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The U.S. Government's Global Hunger & Food Security Initiative

POLICY BRIEF
ENHANCING INVESTMENT ATTRACTIVENESS IN KENYA'S DAIRY SECTOR

How can improvements in the environment for Climate-Smart Agriculture (CSA) improve investment attractiveness? The following analysis showcases potential improvements in ***Standardization and Certification, Aggregation Models,*** *and* ***Financial Incentives,*** *using the* ***dairy*** *sector as a case study. This brief builds on a Public-Private Dialogue, which was organized by Climate Focus in Nairobi, Kenya in February 2018 to determine priority actions.*

1. Executive Summary

The dairy sector contributes 14% of Kenya's agricultural GDP, and Kenya boasts the highest per capita milk consumption in Sub-Saharan Africa, with demand projected to rise. Over 80% of all milk reaching the market is distributed through informal channels. Increasing domestic production to meet projected demand at current productivity levels would require more than doubling current herd size in the next decade, which is unfeasible given land and water constraints as well as national emissions targets. In addition, the *National Dairy Development Policy* envisions Kenya as net dairy exporter by 2030. To meet these goals, substantial improvement and investments in per-cow productivity through better management and input provision, and loss reduction through adoption of chilling technology and enhanced rural infrastructure would be required.

1.1 Main Challenges

Value Chain: Many dairy producers have limited knowledge of quality animal husbandry and limited access to inputs and markets. Poor rural infrastructure limits access to inputs, increases the costs for milk collection and results in high rates of post-harvest milk loss. Implementation of a coherent national dairy strategy is made difficult by the fragmented, largely informal market.

Standards & Certifications: Existing standards for dairy deal almost exclusively with safety and quality, largely excluding environmental and CSA-specific criteria. There is little economic incentive within the value chain to comply with even existing standards, since processors and consumers continue to buy informal milk. Demand for certified products is severely limited.

Aggregation: Cooperatives are the main structure for milk aggregation, but their service offerings vary with the cooperatives' level of professionalization and formality. Aggregation models are perceived as risky, offering little upside in terms of producer loyalty and stability of milk supply while resulting in potentially large upfront cost.

Financial Incentives: Current and proposed tax and fee structures – including the exemption of raw and minimally processed milk from VAT tax – disincentivize formal market growth and value addition. There are no existing incentives to specifically drive the adoption of climate-smart management practices or technologies.

1.2 Key Recommendations

Value Chain: Improve enabling environment for the adoption of technology including milk chilling, processing, and ICT (Information and Communications Technology) to reduce spoilage and enhance supply chain efficiency.

Standards: Efforts to streamline CSA criteria into standards must be coupled with improved communication on the benefits of CSA practices as well as direct support to producers.

Aggregation: Professionalized cooperatives can act as a key promoter of standard compliance in the absence of robust public-sector extension services. Aggregation itself can be incentivized and de-risked through targeted interventions.

Financial Incentives: Fiscal incentives should be redesigned to align with the goal of formalizing markets and improving adherence to standards.For example, provision of existing subsidies throughout the value chain can be made contingent upon standards and CSA criteria compliance. Awareness campaigns and improving access to basic quality testing can enable greater demand for high-quality milk products, which eventually will lead to demand for better practices. Providing financial incentives to producers and aggregators for extension service provision and promotion of standards adherence could be a more effective model than building government extension service capacity.

Table 1 | ***Barriers and Opportunities for Climate-Smart Dairy***

Issue Area	Barriers	Opportunities
Value Chain	Poor rural infrastructure and high costs	• Improve enabling environment for technology adoption in rural supply chains
	Inefficient public service provision	• Explore public-private partnerships for support delivery
	Underutilized processing capacity	• Target productivity increases through better service and input provision • Create demand for processed dairy products
	Limited prospects for strategic growth due to policy incoherence	• Improve coordination and engagement of value chain participants to ensure effective and efficient policy design • Utilize technology for data collection and analysis to inform policy
	Large informal sector	• Tie subsidies and other incentives to producer formalization and standard compliance
Standards & Certifications	Lacking CSA criteria in existing standards and limited enforcement	• Integrate CSA criteria into standards, streamline adoption, and tie subsidies to compliance
	Few incentives for standards compliance	• Link financial incentives and subsidies to standards compliance
	Little producer support for standards adoption and formalization	• Professionalize cooperatives to promote and enable standard compliance
	Limited benefit for self-regulation and voluntary certification	• Continue awareness campaigns and improve access to quality testing kits to build consumer demand for high-quality products
Aggregation	High costs and risks for aggregators	• Provide financial incentives for aggregation and extension service provision, conditional upon formalization and adherence to standards
	Varying levels of professionalization and formality among cooperatives	• Promote and incentivize technology adoption in the value chain to address market inefficiencies and create increased transparency
Financial Incentives	Cost advantage for informal sector due to limited collection of taxes and fees	• Redesign fiscal incentives to address barriers to entry to formal markets
	Overextended and ineffective public sector input subsidy programs	• Leverage private sector for service, input, and finance delivery, stimulated by financial incentives
	Low level of agricultural insurance uptake by producers	• Bundle insurance plans with other high-value services, including access to and training in climate-smart technologies and practices

2. Overview

2.1 Market

Kenya's dairy market produced approximately 5.2 billion liters of liquid milk annually since 2012. The dairy market contributes $2.1 billion USD, 4-8% of GDP,[1,2,3] 14% of agricultural GDP, and 40% of livestock sector GDP.[4] The dairy market is largely driven by liquid milk but there is growing demand for yoghurt, cheese and butter. The majority of milk produced comes from cattle, amounting to approximately 3.4 billion liters in 2015,[5] followed by camels and goats.[6]

The Kenyan government liberalized the dairy industry in the early 1990s. This caused a major shift from monopolized milk processing and marketing through the Kenya Cooperatives Creameries (KCC) to a growing number of new processors.[7] The *National Dairy Development Policy* from 2013 further envisions the government removing itself from the direct provision of services, instead taking a regulatory/oversight-based role while also promoting joint public and private investment into the value chain.[8]

