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USAID-KAVES DAIRY VALUE CHAIN ANALYSIS

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FOREWARD

The goal of the Kenya Agricultural Value Chain Enterprises (USAID-KAVES) project is to increase the productivity and incomes of smallholders and other actors along the milk, dairy and horticulture value chains, thereby enhancing food security and improving nutrition.

This report is one of a series of detailed valued chain analyses conducted by USAID-KAVES to identify critical constraints/gaps and prioritize high-return program interventions that will contribute to the program's core objectives of:

- *Increasing the competitiveness of selected agricultural value chains to increase incomes, mitigate food insecurity, improve nutrition, and increase the incomes of the rural poor;*
- *Fostering innovation and adaptive technologies and techniques that improve nutritional outcomes for rural households, sustainably reduce chronic under-nutrition, and increase household consumption of nutrition-dense foods; and*
- *Increasing the capacity of local organizations to sustainably undertake value chain work.*

While drawing upon the extensive body of existing research on targeted Kenyan valued chains, USAID-KAVES' analysis further builds upon and updates those findings with primary data obtained through detailed field surveys and interviews with value chain participants.

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EXECUTIVE SUMMARY

The dairy value chain is one of the most dynamic sectors in Kenya and critical to the country's rural economy. It is currently valued at over KSh184 billion (US$2.1 billion), and contributes 6-8 percent of GDP. Driven by growing urban demand, the national annual per capita milk consumption is expected to grow at an annual rate of about 3 percent for the next ten years, to reach 139 liters by 2022. Our analysis projects that production will fall short of demand by 1275 million liters in 2022, unless targeted interventions are implemented on a national scale. Market analysis suggests there is significant market opportunity for small-scale dairy farmers if they can increase productivity, reduce their costs of production, improve quality, and become more efficient marketers of their products..

INTRODUCTION AND METHODOLOGY

Milk production is a crucial source of income for more than two million households across Kenya and milk is a significant contributor to the nutrition and health of the entire population. Dairy farming is a high value enterprise that presents substantial opportunities for future smallholder development. The Kenyan dairy sector ranks among the most developed in Sub-Sahara Africa, boasting regional market advantages and substantial untapped production potential. With increasing domestic consumption and the harmonization of dairy product specifications by the East African Community (EAC) and the Common Market for East and Southern Africa (COMESA), the Kenyan dairy value chain needs upgrading to increase productivity, reduce inefficiencies, lower production and processing costs, and improve milk quality to international standards.

Methodology

Using the extensive literature relating to the Kenyan dairy value chain as a starting point, the USAID-KAVES (hereafter "KAVES") team carried out a preliminary analysis in conjunction with local dairy experts to determine existing gaps in knowledge and identify areas where further data collection and analysis would be necessary to guide KAVES' technical assistance strategy. Relevant studies and data were reviewed and are discussed in this report, in some cases, with alternative analyses and interpretations carried out. Based on this process, several field surveys, focus group discussions (FGDs) and key informant interviews were carried out to update key production, trade and consumption figures, validate secondary sources, and provide primary information specific to the KAVES target areas. Data collected as part of the KAVES baseline survey of 1,800 farmers was re-analyzed and pooled with a second panel survey of farmers selected from the first 16,000 farmers receiving KAVES' support. Finally, a smaller survey of dairy farmers, milk bulking/cooling plants, and dispensers was carried out to obtain specific information on cost and margins at different levels of the value chain. The examination of new and existing data provides a unique perspective on dynamics affecting the Kenyan dairy sector and has identified opportunities for high impact interventions.

SUMMARY OF KEY FINDINGS

Consumption and Demand Analysis

Driven by growing urban demand, national per capita milk consumption is expected to grow at an annual rate of 2.8 percent for the next ten years, from 106 liters per person in 2012 to 139 liters by 2022. The total national milk consumption will grow at 6 percent per year to reach 8.0 billion liters, as a result of population growth. Our analysis suggests that urban milk demand will grow at an annual rate nearly double that of rural demand over the same period to 3.91 billion liters. Kenya will require an additional 3.52 billion liters of milk by 2022 (79 percent over the 2012 levels) to satisfy demand, with urban areas accounting for 59 percent of the total growth.

