent on one processor. Dairy cooperatives acted as intermediaries between farmers and financial service and input providers, as well as between farmers and small traders and processors, facilitating milk trade by collecting, bulking and selling milk at a negotiated price. In contrast, there was low horizontal and vertical integration and coordination in the informal value chain which made it difficult to address milk quality issues. Integration in rural areas was less than in areas closer to urban markets, with farmers facing difficulties in accessing stakeholders such as milk traders and input suppliers, particularly during the rainy season due to poor road infrastructure. The informal value chain is mainly spot markets (transactions happening on spot, and no contractual engagements) that utilises verbal contracts and payments are done immediately.

## **Stakeholders relationships**

The process NetMap exercise disentangled the four types of linkages (milk trade, information exchange, regulations and input and financial supplies) between stakeholders in the dairy sector. It revealed that there were more elaborate relationships in the formal value chain, than the informal value chain, as actors were more integrated. The Net-map findings revealed that stakeholders varied in the levels of power exerted and influence over milk quality. Dairy cooperatives, processors, regulatory authorities and consumers had the most power when it came to determining milk quality and influencing other stakeholders to change or improve the quality parameters of the final product reaching consumers. Dairy cooperatives demanded quality milk to meet the required national standards and requirements stipulated by their clients mainly the milk processors. Processors demanded high quality raw milk as it influenced the products they could manufacture, and they faced strict quality requirements stipulated by the Kenya Bureau of Standards (KeBS). Regulatory authorities enforced milk quality regulations stipulated by law while input suppliers had the power to determine milk quality as they were responsible for the sale of inputs (feeds, semen, drugs etc) to farmers which either translated into low or high-quality milk. Consumers had the power to determine milk quality through their purchasing habits.

Farmers were the core stakeholders in the dairy sector, with links to input providers, extension providers and financial institutions offering services necessary for dairy production. In the formal value chain, farmer groups (producer organisations) and dairy cooperatives sold milk in bulk and negotiated prices on behalf of farmers. Farmers were also linked to transporters who collected and bulked milk on behalf of cooperatives and processors or as informal traders. In the informal value chain, farmers were linked to informal traders selling milk at informal markets.

## **Impact of power relationships on milk quality**

Discussions revealed that stakeholders in the dairy sector (in both the formal and informal dairy value chain) were motivated to maximise their relative advantage over others rather than collaborate to realise common goals which would benefit all stakeholders. Lack of collaboration resulted in scarce resources such as milk cooling tanks not being optimally distributed, which hindered milk quality especially in rural areas with poor or limited infrastructure. Milk quality was also compromised by a lack of formal contracts between stakeholders, as there are no agreed guidelines or specifications as to how the final product (milk) should be delivered or what quality standards it should meet. In the formal value chain, the use of formal contracts was rare except where farmers were members of a cooperative.

Those belonging to cooperatives were incentivised to realise an improvement in milk quality as they could obtain loans and farm inputs through a check-off system, where the collateral was the milk which they delivered to the cooperative or processor. They were also in a position to purchase equipment or obtain higher-quality inputs than non-members. Moreover, farmers belonging to cooperatives had a means of saving, as milk proceeds were paid at the end of the month and could access school fees or emergency hospital loans in time of need. In contrast, in the informal value chain, agreements were based only on word of mouth and goodwill.