National per capita milk consumption is among the highest in Sub-Saharan Africa. It is expected to grow 6% annually from 2012 through 2022, increasing from 106 to 139 liters/person to total 8 billion liters.[9] By 2030, consumption is projected to reach 220 liters per capita,[10] with total milk demand at 12.76 billion liters.[11] As of 2016, annual consumption was reported to have reached 115 liters/person.[12] The projected growth is linked to population trends, especially urbanization: urban milk demand is predicted to grow at twice the annual rate of rural demand, reaching 3.91 billion liters and representing 59% of total growth in 2022.[13]

The national processing volume has grown 244% from 152 million liters in 2001 to 523 million liters in 2013.[14] However, only a small fraction of total milk production is processed; from 2007 – 2013, processed milk amounted to 10% of total production and comprised 18% of milk reaching informal or formal markets.[15] Raw milk is more affordable than pasteurized milk and preferred by all consumers except high-income households.[16] As a result of low demand for pasteurized milk and the seasonality of production, processing companies operate at as low as 40% of installed capacity.[17]

At current levels, domestic production is unable to meet projected demand. After adjusting for losses, domestic production is expected to reach 6.72 billion in 2022, falling short of projected demand by 1.28 billion liters.[18] This shortfall was projected to occur as early as 2017, though droughts led to production declines that did, in fact, necessitate increased imports to meet demand and stabilize prices.[19] To meet the projected domestic demand by 2022, Kenya would require a 79% increase in current average production levels in non-drought years.[20] Historically, such increases have been achieved by increasing the milking herd size. If cattle milk productivity per animal remains stagnant at a relatively low rate of 1800 liters/year[21] (4.9 liters/day) and maintains an 80% share of total milk production, meeting the forecasted 2022 and 2030 estimates would require an additional 5.67 million heads of cattle, more than doubling the current herd size to 11.34 million. Such an increase in herd size would be unsustainable given land area constraints, water shortage, and emissions produced per head of cattle.[a]

Regional climatic conditions are suitable for different cattle breeds and management practices, causing average milk yields to vary widely across the country.[22] The dairy market tends to be concentrated in the highlands, the Rift Valley and Central Provinces[23] due to more conducive agro-ecological conditions for high-yielding dairy breeds. Droughts have presented a major challenge for dairy production in recent years, impacting yields and causing smaller producers in drier regions to struggle with animal mortality. Droughts in May 2017 caused a 35% reduction in milk production for 2018, which dropped an average of 20% in regions using supplementary feed, fodder, hay, and silage and 50% in regions where open grazing is practiced.[24] Adaptation measures are therefore receiving increasing attention.

[a] There are inconsistent estimates on herd size ranging from 3.5 to 6.7 million heads of dairy and dairy crosses, producing 3.4 to 5.1 billion liters of milk annually. This analysis suggests a need for 5.671 million additional heads of cattle.

Despite national demand appearing to outpace supply and the challenges to production under climate change impacts, the National Dairy Development policy envisions Kenya as a net exporter of milk of 2030. Current exports remain low, totalling 11 million liters in 2012 and projected to reach 32 million liters in 2022.[25] Exports were largely in the East African region[26] and Southern Africa. Exports tend to be long-life milk and powder milk products. Despite the current challenges in having domestic supply meet domestic demand, export remains a key strategy of the government since Kenya has the largest milk production capacity on the continent after South Africa. In order to become a strong export player, Kenya will have to significantly increase production and processing capacity as well as value addition.

The dairy sector contributes significantly to Kenya's total greenhouse gas (GHG) emissions. Dairy cows contribute about 20% of the country's annual agricultural emissions, or about 12.1 million tonnes CO2eq.[27] About 11% of emissions from milk production are due to manure management, while over 88% come from methane produced during enteric fermentation. Poor feed contributes to high methane production during rumination. The average emissions intensity for milk production is 3.8 kg CO2eg/kg, with significant differences depending on the system of production: purely pasture-based systems average 7.1 kg CO2eq/kg, while confined feeding systems and hybrid systems average 2.1 and 4.1 kg CO2eq/kg, respectively.[28] Water and energy used for milk collection, cooling, and processing further contributes to the sector's impact, while poor on-farm manure management can lead to significant local pollution.[29]

In order to meet national demand, achieve export objectives, and reduce environmental and social impacts, it will be imperative to increase the existing herd productivity and reduce losses through better management practices. The Ministry of Agriculture, Livestock and Fisheries, along with the Ministry of Environment and Natural Resources and the Kenya Dairy Board (KDB), has developed a Nationally Appropriate Mitigation Action (NAMA) plan for climate-resilient dairy, supported by international funders and advisors. The initiative recognizes the key role of increasing productivity to reduce emissions while increasing production and improving livelihoods for smallholder dairy farmers.[30] Increasing milk productivity decreases the emissions intensity of each unit of milk produced while being more cost- and space-effective for producers. Practices that boost productivity while mitigating emissions include providing improved feed, improving herd genetics through artificial insemination (AI) from resilient and more productive cattle breeds, and ensuring access to veterinary care to mitigate "unproductive emissions" due to morbidity and mortality.[31] In addition, dairy processors are seeking to improve their energy efficiency to reduce costs given low milk prices and the high cost of electricity. Such measures would reduce sector emissions still further while reducing milk loss at the processing stage.[32]

Private investment will be crucial to achieving this mission. However, a range of barriers in the value chain prevent capital from flowing to enterprise and dairy producers at scale. The following sections discuss barriers and possible solutions that would enhance the attractiveness to deploy capital in the dairy value chain.