The higher demand for milk and dairy products will favor domestic production, given the strong preference for fresh (loose) milk among Kenyan consumers. Processed dairy products used about 16 percent of total milk output in 2012, and rising demand is expected to drive the market

and stimulate growth in the near term. Successful revival of the school milk program (SMP) would increase national demand for milk by more than 4 percent per year, depending on the level of adoption by county governments, and therefore requires either increased milk production or increased imports of powdered milk and butter oil for reconstitution. Overall, five major factors will drive the demand for dairy products in the near term:

- Continued growth and increased sophistication of the informal milk markets.
- Changes in consumption habits and lifestyles, as incomes and urbanization increase.
- Increased preference for convenience products that will drive demand for dairy products like yoghurt.
- Increasing population and per capita consumption, especially by the rising population of 0-5 year old children.
- Increased demand for quality, safety and standards with increasing consumer sophistication and attention to health.

Supply Analysis and Production Potential

Kenya currently suffers deficits in milk and dairy products, especially in years of drought. The country produced 4.8 billion liters of milk in 2012, with 75 percent coming from cattle and the rest from camels and goats. The dairy sector is characterized by low-input, low-yield systems that produce below the national herd potential. It relies on about 6.8 million cross breed and hybrid undernourished cattle producing about 3 billion liters of milk annually, with average annual yields per cow (1265 liters) well below global averages. A baseline survey conducted by KAVES in its 22 targeted counties concluded that each dairy cow produced an average of 1,418 liters in 2012, translating to a national yield that is 43 percent below the global average.

Our projections in Section 3.6 indicate that, without any gains from increased yields and output, domestic milk supply will fall short of demand by approximately 675 million liters in 2017 and 1,275 million liters by 2022. In the absence of significant increases in domestic production, imports will play an increasing role in national milk supply. The analysis indicates market opportunities for smallholders are substantial, if they could ensure the financial viability and competitiveness of dairy enterprises by increasing yields and reducing the cost of production. We have built scenarios that show how the projected milk deficits in 2017 can be eliminated by modest (20 percent) increases in average milk yields (to 1,520 liters per cow per year). These can be realized through interventions that narrow the management and technology gaps, promote animal breed improvement, introduce better animal husbandry practices, and target greater availability of water and feed/fodder year round. Critical to this are innovations on breeding technologies and management that improve the genetic quality and milk potential of dairy herds within a shorter time as opposed to the current average calving interval of 600 days.

The Milk Value Chain

Dairy supply chains in Kenya show a large variation in terms of size, geographical distribution, degree of licensing, relative rewards, quality perceptions and long-term potential. A number of critical issues affecting each point in the value chain and moderating future impact are described below:

- *Input Suppliers* tend to be limited in their ability to provide appropriate services to farmers across the country. A lack of access to finance and technical expertise severely limits the quantity and quality of services they can provide to farmers. Long distances between input suppliers and the farmers they serve further limits their ability to effectively service smallholder farmers.
- *Small-scale farmers* supply more than 80 percent of the total milk consumed in Kenya, obtained from mostly crossbred animals raised on open and semi-zero grazing systems. They sell milk directly to consumers or through local traders, and tend to have a diverse array of access issues, including difficulties obtaining feed, fodder, and water.
- *Informal milk traders* are the single most important marketing actor, controlling over 70 percent of marketed milk.

- *Low quality and milk safety* pose considerable constraints. Reliable quality testing is virtually non-existent and the equipment used for handling and transportation of milk does not meet the minimum food safety standards set by industry regulators.
- *Milk bulking/cooling centers* have emerged as important business hubs for producers, minimizing the cost of collecting milk from small, scattered producers by the major processing firms. While there currently are an estimated 200 chilling plants in the country, poor management and a lack of efficient operational systems lead to prohibitive start-up costs and significant losses.
- *Milk dispensing enterprises* have emerged as a popular alternative source of milk, providing low-income consumers with quality milk at affordable prices. They present significant opportunities to develop the dairy value chain but require interventions to identify safety issues and facilitate investments in more dispensing units, especially in lower income urban areas.