**Table 1: Stakeholders and their roles in the dairy sector**

<b>Actor (Stakeholder)</b>	<b>Function</b>
Kenya Bureau of Standards (KeBS)	<ul style="list-style-type: none"> <li>• Codex alimentarius contact point in Kenya</li> <li>• Maintain quality through surveillance and issuing of quality mark used in products</li> </ul>
Kenya Dairy Board (KDB)	<ul style="list-style-type: none"> <li>• Coordinate dairy industry, facilitate research, participate in policy development</li> </ul>
National government	<ul style="list-style-type: none"> <li>• Provide country level policy and dairy plan</li> <li>• Set standards and fund national institutions (KDB, KeBS etc)</li> </ul>
County government	<ul style="list-style-type: none"> <li>• Control of county dairy planning</li> <li>• Fund extension and livestock department to serve farmers</li> </ul>
Public health department	<ul style="list-style-type: none"> <li>• Inspect premises to ensure they meet required standards</li> <li>• Issue health certificates to people handling food</li> </ul>
Financial institutions	<ul style="list-style-type: none"> <li>• Work with different institution to provide finance and information to different actors in the dairy sector</li> </ul>
Input providers	<ul style="list-style-type: none"> <li>• Provide inputs and information to farmers</li> </ul>
Livestock production department	<ul style="list-style-type: none"> <li>• Mandated with providing farmers with extension and other services to farmers by county government</li> </ul>
Non-Governmental Organisations (NGOs)	<ul style="list-style-type: none"> <li>• Provide inputs, information and services to farmers</li> <li>• Research and present evidence to government agencies</li> </ul>
Dairy cooperatives	<ul style="list-style-type: none"> <li>• Help with milk marketing, provision of inputs and services to farmers</li> </ul>
Farmers	<ul style="list-style-type: none"> <li>• Produce milk</li> </ul>
Consumers	<ul style="list-style-type: none"> <li>• Consume milk and milk products</li> </ul>
Sales and marketing groups	<ul style="list-style-type: none"> <li>• Bulk and market milk on behalf of farmers (can also be cooperatives or farmer groups in some cases)</li> </ul>
Transporters	<ul style="list-style-type: none"> <li>• Bulk and transport milk to processors and markets</li> </ul>
Informal traders	<ul style="list-style-type: none"> <li>• Sell milk to consumers mainly trading small quantities</li> <li>• Some pasteurise milk and some make yoghurts</li> </ul>
Veterinary department	<ul style="list-style-type: none"> <li>• They are mandated to provide veterinary services and perform disease surveillance and funded by the national government</li> </ul>
Extension department	<ul style="list-style-type: none"> <li>• They are mandated to provide training, information t farmers and funded by county government</li> </ul>
Research and academia	<ul style="list-style-type: none"> <li>• They provide innovations, technologies and research needed for production at farm level. Their finding also inform policy</li> </ul>
Processors	<ul style="list-style-type: none"> <li>• Process milk to milk and milk products (value addition)</li> </ul>