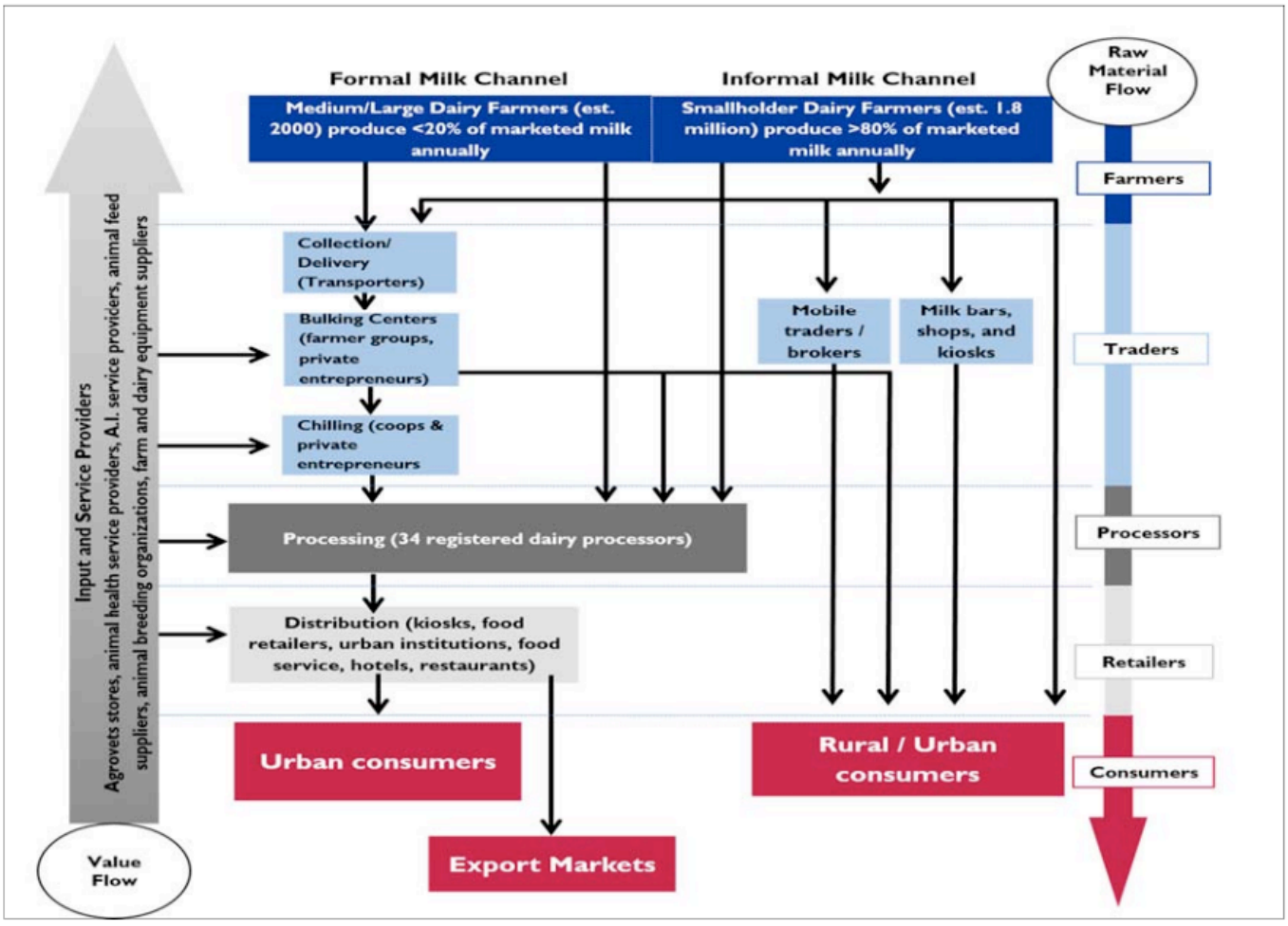
2.2 Value Chain Structure

The landscape is dominated by estimated 1.8 million small-scale dairy producers.[33] They control an estimated 80% of cattle and produce over 56% of total milk production.[34] On average, smallholders own 1-4 acres of land[35] and 1-5 heads[36] of cattle and are largely reliant on forage and small quantities of concentrate to feed their herds. There are approximately 5,000 medium- and large-scale producers that contribute the remaining 44% of total production.[37] Large-scale producers tend to be located near urban centers and often deliver to formal markets via processing firms or have their own processing and dispensing enterprises. Only Nandi and Uasin Gishu counties show significant numbers of these large-scale dairy producers.[38]

Large parts of the value chain remain informal. 45% of milk production is typically consumed by producers at the household level. The remaining 55% of milk, or roughly 2.8 billion liters, enters the market through formal or informal channels.[39] The informal channel, making up 80-90% of all milk reaching the market, is largely composed of producers, hawkers, and traders distributing raw and semi-processed milk to cooperative, milk bars and dispensers.[40] Much of the milk moving through the informal channel is marketed as raw milk. However, a small

percentage (~5%) of informal milk is processed and distributed through milk dispensers.[41] The formal channel, composed of licensed operators that include processors, mini dairies, cottage industries, and milk bars, only represents 10-20% of milk reaching the market and is characterized by industrial dairy processors that produce processed milk, yoghurt, cheese, butter, and ultra high temperature milk (UHT). These processors will often source from more formal cooperatives.

Milk tends to be transported first from the farm to a bulking/cooling center and then to the processors.[42] Producers and informal traders/transporters often compose the first stage of transport. Informal transporters/traders often use bicycles or motorcycles and unapproved containers (e.g. jerry cans). Poor road infrastructure and/or improper storage containers can lead to bacterial growth or milk spoilage, posing a potential health risk and/or leading to heavy losses in production. The next level of transport is largely composed of more formal transporters. These formal, licensed transporters often have specially built trucks for milk transportation or use open trucks with authorized aluminium cans, some with refrigeration capacity. Formal milk traders may also purchase directly from producers or dairy cooperatives and sell directly to consumers, milk bars, or milk processors.



Source: Adapted from GATES EADD project and other sources

Figure 1 | ***Dairy Value Chain Structure adopted from USAID***[43]

Cooperatives and milk bulking/chilling centers are integral to maintaining the cold chain to preserve the quality of the milk. There are some 200 milk cooling plants linking producers and processors. Many cooperatives operate as bulking and chilling centers and provide additional services to producers, including marketing directly to end consumer or providing artificial insemination, veterinary services, feed, and other inputs directly to producers. These milk centers have become important business hubs for dairy producers and connect them to processors. Processing companies rely on milk centers to lower their own cost of collection from small and

scattered producers. In addition to milk collection and distribution, cooperatives provide various services and inputs to their members, including cooling facilities, veterinary services, extension services, AI services, and access to finance.[44] Smallholders in the formal sector transport their outputs to cooling centers or hubs (MCCs)[45] that are usually owned by processors. Licensed aggregators and processors sell packaged milk and processed dairy products.