Margins Analysis

Using KAVES baseline data and sample data from milk bulking and dispensing enterprises collected in December 2013, this report estimates that dairy farmers received the highest share of the final price, at 35 percent, followed by milk dispensers at 33 percent. Along the value chain, milk producers realized 56 percent margins per liter of milk, bulking centers 15 percent, traders 10-20 percent, and dispensers 30 percent. The average unit cost of production is KSh17 per liter, with feed and labor accounting for over 84 percent of the total cost. The margins analysis shows dairy farming is profitable, with the value of milk produced increasing by 3.2 times (KSh53) from the farm gate to the final consumer dispensing units. Farmers earned an average KSh32 per liter of milk sold, generating about KSh172,000 in enterprise income per year (≈KSh47,000 per cow). As an economic activity, the average dairy enterprise easily satisfies the minimum annual consumption expenditure requirements of individual rural households. **To be economically viable as the only source of household income, however, an average dairy farmer requires at least three cows.** Our analysis suggests that interventions targeting the reduction of costs for feed and labor and increased productivity will maximize small-scale farmer returns in the dairy sector.

Business Enabling Environment

Kenya's institutions responsible for developing the dairy sector, especially public institutions and farmers' and traders' associations, are not adequately developed to provide effective support to the value chain. Neither public nor private institutions are reported to be proactive in developing a vision for the development of the sector. These weaknesses notwithstanding, Kenya has one of the most developed networks of public and private dairy research institutions in Africa, with several public and donor-funded national and multinational breeding and research programs. Critical to their future contribution will be speeding up knowledge transfer to smallholders, particularly in promoting the adoption of animal breeds appropriate for different ecological conditions. This will require stronger dairy extension and training services, whose provision remains woefully inadequate with less than one-third of dairy farmers accessing any form of extension services. **At the current farmer to extension provider ratio of about 1:4000, a majority of dairy farmers in Kenya hardly ever receive advice from either public or private extension services.**

Development of the dairy value chain to serve the needs of a growing population, requires an enabling legal and regulatory environment targeting industry growth. The current policy framework is focused on diminishing the dominance of informal markets, through formalization of milk trade. However, informal markets continue to dominate the industry handling over 80 percent of marketed milk supplies (mostly in raw form) but presenting public health concerns. Future development of the dairy value chain therefore critically depends on streamlining the informal sector and implementing dairy regulations that promote the small scale dairy traders while ensuring compliance to quality and safety standards. Additional challenges facing the sector include poor roads and transport networks, unsafe water and sanitation facilities, inadequate milk storage and preservation infrastructure, and unreliable rural electricity supply that increase the cost of production, processing and marketing.

Upgrading Interventions

The overall goal of USAID-KAVES is to increase the productivity and incomes of smallholder households and other participants along selected value chains, thereby enhancing food security and improving their nutritional outcomes. Milk plays a major role in food security, nutrition and health, and presents many new commercial opportunities for smallholder farmers. The relatively short value chain means that farmers are able to deal directly with buyers, both informal wholesale traders and processors, and have more access to market and product information.

The table below presents three components for a KAVES intervention strategy to upgrade the smallholder dairy industry, supported by six specific strategic interventions and twenty objectives that will increase on-farm productivity, streamline milk aggregation, leading to improved milk quality, a wider range of dairy products and growth in market demand for milk. Interventions have been selected that will contribute directly to the goals and objectives of the KAVES project and are highly scalable through private sector partnerships, with varying levels of public sector support. The interventions all rely heavily on the mass adoption of new technologies, supported with specialist training and extension; new sources of investment and credit to unlock value chain constraints; and engagement of private sector partners for market development and sustainability