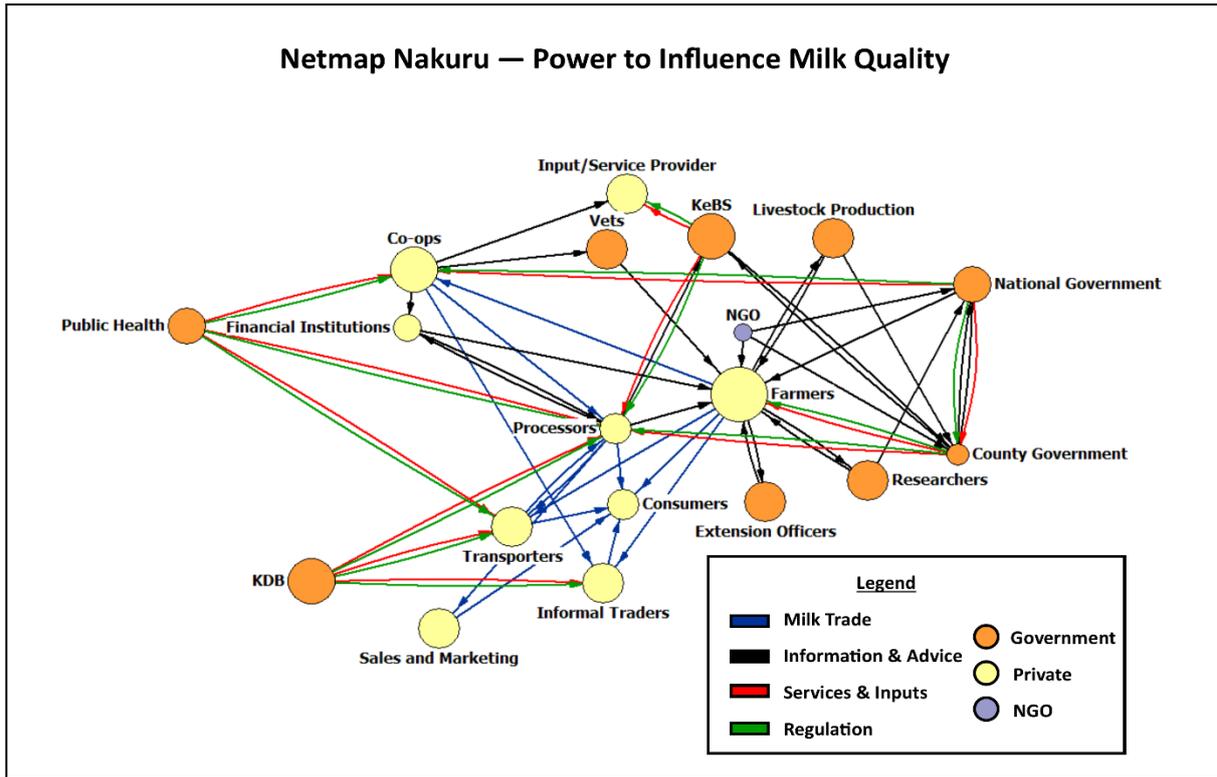


Figure 1: Net-map of Nakuru, showing the relationships between stakeholders and their power to influence milk quality (the node size the denotes the perception of power)

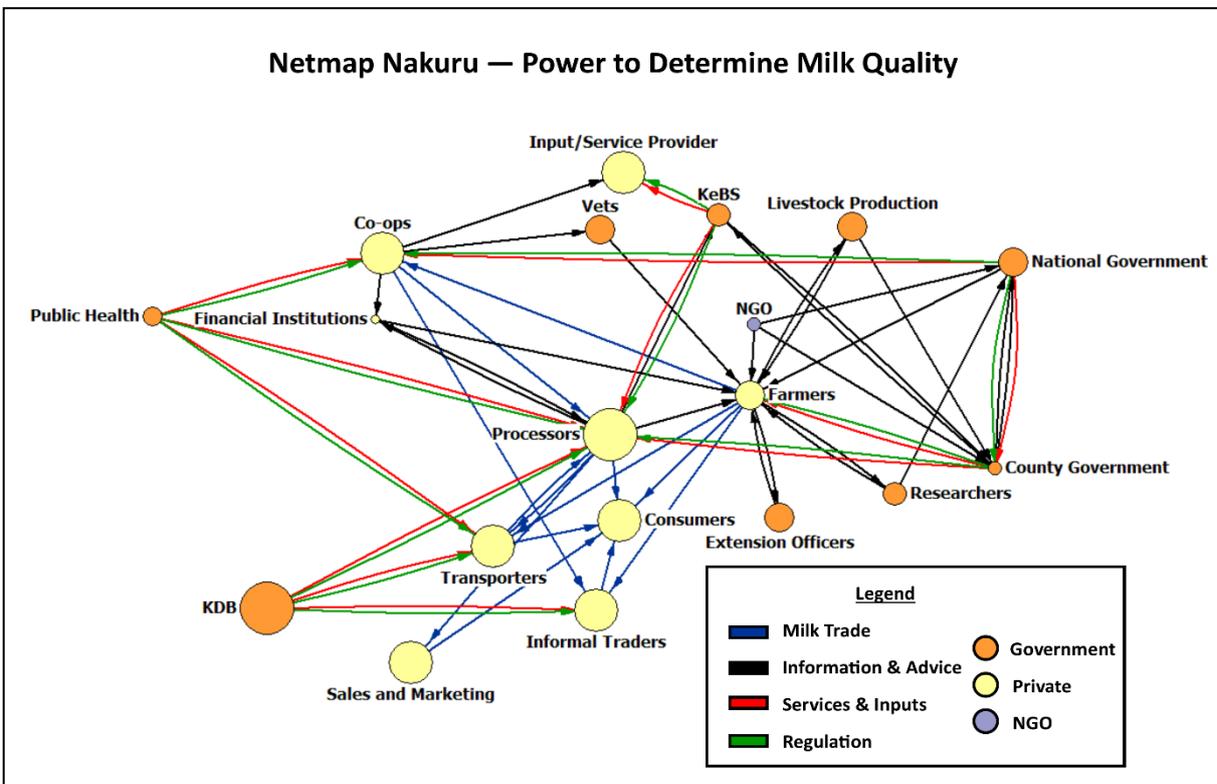


Figure 2: Net-map of Nakuru, showing the relationships between stakeholders and their power to determine milk quality (the node size the denotes the perception of power)