While the exact number of processors is unknown, the four largest processors control at least 85% of milk intake. While the KDB estimates that over 40 milk processors have been licensed since 1992, only 25-27 are currently active. The Kenya Agricultural Value Chain Enterprise (KAVES) project of USAID estimates that there are 92 dairy processors, including 35 large, 30 medium, and 27 small scale. Small-scale processors buy milk through contractual arrangements with producers, but responsible business practices, contract enforcement, and dispute resolution mechanisms in the sector are lacking. The four largest processors intake over 100,000 liters/day on average and can reach over 400,000 liters/day during the peak season. As of 2017, the market further consolidated and the top two processors, Brookside and New KCC, collectively controlled about 75% of the raw milk market.[46] The main products from processing plants include: white liquid milk (pasteurized and long life), flavored liquid milk, fermented milk (yoghurt and cheese), milk powder, cheese, butter, ghee, and cream.

Retail is characterized by a diverse set of players including milk bars and dispensers, supermarkets, retail shops, and kiosks. The milk traders and retailers are divided into several categories. Fixed retail is composed of supermarkets, kiosks and chain stores, and tend to source from the formal markets. Milk bars source from both formal and informal markets, and sell fresh milk, yoghurt, milk shakes, maziwa lala, and other milk-based products. Milk dispensers are located in supermarkets but can also be stand-alone in cities. They provide larger dairy cooperatives with an opportunity to compete with processors in the fresh milk market. Finally, informal venders collect milk from producers and sell directly to consumers via bikes or on foot, often in urban areas. Milk quality and safety issues in formal dairy markets have, however, led to a growing informal sector which is gradually advancing into urban areas that are usually dominated by formal sector players.[47]

2.3 Main Challenges

Current processing capacity is underutilized. There is a low utilization rate of processing capacity in the region.[48] This is partially due to low consumer demand for a variety of processed dairy products, with high consumer preference for raw milk. Pasteurized whole milk constitutes 60% of existing processed products. In addition to consumer preferences, seasonal fluctuations in supply are due to reliance on rain-fed pasture systems and poor planning of fodder production that affects feed availability, quality, and cost.[49] Variable demand can also lead to the underutilization of processing capacity. Milk surpluses could be processed into longer-lasting products such as milk powder but there is limited business rationale for increasing processing capacity when much of it would remain idle when production is low.

Inefficient service provision further stifles growth. Many producers in the informal market are limited by a lack of training and extension services that would help ensure quality animal husbandry and farming practices. Access to inputs is limited due to long distances to provision stores, making procurement costly and inconvenient to producers. Input suppliers are limited in their ability to provide comprehensive services to producers due to their own lack of technical knowledge and capital constraints.

Poor rural infrastructure leads to higher costs. Poorly constructed or maintained roads and intermittent access to electricity leads to both high costs of milk collection and high rates of post-harvest milk loss. Spillage, lack of linkages to markets, and poor quality or health concerns can prevent smallholders from marketing their products. The sector further suffers from a lack of accurate and timely information gathering for planning and decision-making including the number of animals, inputs, production, and sales.

There are limited prospects for strategic growth. The dairy industry lacks a common vision for growth and competitiveness. The majority of the market is informal and fragmented without a clear path to enhanced

formalization and value addition. As urban centers grow and drive increased milk demand, it is likely that much of it will be met through the informal market with negative implications for regulation, milk quality, and export potential.

3. Standardization and Certification

A range of mandatory standards and voluntary certification schemes exist. Standards are required for access to local and national markets or to sell milk products through formal value chains, but they are rarely applied in the vast informal markets which limits their effectiveness. Voluntary certification schemes are typically associated with niche segments, seeking to guarantee higher quality and/or production practices that can enable access to higher prices.

More formal value chains would enhance investment attractiveness. Streamlining, wider spread adoption, and stronger enforcement of standards could accelerate the transition towards a more formal value chain. The integration on environmental criteria and climate smart practices - which currently remain limited - could further improve investor and consumer confidence. This might include climate-resilient fodder management, increasing domestic investments in climate-resilient infrastructure to improve dairy smallholders' linkages to markets, improving manure management, and promoting fodder tree planting.[50]

3.1 Current Standards

As with any other food product for human consumption, dairy products are required to meet a range of national standards. The majority of standards relevant for the dairy sector revolve around food security and hygiene control and are mostly benchmarked against standards for regional and international standards to ensure regional alignment also as a basis for accessing export markets. This includes standards such as the Common Market for Eastern and Southern Africa (COMESA) and international FAO Food Standards by the Codex Alimentarius Commission.

National standards for the dairy sector are prepared by the Dairy Technical Committee (TC) and the Kenya Bureau of Standards (KEBS) serves as secretariat. Key public institutions and private stakeholders are represented on the Technical Committee, and the KDB serves as chair to design and review new standards and regulations. Members of the Kenya Dairy Board may develop and submit standards for approval. Once accepted by the KDB, the proposed standards are forwarded through the Dairy Technical Committee and to the KEBS for adoption.

Standards for the Kenyan dairy sector focus on food quality and safety with limited criteria related to environmental aspects of production and processing. The main standard text that relates to environmental factors is the *Code of hygienic practice for milk and milk products, KS 1552:2016*.[51] The code sets guidelines for hygienic production, processing, and handling the bulking and distribution of milk and milk products. Producers that meet the regulations are expected to have enhanced access to formal dairy markets.[52] While these requirements on 'environmental hygiene' address manure, fodder residue, and water management, they do not specifically address CSA-related aspects.[53]

There are no national standards for environmental or climate-related criteria. The *Environmental Management and Co-ordination Act of 1999 (EMCA),* amended most recently in 2018,[54]

Box I: ***Existing Standards and Gaps for Kenyan Dairy***

Kenya has a range of mandatory standards and voluntary certification schemes for its dairy sector, but none specifically include environmental or climate-related criteria. The majority of standards deal with milk quality and safety and are benchmarked against international standards,

The *Environmental Management and Co-ordination Act of 1999* outlines general regulations on environmental protection for industry, but does not include specific guidelines for milk production or processing. Standards are required for access to local and national markets or to sell milk products through formal value chains, but they are rarely applied in the vast informal markets which limits their effectiveness.