Recommended intervention	Specific upgrading objectives	Challenges	Expected outcomes
Strategic component 1: Increase Milk Productivity			
1. Improve the quality of dairy breeds	1 Farmers have access to qualified A.I service providers 2. Farmers have increased knowledge of animal breeding 3. Farmers able to purchase semen in bulk at discounted rates 4. County governments have dairy strategic plans	• Shortage of veterinary technicians • Poor distribution of AI service providers • Few facilities for semen preservation and poor quality control of semen	• Increase in numbers of high-yielding dairy cows • Higher incomes from milk sales • Increase in household consumption of milk
2. Increase year-round availability of quality feeds and water	5. Major increase in fodder production 6. New technologies adopted 7. Increased use of on-farm feed formulation, and supplements 8. Feed preservation technologies adopted including silage and hay making 9. Farmers organized to purchase animal feed in bulk for better prices	• Inadequate supply of seeds for fodder crops • Cost of introducing new technologies • Poor regulation of animal feed quality	• Improved cow nutrition and fertility • Increased milk yields • Higher incomes from milk sales • Fluctuation in milk prices reduced
3. Train animal health providers	10. Farmers have increased access to private and public service providers 11. New technologies for animal pest control adopted	• Low capacity of county governments • Few qualified animal health technicians	• Higher milk yields • Better quality milk • Greater consumer health benefits
Strategy component II. Milk Bulking, Processing and Cold Chain Development			
4.Increase level of milk bulking, cooling, and collection	12.Milk collection groups have stronger capacity for product aggregation including finance, business planning, and conflict management skills 13. No. of dairy hubs increased 14. More bulking and cooling centers 15. Milk collection systems improved and cost of aggregation reduced	• Strength of informal milk marketing systems • Groups have weak business skills • Cost of investment in new facilities	• Improved milk quality • Increase in milk production • Higher consumption and market growth in non-traditional dairy areas

Strategy component III: Improve Market Efficiency and Value addition			
5. Improve Market Access	16. Facilitate investments in milk dispensers by entrepreneurs and producer groups 17. Link farmer groups to existing and new markets, particularly institutions	• High cost of capital Lack of regulatory framework for innovation	• Higher prices and returns • Increased access to markets • Stronger and more sustainable market relationships
6. Increase range of value addition products	18. Feasibility studies completed for new product development 19.Groups linked to equipment suppliers, investors and credit providers 20. Groups develop marketing plans and product branding and bar-coding	• High cost of initial capital • Low capacity of farmers to meet market standards and requirements	• New income generated from dairy products such as yoghurts • Small-scale dairy groups more sustainable • Growth in market demand for milk

1. INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

According to the Kenya Dairy Master Plan (DMP) 2010-2030, the dairy industry has grown at a rate of 3 to 4 percent annually (SDOL, 2010) and its continued growth is a key factor in attaining the national development goals as spelled out in Vision 2030. This growth is largely a result of increasing herd size rather than rising productivity levels. Currently, smallholder farmers, who produce over 80 percent of the domestic milk, dominate the dairy industry. Commercial dairy production is concentrated in Central and Rift Valley regions, but farmers in other areas are increasingly taking up small-scale dairy farming.

At an estimated annual consumption of 106 liters per capita, Kenyans consumed approximately 4.5 billion liters of dairy products in 2012, compared to domestic production of 4.8 billion liters (4.13 billion available). Accounting for net trade, the country had milk deficit of about 339 million liters (7.6 percent of total consumption).

The dairy marketing system has been successful in meeting a growing rural and urban demand, but it is characterized by low compliance with safety and quality standards, a diffuse market structure consisting of thousands of small-scale marketing agents, limited product diversification, and weak participation of producers in policy formulation. A growing processing industry faces competition from thousands of small informal traders who offer farmers better prices and more reliable payments and supply consumers with affordable, convenient milk. Most dairy processors are operating well below installed capacity. This report critically analyzes the dairy value chain to shed more light on its status and highlight areas for upgrading intervention.

Justification for Dairy as a USAID-KAVES Targeted Value Chain

- Decent source of income for smallholders with limited land for crop production, and as a key pillar of national food security and nutrition.
- High potential impact on household and national incomes due to high production and distribution multipliers.
- Offers the most accessible market and source of income for many farmers through extensive networks of existing local buyers of surplus milk.
- Likelihood of increasing smallholder competitive advantage in the domestic and regional markets.
- High potential dairy zones located within Feed the Future target counties, including opportunities for particularly vulnerable households in marginal SA2 areas.
- Potential for integration with cash crop production in milk-fodder legumes rotations.
- Promising emerging business models to make milk production and marketing systems more efficient, such as cooling and bulking enterprises.
- Strong world-class partnership opportunities with private sector companies, national and international dairy research institutions based in Kenya.