Discussions revealed that farmers perceived milk prices as being very low. Although dairy cooperatives collected, bulked and sold milk on behalf of farmers, they could not guarantee high prices for farmers. Dairy cooperatives should increase farmers' collective bargaining power, but in the fragmented dairy sector in Kenyan, this has not been the case. Dairy cooperatives sell milk to many different actors on negotiated prices and the average of all sales determines the farm gate price. Milk prices are fixed by processors without consulting other stakeholders in the value chain. There is a lack of transparency around how processors in the formal value chain determine milk prices. Retail milk prices are high (Ksh 110 per litre), while farm gate prices range from Ksh 30 to 35, with little explanation of the breakdown of costs incurred and profit margins enjoyed by processors. Relative to processors in the formal value chain, informal traders offered farmers a better farm-gate price. Although they were not reliable as buyers, as they were unable to purchase a large volume of milk. Due to the higher farm-gate prices and the relatively lower quality requirements demanded, selling milk to informal traders was an attractive proposition for farmers, relative to engaging with formal processors.

The stakeholder discussion revealed that low use of formal contracts specifying the quality of raw milk to be delivered to processors and cooperatives, hinders milk quality improvement. If milk was rejected by the formal dairy value chain (dairy cooperatives or processors), it could still be traded in the informal dairy value chain. In the study area, poor infrastructure led to rapid deterioration of milk quality. The poor quality of earth roads made it difficult to transport milk, especially in the rainy season. In more remote rural areas, it took a long time to transport milk to cooling plants, leading unscrupulous actors (mainly traders) to engage in adulteration of milk to extend its shelf life. The chance of being caught adulterating milk was low as stringent testing of milk was not observed.

Further discussions and subsequent observations by the researcher revealed there was too much handling of milk during bulking. Most actors, especially small traders, used plastic containers which were difficult to clean. Upstream actors (cooperative and processors) were of the opinion that downstream actors (farmers and transporters) had low knowledge levels about hygiene and good milk handling practices. Stakeholders reported in the discussions that lack of vertical integration and coordination made it difficult to exchange information on quality requirements. The low milk prices and the lack of a quality-based payment system meant that there was no economic incentive for smallholder farmers and transporters to improve milk quality.

## Discussion

Farmers, cooperatives and processors in the formal value chain are the core stakeholders in the Kenyan dairy sector as they are most connected to other stakeholders through relationships facilitating milk trade, information exchange, regulations and input and financial supplies. They are horizontally and vertically integrated, and constitute the most appropriate group for interventions if their collective power to improve milk quality can be harnessed. However, given that most people depend on informal markets for their milk and milk products – informal value chain stakeholders controls 80% of milk transactions - there is need to help the informal traders to improve their food safety practices. Although, informal dairy value chains offer farmers a higher farm-gate price and have few quality requirements (Kaitibie et al., 2008; 2010), which is also the case in this study, it is a channel for milk of poor quality rendering regulation in the formal chain ineffective (Roesel and Grace, 2014).

Although the Kenyan dairy sector is liberalised, the government has an important role to play in supporting farmers. The results of this study support the findings of other studies, that there is a clear need to improve road infrastructure as impassable roads during the rainy season affect the efficiency of milk collection and cooling, access to inputs, access to market information and access to important extension and artificial insemination services (Odame et al., 2008; Kilelu et al., 2016).