Export market standards are limited to milk quality and milk safety, and similar to national standards, do not consider environmental or climate-related criteria.

contains the most tangible and applicable regulations for the dairy sector in the environmental context. However, these do not include concrete guidelines on climate-friendly practices for milk production and processing. Large scale processors are regulated under the *Energy Act (2006)* and the *Energy (Energy Management) Regulations (2012)* which require regular energy audits and energy conservation for all large manufacturers,[55] but these requirements are not specific to the dairy sector and affect only a small proportion of marketed milk.

Export products need to fulfill additional product standards. These cover specific compositional, hygienic, food safety, and labeling requirements (such as microbiological criteria, mycotoxin residues, contents of antibiotics, and/or cheese maturation procedures). The prevailing issues for export market standards revolve around milk quality and milk safety. Milk quality concerns stem from unimproved milking practices and a lack of cooling systems. Milk safety issues are regulated through the *Dairy Industry Act (CAP 336)* and the *Public Health Act* (CAP 242) but many producers face challenges with compliance. These milk quality and safety issues continue to negatively affect dairies' ability to access export markets.[56]

3.2 Voluntary Certification Schemes

Higher quality dairy products can receive voluntary certification marks. Two such marks are available through existing KEBS standards. These include the Diamond Mark of Quality and the Food Fortification mark.[57] The latter mark indicates the addition of one or more vitamins and/or minerals to a food to improve its nutritional profile.[58]

Additional voluntary certification schemes cover niche or premium products. For example, organic dairy products follow the East African Organic Product Standards (EAOPS) or international schemes (e.g. IMO, Ceres, and Bio Suisse)[59] for export markets. Although the market for organic dairy produce is growing, especially in Nairobi, it caters mainly to high-income customers. Overall demand remains insufficient to entice a greater number of producers to adopt associated production practices.

There are few certification schemes available for the dairy sector, especially for relevant environmental practices. The promotion of Good Dairy Farming Practices (GDFP) through initiatives such as the Smallholder Dairy Commercialization Programme (SDCP) (See **Box 1**), could be viewed as an initial intervention to introduce environmentally-friendly criteria and enhance producers' access to climate-smart practices and technologies.[60]

3.3 Barriers

There are limited incentives to follow mandatory standards. For certification, there are indications that the use of CSA-related good dairy farming practices remains unsatisfactory and further capacity building for smallholders on GDFP is needed to increase the quantity and improve the quality of milk production.[61] The high market share of the informal sector, the high number of small-scale dairy producers, and the apparent indifference of consumers all challenge regulatory and monitoring efforts to enforce existing standards.[62] The lax enforcement of standards does little to discourage this behavior, and few incentives exist that would entice producers to meet standards on their own. Only once producers seek access to formal markets do standards become truly mandatory. As long as processors continue to purchase non-compliant milk, producers do not face economic pressure to adhere to standards and enter formal markets.

Difficulties in standard creation and enforcement further enable non-compliance. With a limited number of auditors and officers on the ground, there is limited capacity by the public sector to enforce compliance in the highly fragmented and unorganized value chain. There is also an absence of political momentum within key standards-setting and enforcement institutions, especially those with key roles in environmental/CSA regulations and agricultural sectors. Additionally, new standards are developed and proposed by industry players that may not be motivated to support additional regulations that would restrict their production practices or lead to higher compliance costs.

The public sector has limited capacity to support producers in standards adoption and formalization. If standards were to be adopted and enforced across the entire formal and informal market, producers would require additional assistance in applying streamlined standards and simplified criteria. Currently, a lack of personnel and limited training capacities complicate public extension services and remain a major obstacle to driving wide-scale adoption of standards.

Limited incentives exist for self-regulation or pursuing certification. Current incentives, in terms of higher prices for certified produce or access to particular markets, are not sufficiently attractive to shift production practices. Additionally, the dairy processors association argues that competition with global prices requires a focus on increased productivity, not on price incentives.[63] Additionally, insufficient demand for higher quality goods and a low willingness to pay reduces the market for certified milk.

3.4 Opportunities

Linking financial incentives (see Section 2.4) **to the adoption of standards would encourage compliance.** Value chain actors enjoy a range of subsidies that could be made conditional on standard compliance. In addition, targeted financial incentives could be created and provided alongside training to shift towards formalization.

Integrating CSA criteria into standards and streamlining adoption may also improve standards compliance while increasing the uptake of environmental practices. While the Smallholder Dairy Commercialization Programme's (See **Box 1**) approach may not be viewed as a natural entry point for certification, it serves as a valuable example of how measures of small-scale dairy producers' improved market linkages and improved productivity can serve as incentives to include CSA practices in the dairy value chain. The benefits of CSA-practices in terms of enhancing productivity and increasing resilience need to be better communicated through these types of programs if greater adoption is to be achieved.

In the absence of capacity for extension services, professionalized cooperatives can be a key vehicle for promoting standard compliance. Agricultural extension services have been devolved to the county level, and consequently there are varying types, levels, and quality of services being offered throughout the sector. Cooperatives are the key access point for many services and resources for producers and also serve as intermediaries for reaching processors and consumers. Given their status as a convening point for several upstream and downstream processes, cooperatives can serve as a channel for targeting support or incentives from processors or downstream private sector to enable producers to attain higher standards. Cooperatives that are not as strongly linked to a processor can improve their competitiveness and marketing by bulking according to different grades of milk quality. This could enable entry into higher-value markets and make for a convincing business case for cooperatives.