The rest of the report is organized as follows: Section 2 provides an analysis of domestic consumption and demand characteristics. Section 3 examines production/trade trends and estimates future supply under various scenarios. Section 4 describes the roles and dynamics affecting the various players across the dairy value chain (highlighting key actors, their interactions and critical constraints and gaps). Section 5 examines gross margins along the value chain using primary data collected through field surveys. Section 6 provides an overview of key constraints to the business enabling environment. Based on the gaps, constraints and opportunities identified, Section 7 provides recommendations for "upgrading interventions" along the value chain where USAID-KAVES is best placed to stimulate increases in productivity, incomes and food security.

1.2 METHODOLOGY

Because various aspects of the dairy value chain have been the subject of numerous other studies and analysis over the past decade, a preliminary SWOT analysis was carried out in consultation with all members of the USAID-KAVES technical team, subcontractor Farm Concern International (FCI) and

other dairy sector experts to determine the most critical gaps and constraints within the value chain and to identify areas where further data collection, research, and analysis were needed to prioritize interventions. Based on this initial SWOT analysis (see Table), field surveys, focus group discussions (FGDs), and key informant interviews were carried out to update outdated information, validate secondary sources, and particularly to obtain primary information specific to USAID-KAVES' targeted geographical areas.

Table 1: SWOT analysis for dairy production and marketing

Strengths	Weaknesses	Opportunities	Threats
• Low unit cost of production • Favorable production conditions • High farm income margins • Dairy animals are household assets • High supply potential with increasing investment in production and trading • Availability of dairy herd/breeding stock • Established private and public vet services delivery system • Large installed processing capacity	• Limited knowledge/technical know-how among farmers and services providers • Inadequate supply of inputs • High cost of capital investment • Poor access to support services • High cost of labor, and low labor productivity • Highly perishable products due to limited preservation and processing • Low adoption of technologies and innovation • Inadequate regulation and/or weak enforcement of regulations • Ineffective and inefficient knowledge, information, communication systems • Inadequate diagnostics laboratories and equipment • Weak capacity for market research • Limited facilities for and inefficient milk collection	• Expanding domestic and regional markets • Major potential to increase milk yields • Improvements in milk handling technology • Extension services • Fodder production • Expansion to non-traditional and peri-urban production areas • Employment opportunities, especially for the youth • Large installed and new feed processing capacity • Strong production research system • Expanding financial, technical services • Political support and goodwill	• High cost of feed and services • Changing climate patterns • Inadequate and poor quality inputs • Poor quality and unsafe milk • Increasingly scarce land • Diseases & pests • Increasing competition from EAC and developed country imports • Stringent food safety regulations • Declining animal genetics • Environmental concerns

All relevant studies and data were reviewed and are discussed in this study, in some cases with alternative analyses carried out and interpretations made. These are referenced throughout the study and all sources are listed in Annex I. Primary validation data was collected by subcontractor FCI through a series of FGDs with farmers, traders and processors in selected target counties. Data collected as part of the USAID-KAVES baseline survey of 1,800 farmers was analyzed and pooled with a panel survey of farmers selected from the first 16,000 USAID-KAVES farmers receiving support. Finally, a smaller survey of traders was carried out to obtain specific information on margins at different levels of aggregation. The study was carried out between March 2013 and January 2014.

This final report incorporates comments and suggestions by a panel of reviewers assembled to critically assess the draft and results of a stakeholders workshop held in September 2014 to discuss and validate the findings.

2. CONSUMPTION AND DEMAND ANALYSIS

This section examines how much demand is likely to increase in the next five to ten years. We build consumption and demand scenarios to evaluate the future of the dairy industry in Kenya, including how changing food preferences (i.e. the increasing shift to consumption of alternatives to dairy) will affect the outlook for the industry. We use population statistics, urbanization rates, and per capita consumption trends to project Kenya's dairy needs into 2022.

Recent data on consumption of dairy products in Kenya is limited and, whenever available, are narrowly focused on major urban centers, particularly Nairobi and Mombasa. Existing consumption calculations are based on government and international statistical organizations' estimates of national milk production and supply rather than actual consumption data. Projections of national milk supply and demand are often conflicting, with some predicting surpluses and others deficits (FAO, 2011a).