The results of this study also shows that farmers do not participate in price determination, especially in the formal dairy value chain. Unequal power relationships in the dairy sector are evidenced by the process of setting milk prices. Prices are set by processors without

consultations with other stakeholders, which made farmers feel short-changed given the small profit margins in dairy production. The large number of smallholder dairy farmers producing a small quantity of milk were limited in their ability to influence market conditions or the price of milk in the formal dairy chain (Mugoya and Rwakakamba, 2010). The uneven playing field has led to the thriving and dominance of the informal dairy value chain in Kenya, linking directly producers and consumers and providing an alternative market channel. It has also led to continued dominance of a system of food production and distribution at odds with that dominated by processors, where farmers have no influence and power (Hinrichs, 2000).

Although the findings of this study show that informal traders are mostly peripheral actors (in terms of centrality measures in social networks), they are important as they continue to dominate in the dairy sector. A policy change in 2004 to liberalise the milk market allowed legalisation of informal actors in the milk value chain which reduced political rent payments (corruption) demanded to avoid confiscations of milk jars (Kaitibie et al., 2010). This has led to improved relationships between the government and informal dairy value chain stakeholders and redefined the roles of individuals or organisations in milk transactions (Vermeulen, 2005). A continued increase in horizontal coordination (formation of farmer groups and dairy cooperatives) facilitating collective bargaining by farmers could lead to stronger vertical integration and relationships in value chains (Coles and Mitchell, 2010).

The results of this study suggest that price-setting mechanisms are dictated by large processors, and are in agreement with the study by Akinwumi et al. (2009) who argue that price-setting mechanisms often leave farmers with limited bargaining power, especially where farmers are dependent on a contractual relationship with one large processor. Promotion of both horizontal and vertical integration could help address the milk-quality challenges facing the dairy value chain in Kenya by ensuring equitable distribution of benefits through collective bargaining as evidenced by the practice of cooperatives in the study area.

The government (national and county) is the most powerful actor in the dairy sector, as it designs policies in collaboration with stakeholders and also implements and enforces these policies. However, it was reported that the government can be influenced by lobbying especially by the large processors, which leads to the design and implementation of policies that fail to address the needs of stakeholders with less bargaining power, as was the case in the process of policy change in Kenya in 2004 to liberalise the milk market (Leksmono et al., 2006). One of the best models for quality improvement is co-governance (Giz, 2012), where every stakeholder accepts and plays an important role in the milk quality governance process (Fung, 2006). Stakeholders in the informal value chain have an important role to play in improving food safety especially in countries (Roesel and Grace, 2014; Nyokabi et al., 2018). There is also an opportunity to formalise their activities, integrate into the formal value chain (supplying quality raw milk) through already existing business models such as dairy hubs (Kilelu et al., 2017, 2012).

## Recommendations

1. One way to improve the functioning of the dairy sector and improving milk quality would be to improve the currently low vertical and horizontal integration, which could lead to better information sharing. The dairy industry is like a "Tower of Babel" where the goals of different actors may be similar but the approach to realising the goals varies as actors work independently in their pursuit of success.
2. This paper highlights the importance of considering the dairy sector (the formal and informal dairy value chains) as social networks where information can be disseminated through different channels. The knowledge can be used to identify powerful actors who can be agents of change and also identify coalitions that can drive changes within the industry.
3. There is need to introduce context-specific technologies and innovations that address local issues. To address infrastructure challenges, small coolers (located in the villages and near to the farmers) could be installed to cool milk immediately after milking, preserving the evening milk which often ends up spoiling in rural locations.

These coolers could be solar-powered in areas where there is no electricity. Processors and cooperatives could invest in testing equipment and implement a quality-based payment system that would provide economic incentives for farmers and transporters to improve milk quality.

4. There is also need to create enabling environment that allow informal actors to purchase equipment to pasteurise and add value to milk. Moreover, there is a need to licence and train informal actors to adopt hygienic milk handlings as was envisaged in the policy change of 2004 that liberalised the milk markets. Improved milk quality would enable these stakeholders to reap better prices.
5. Although results showed that stakeholders in the dairy sector (in both the formal and informal dairy value chain) were motivated to maximise their relative advantage over each other rather than collaborate to realise common goals which would benefit all stakeholders, an improvement in the quality of milk could lead to greater coordination and cooperation between stakeholders currently pursuing their own interests.

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