Continued sensitization campaigns and enhancing knowledge and access to basic quality testing kits can enable greater consumer demand for high-quality products. The government has launched several campaigns to warn consumers against purchasing unprocessed raw milk, and the KDB has promoted the use of good handling practices and hygiene amongst unlicensed or informal traders. Additionally, the promotion of milk ATMs as a means to receive pasteurized milk is gaining traction and ATMs are growing popular in rural areas.[64] There is evidence of some milk traders performing informal and basic quality tests for spoilage, adulteration, alcohol control, and clot boiling before selling milk to consumers.[65] These practices should be promoted amongst vendors to further expose consumers to better quality milk at minimal cost.

4. Aggregation

In addition to enhancing access to market, producer aggregation can be a powerful channel for delivering services, training, inputs, and finance. This addresses many of the key barriers faced by smallholders in informal markets.

4.1 Existing Aggregator Models

Cooperatives are the primary structure for milk bulking and marketing but vary in their service offerings to smallholders. The KDB estimates that there are approximately 365 cooperative groups that collect, bulk, and market the raw milk to processors, mini dairies, milk bars, and traders. Dairy cooperatives dominate milk marketing[66] in both formal and informal market segments, with roughly 60% of marketed milk going through cooperatives, traders, hotels, and kiosks.

Processors often work directly with cooperatives to provide extension services and access to inputs to smallholders in an effort to secure supply. Five of the largest processors work directly with cooperatives and producer groups to offer trainings, extension services, and access to inputs such as improved fodder, feed, and agro-vet services.[67] However, their reach is still limited, as only about 57,000 farmers have access to these services, compared to 1.8 million producers in the entire sector.[68] Processors are able to invest in extension services in exchange for a guaranteed supply of milk. Larger processors that work directly with cooperatives are able to offer incentives such as guaranteed purchases and timely payments to encourage more collaboration and to improve service delivery. Processors are often directly engaged and invest in capacity-building for cooperatives in an effort to professionalize their operations.

4.2 Barriers

Aggregation of producers is a costly and risky process that currently offers little upside. The physical aggregation of supply and working with producers to ensure milk quality and stable quantity can incur significant costs that must be matched by higher prices and guaranteed off-take by processors and manufacturers. In addition, the risk of producers side-selling to other buyers must be carefully managed. While the provision of extension services to producers in exchange for stable supply can lead to higher overall productivity, producer loyalty, and value chain efficiencies in the long run, extension services can entail in heavy short-term losses and face financing difficulties.

Cooperatives have highly variable levels of professionalization and formality. Many cooperatives do not adequately address producers' issues or actively promote formalization. Less formal cooperatives offer varying levels of support in terms of services offered, milk marketing approaches, and capacity for meeting phytosanitary standards. In response, many producers have created Dairy Farmer Self-Help Groups (DFSHGs) to address these shortcomings; in particular, these groups are popular amongst smallholders that want fair prices for milk they sell directly to processors and dealers.[69] DFSHGs function as a form of aggregation model for producers to aggregate output, organize the milk transports to processors, and provide a range of services including training, access to inputs, and finance.[70]

4.3 Opportunities

National and county governments could directly support aggregation and extension services through financial and other incentives (see Section 2.4), conditional upon formalization and adherence to standards (see Section 2.2). Processors tend to work through cooperatives to offer extension and other services to producers that may not directly benefit the processor, especially if producers choose to side-sell part of their production. To stimulate aggregation and extension service provision through aggregators, financial incentives including tax breaks could be provided to aggregators and processors. Such a model may be more effective than building government extension services and would hold the private sector accountable.

Technology can address market inefficiencies and encourage formalization by providing more direct links between value chain actors, creating transparency, and enhancing trust. There has been recent success with the formalization of small scale milk vendors (SSMVs) through the KDB's promotion of milk vending machines. These machines have an inbuilt-boiling and pasteurization system that regulates the quality of milk that consumers purchase. Traders that previously sold raw milk directly to end-consumers are instead encouraged to receive training and become licensed in safe handling practices. These licenses allow them to deliver to milk ATMs, effectively providing a semi-guaranteed access to market and enhancing marketing effectiveness.

5. Financial Incentives

Financial incentives are a powerful tool to encourage behavioral change. The use of financial incentives in agriculture has been extensively studied for their effectiveness, especially input subsidies in Sub-Saharan Africa.[b] As discussed in previous sections, financial incentives could play an important role at different points in the dairy value chain (e.g. aimed at processors, aggregators, or direct to producers) to encourage standards adoption, provide producer support and encourage aggregation, and/or to reward a particular form of production. The following section provides an overview of possible incentives and their applications in the dairy sector.

5.1 Existing Financial Incentives

There are numerous taxes, levies, and fees for formal and informal producers at the local and national levels whose reform could shift producer behaviour. The KDB generates revenues by collecting taxes and levies as well as charging for penalties, licenses, and permits.[71] These revenues are meant to be reinvested into the sector. Raw or minimally processed milk, without additives or sugar, are exempt from VAT taxes while processed milk products are subject to a 16% VAT.[72] As such, the current taxation regime can be seen as encouraging low input use and minimally processed dairy production, which runs counter to the ambitions of enhanced quality, productivity, and value addition. In 2013, there was widespread backlash after unprocessed and minimally processed milk products were included under the 16% VAT, leading to a later clarification of the law and reclassification of the products to zero-rated goods.[73] This further underlines the lack of public demand for high-quality milk. Additionally, as part of the East Africa Community free-trade zone, Kenya can export processed milk products while benefiting from a 60% Common External Tariff on other foreign dairy products.[74]

There are proposed changes to fiscal policies in the sector. The *Statute Law (Miscellaneous Amendments) Bill* for 2018 proposes a 1% fee on processed milk and would allow for further local taxes to be charged by the county governments.[75] The bill would also raise penalties against unlicensed milk operators, including requiring milk ATMs to receive a permit. While it is believed that this structure would relieve producers of costs, the burden of the tax may be shifted to the consumer instead as processors increase consumer prices in response to the new tax.[76] This is likely to prove politically difficult given the popularity of milk products in Kenya and runs counter to the government's current stance to promote domestic consumption.