2.1 SUMMARY OF EXISTING RESEARCH

To compute projections of milk demand, it is necessary to first estimate the milk consumption per capita. Existing estimates of per capita consumption vary widely across the literature. The variation is a result of imprecise estimates of the population of milking animals, differences in consumption between milk producers and non-producers not easily captured in averages, difference in urban and rural population's dairy product consumption per capita, and different methods of calculating supply and consumer population, among others. Despite the variations in estimates, what is clear is that Kenyans consume very large quantities of dairy by global standards, with only Mauritania and Mongolia consuming more milk relative to the average income per capita (SDP, 2004a).

2.1.1 Per Capita Consumption Levels

Most consumption estimates are based on absolute per capita milk availability, which has ranged from 80 to 125 kg nationally in the past decade. Recent literature has adopted 145 liters as the estimate of Kenya's per capita consumption, one of the highest in Africa, and five times the East African average (Wanyoike *et al.*, 2005; Kaitibie *et al.*, 2010; FAO, 2011a; Njarui *et al.*, 2011; Wambugu *et al.*, 2011; Mulford, 2013). Among the difficulties encountered in estimating milk consumption is the significant variation depending on geographical location, demography, income, and milk production status, among others. Regions and households with high per capita milk production tend to consume much more milk per capita than those with low or no production. For example, per capita consumption was estimated at 144 to 152 liters in the high-production Central and Rift Valley regions and only 38 to 54 liters in all other regions (SDP, 2004a).

2.1.2 Income and Consumption Levels

Milk demand tends to be a function of price and consumer income (SDP, 2004a; Argwings-Kodhek et al, 2005; Kamau et al, 2011; Njarui *et al.*, 2011; SNV, 2013). Price elasticity estimates show that milk demand is less responsive to price changes, which implies Kenyan consumers respond to increases in milk prices by reallocating food budgets rather than reducing milk purchases (SDP, 2004a). SNV (2013) found price/affordability was one of the leading determinants of dairy/milk consumption among urban (Nairobi) lower income households. Raw (loose) milk was most preferred because it is relatively (60%) cheaper than processed. Consumption studies in Nairobi show per capita consumption of dairy products strongly increases with income (Kamau *et al.,* 2011; Argwings-Kodhek et al, 2005; SNV, 2013). Urban households spend about 15-20 percent of their food budgets on dairy products, and the share

rises significantly with income.[1] More specifically, Kamau et al. estimate that households increase per capita milk consumption by 5 percent for every 10 percent increase in income. In Nairobi's lower income households, SNV (2013) found average expenditure on dairy products increased 79 percent from the lowest socioeconomic class to richer class. We therefore expect future milk consumption to increase faster in urban areas due to higher per capita income and faster growth.

2.2 NATIONAL DEMAND ESTIMATION

This section estimates per capita consumption for urban and rural areas, then uses population estimates to compute the demand for milk. A limited number of studies have estimated dairy consumption at the household level (Njarui *et al.*, 2011; Argwings-Kodhek *et al.*, 2005; Nicholson *et al.*, 2004). Table 2 summarizes these studies results. It is impossible to discern any particular pattern in the consumption data. We estimate per capita consumption for the years 2009 and 2012 by applying various consumption parameters to develop projections.

Table 2: Summary of recent per capita milk consumption estimates for Kenya

Author (Year)	Consumption (per capita)
Kenya Dairy Master Plan (1991)	64 liters; 19 liters in rural and 125 liters in urban
Smallholder Dairy Project (2004a)	97 liters (for year 2002)
Nicholson et al. (2004)	43.5 liters (Coastal Kenya only in 1998)
Argwings-Kodhek *et al.* (2005)	73 liters (Nairobi only in 2004)
Wanyoike et al (2005)	148 liters dairy producers and 48 liters non-producers (rural areas only)
Birechi (2006)	82 liters; 64 liters in rural and 125 liters in urban areas
Njarui *et al.* (2011)	142 liters; 194 liters in urban areas and 94 liters in rural areas (Machakos District only in 2009)
SNV (2013)	163 liters (lower income milk consumers in Nairobi); 135 lts in lowest income and 182 lts in lower income.