Many input subsidy programs are managed by county governments. At the producer level, subsidies for livestock inputs include AI, veterinary services, feed, fodder, and basic capital inputs such as cooling and milk transport tanks. This can take the form of favorable financing arrangements, reduced costs, or direct provision. Producers, both in formal and informal value chains, often access subsidized inputs through cooperatives or local markets depending on the specific program. For example, Busia and Mukueni provide subsidized AI services through government extension workers[77] and Kirinyaga County has an AI unit for producers to receive subsidized seed.[78] Murang'a County set up a "One Youth One Cow" project with a dairy SACCO cooperative organization to provide access to credit and high-quality livestock in an effort to encourage youth participation in livestock and dairy.[79]

The Kenyan Livestock Insurance Program (KLIP) is a national subsidy program for livestock insurance. The Index-Based Livestock Insurance (IBLI) product was developed by the International Livestock Research Institute and is implemented through a consortium of private sector partners. Using a Normalized Difference in Vegetation Index (NDVI) to analyze satellite-based imagery of vegetative cover in pastoralist regions, the program can approximate drought intensity and estimate the corresponding livestock mortality as the basis for payments. The KLIP subsidizes pastoralist households in 14 drought-prone regions for purchasing insurance through the private sector partners. The scheme covers up to five "tropical livestock units" i.e., 5 cattle or 50 goats/sheep, and households can pay additional premiums directly to the private insurance provider for expanded coverage. Nearly 200,000 policies are expected by the end of 2018[80] and 2017 pay outs totalled over 500 million KSH.[81]

[b] For an illustrative list of references, see: "Fertilizer Subsidies in sub-Saharan Africa," FAO 2012, http://www.fao.org/3/a-ap077e.pdf ; "Agricultural Input Subsidies in Sub-Saharan Africa," DANIDA, https://www.oecd.org/derec/49231998.pdf ; "Myth and Realities about Input Subsidies in Sub-Saharan Africa," https://www.oecd.org/derec/49231998.pdf ; "Review: Taking Stock of Africa's Second-Generation Agricultural Input Subsidy Programs," https://www.sciencedirect.com/science/article/pii/S0306919217308618

There is ongoing interest by the KDB and others to revive national and county-level school milk programs (SMP). From 2007 to late 2008, KDB along with private and governmental partners implemented a Pilot School Milk program to test the feasibility of re-introducing a national program,[82] with some advocating for a public-private partnership model.[83] As of March 2018, SMPs are currently operating in seven counties[c] serving 9% of total early childhood education students.[84] KDB promotes SMPs as a market development tool that will benefit smallholders and all actors along the dairy supply chain through increasing local demand for milk and creating more competition[85] [86] while supporting national health, nutrition, and educational outcomes.[87] By encouraging county governments to arrange public-private partnerships for local SMPs, the KDB hopes to spur private investment along the value chain to supply this guaranteed market, with government subsidies only used to supplement the cost of milk for the poorest students.[88] However, the latest raft of SMPs includes very few producer-targeted incentives to actually achieve this goal.

5.2 Barriers

Taxes, levies, and fees are difficult to collect in the informal sector and primarily target processed products. Generally, only the formal, processed milk market is charged the full range of taxes and fees, which creates a cost advantage for operations on the informal sector.[89] This creates a misalignment of incentives for producers and traders, indirectly rewarding informality and acting as a barrier to formalization for accessing higher-quality and higher-value markets.

Many of the input subsidy programs have faced implementation obstacles. The publicly-run support services at the county levels are often viewed as unreliable, partially due to demand for inputs and services exceeding existing personnel capacity.[90] For example, county-run AI programs, including those in Busia and Mukueni,[91] are inconsistently delivered and cause many producers to use the cheaper and lower-quality bull services available locally.[92] One analysis of the Kenyan dairy sector found that input subsidies and deliveries tended to lack in "software," i.e., investments into targeted training and advisory services, data collection, and analysis, which have all been identified as key constraints in developing the value chain.[93]

The most pressing obstacle for agricultural insurance is the low level of uptake by producers. As detailed in *the National FinAccess Survey* for 2016, the main determinants for households not purchasing insurance included a lack of knowledge about insurance products; being unable to afford insurance; and not seeing the benefits of having insurance.[94] Producer knowledge of insurance and financial literacy remain key barriers, and though many products can be delivered through mobile money and other payment services, access issues remain.

5.3 Opportunities

Fiscal incentives should be designed to address barriers to entry to formal markets. For example, high costs of production can be mitigated through targeted subsidies or favorable financing arrangements for producers. In-kind support and training could be deployed to more informal cooperatives to enhance their service provision to smallholders. The ongoing development of a national school milk program could ensure that smallholders benefit from access to local market outlets without the competition in the formal bulk milk sector. Programs such as these could also be used as a bridge between the formal and informal markets by making access conditional on standard adherence. If producers are required to attain certain quality thresholds to access school milk programs or subsidies and receive the requisite support to comply, a gradual transition to more formalized markets could be facilitated. See **Box 2**.

Leveraging the private sector for service, input, and finance delivery - stimulated by financial incentives - can increase efficiency. Having a strong private sector partner for implementation of subsidy programs at the national and county levels has proven to be effective in overcoming public sector delivery issues. KLIP implementation through private sector partners is a concrete example. For future school-milk programs, the KDP is promoting a decentralized, public-private partnership model that establishes SMPs through county-level trust

[c] Mombasa, Migori, Murang'a, Kilifi, Meru, Embu, and Nyandarua

funds to receive co-financing by government and private sources to promote long-term financial sustainability, transparency, and accountability. Similar models could be used to stimulate aggregator development as well as service and finance delivery to smallholders.

Insurance uptake can be achieved through bundling with other high-value services, including access to and training in climate-smart technologies and practices. Index-based insurance is most effectively marketed as one component of a larger risk management strategy. Private companies that implement KLIP have found that combining the selling of the service with trainings on financial management and planning for drought can increase demand for the product. Recent studies have shown that farmer uptake of insurance increases further when plans are bundled with other income-generating development interventions,[95] which can include climate-smart interventions to improve productivity and resilience.[96] When insurance is combined with access to improved feed and AI services to improve cow genetics, insurance premium payments can be offset by increased milk yields.[97]

Box 2: ***Happy Cow Pilot and SNV pilot: an innovative approach to integrate financial incentives and improved standards***

Beginning in 2014, the dairy processing company Happy Cow began to pilot a Quality-Based Milk Payment (QBMP) system with SNV. Happy Cow sources milk through two cooperatives and has initiated QBMP in an effort to reduce processing costs and increase the quality of the milk. Built on a tracking and traceability system that is able to trace milk back to the producer, milk is tested as it moves through the value chain for: Total Plate Count, Total Solids, Freezing Point Depression, and Anti-Biotic Residues.[a] Based on the results, milk is categorized as high quality, standard, or substandard. At the end of each month, producers receive premiums for high quality and the market price for meeting standards.[a] At present, producers are not penalized for falling below standard levels, but this is a planned future component of the program.

6. Conclusion: Criteria for Success

Currently, there is a misalignment of incentives for smallholders that discourages formalization and a lack of incentives for the adoption of CSA practices and technologies. The potential benefits of formal markets including greater value generation do not outweigh the additional cost of standard compliance, license requirements, and duties and fees. Entering formal value chains is therefore viewed as having high costs and few benefits for the average smallholder. Informal markets and a high degree of fragmentation in turn are an unattractive territory for many investors, hence restricting capital flows. While higher penalties for non-compliance could cause some producers to exit the informal sector, policies seeking to lower costs while increasing the benefits of formalization are likely to have more substantial impact. Streamlined standards and certification schemes with CSA criteria, aggregation models and support provision driven by targeted incentives are means to encourage a gradual type of transition to more formal markets and greater adoption of CSA practices, which in turn would make the sector more attractive to private investors.

6.1 Informal Sector Support

Combine new regulations, standards, and certification schemes with direct support via trainings, input access, and/or finance. Such support does not need to be provided directly by national or county governments but can also come from local agents, extension workers, or other market players. Currently, the Quality-Based Milk Payments System (QBMPs) operated by Happy Cow and its sourcing network is a successful example of how targeted financial incentives may encourage smallholders to attain higher quality, yet it is tied to more formal and integrated value chain (See **Box 2**). In informal markets, there are fewer opportunities for quality-differentiated products and incentives are can motivate market entry. However, bundling the provision of services with other needed inputs or trainings can expand access.

Target productivity rather than herd expansion. Producer support should emphasize improvements on the quality and quantity of milk produced by current herd sizes before expanding herd size, especially through smoothing out production disparities over the dry and wet seasons. Increased access to improved fodder during the dry season would reduce unproductive emissions while increasing household income during periods of high milk prices.[98] For

example, the "One Youth, One Cow" initiative only provided credit and cows without support and many producers complained of the low milk productivity. Participation in such programs could require producer attendance to classes or be combined with access to extension agents and high-quality feed.

6.2 Policy Coherence and Coordination

Improve coordination and engagement among value chain participants to ensure effective and efficient policy design. This is especially relevant given the myriad of institutions involved in the value chain. Domestic standards can be strategically designed to incorporate climate criteria in line with Kenya's national climate action goals while reflecting regional and international standards and certification schemes to further enable growth of export markets. Enhancing demand for higher-quality milk can occur from public or private channels, and country-level programs can be met with national support provisions to ensure policy coherence across governance levels. Knowledge sharing and research across county-level programs can further enhance the design of future policies. Professionalized aggregators and cooperatives can serve as delivery agents for climate-smart standards/certification and incentives.

Remove disincentives for the uptake of improved practices. Currently, high VAT for various inputs and fees for entering the formal value chain serve as major barriers to entry for smallholders and smaller market vendors and enterprises. One consideration could be reduced taxes or subsidized cost of entering formal market conditional on adherence to certain criteria. Targeting informal retailers and consumers through sensitization campaigns can further raise the demand for quality products.

6.3 Opportunities with Technology

Technology has helped in successfully overcoming many market inefficiencies, but challenges for reaching scale remain. The high penetration of mobile phone usage and the transition from paper-based to digital management systems by aggregators are streamlining supply chain management systems. Technology can enable information flow amongst stakeholders by expand access to knowledge, eradicating information asymmetries, and signalling current weather or market conditions to improve climate adaptability. Additionally, as demonstrated by LishaBora (See **Box 3**), technology can utilize existing market structures to improve input access and by bundling service offerings at informal aggregation points.

Box 3: ***LishaBora market building app***

LishaBora operates a supply chain management solution for traders that allows for the improved delivery of inputs and streamlined milk aggregation services. The app works like a digital ledger allowing traders to more efficiently manage ongoing credits (e.g. inputs provided to producers) and debits (e.g. milk received from producers) within their producer networks. The platform also acts as a digital marketplace by offering various inputs, including LishaBora's improved feed product. The main advantage for traders lies in the replacement of paper records with digital records and building long-term producer profiles that provide a basis for extending inputs on credit as well as services. The app has the potential to enhance producer loyalty and build stronger value chain links.

Technology for data collection and analysis can improve policy design and targeting. Increased access to data and information can improve the impact of existing and help design new incentives and programs. The QBMP system is particularly innovative in its sophisticated data storage, analytics, and sharing capacities. The QBMP system is built on a centralized database that stores milk production and quality data for specific producer IDs. This data can be analysed to identify those producers that consistently produce higher-quality milk. Higher prices paid for high-quality milk can help to offset the cost of climate-smart practices like supplying improved feed and proper manure management. Happy Cow is able to share results with cooperatives to recommend relevant extension services to improve milk quality. Additionally, Happy Cow is supplying the KDB with quality information to support future extension services and to inform further standards development. There are future plans to incorporate cooperative knowledge/data on individual producer's management practices and to extend traceability to the cow level to provide even more tailored recommendations.

Scaled-up adoption of renewable energy technologies for milk chilling and processing can significantly reduce emissions, lower cost, and enhance access in rural areas with insecure energy supply. Technology solutions exists and case studies demonstrate their business case but their adoption is limited by a lack of capital and suitable financial mechanisms for upfront investment and limited technical knowledge and dissemination. To learn more about options to expand renewable energy in agriculture systems, explore USAID's *Energy Opportunities for Agriculture Systems and Food Security Project*[99].

DISCLAIMER

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