Our calculations are based upon the following assumptions: 1) rural average consumption per capita is about 48 percent the average for urban areas; 2) urban per capita consumption is 8 percent higher than that of rural milk producers; and, 3) rural milk producers consume 2.2 times more milk than rural non-producers (net purchasers).[2] The parameters used in this analysis are contained in Table 3 and are based on the assumptions and findings from SDP (2004a), Argwings-Kodhek *et al.*, Wanyoike *et al.*, and Njarui et al. Since it is the most recent study comparing rural and urban dairy consumption, Njarui *et al.* (2011) provides a useful benchmark for our estimation.

Based on the parameters described above, we estimate the average per capita milk consumption in 2009 was 77 liters in rural areas and 160 liters in urban areas, having grown at an average rate of 2.9 percent per annum from 2003. Applying rural and urban population, we estimate Kenyans consumed 96 liters of milk per person in 2009. Assuming per capita consumption grew at a decreasing rate of 10 percent per year, **we estimate rural and urban areas consumed 83 liters and 177 liters, respectively, in 2012. The national per capita milk consumption in 2012 was 106 liters and expected to increase to 139 liters by 2022, equivalent to 2.8 percent growth per year** (Table 3). Our estimates are largely in line with KNBS (2014) that calculated per capita consumption of 108 liters in its Food Balance Sheet (FBS) for 2012.

[1] Musyoka et al. (2010) estimated it at 18.5 percent in 2003, while SNV (2013) found it was 20 percent among Nairobi lower income dairy consumers.

[2] Available data suggests that urban households consume nearly 50 percent more milk per capita than rural households, and Nairobi and Mombasa account for about 84 percent of the urban demand and consume 80 percent of processed milk products (Birechi, 2006).

National milk consumption will grow at 6 percent per year between 2012 and 2022, to reach 8.0 billion liters, as a result of increasing urbanization, population growth and growth in per capita milk consumption. With increasing urbanization, the evidence suggests that urban milk demand will grow at nearly double the rate of rural milk demand (8% per year, c.f. 4.4%) over the same period. At per capita consumption of 177 liters in 2012, urban milk demand was approximately 1.83 billion liters. From the 4.13 billion liters available from domestic production in 2012, urban consumption represented 41 percent. Urban per capita consumption is projected to increase at about 2.5 percent per year to reach 227 liters per person by 2022. Total urban consumption will increase to 2.72 billion liters and 3.91 billion liters in 2017 and 2022, respectively, nearly equaling the total amount of milk consumed in rural areas (urban will take 49 percent of total demand).

Table 3: Estimated and Projected Milk Demand, 2012-2022

		2012	2017	2022
Population Projections	Population ('000)	42,184	49,496	57,401
	Urban share of population (World Bank estimate)	24.4%	26.9%	30.1%
	Annual population growth rate (5-year periods)	2.7%	2.7%	2.5%
Per Capita Consumption (liters/year)	National*	106	122	139
	Rural	83	92	102
	Urban	177	204	227
Consumption & Demand Estimates (million liters)	National	4,477	6,060	7,995
	Rural	2,651	3,340	4,083
	Urban	1,826	2,720	3,913

*Source: USAID-KAVES estimates/calculations. * Urban per capita consumption grows at CAGR of 2.5% and rural per capita at 2% annually through 2022*

Kenya will therefore require an additional 3.52 billion liters of milk by 2022 (79 percent over the 2012 levels) to satisfy human consumption. Urban areas, especially Nairobi, will be responsible for 59 percent of the total growth in milk demand, with the total demand in 2022 more than double (114 percent) its 2012 levels, compared to 54 percent growth in rural areas. In its mapping of supply/demand for animal-source foods to 2030, the FAO (2011b) estimated Nairobi alone would contribute 32 percent of the total growth in milk demand in Kenya; about 56 percent of the total urban demand growth. The major cities of Nairobi, Mombasa, Kisumu and Nakuru will remain the driving forces behind increasing milk/dairy consumption in Kenya in the medium term. It is imperative that interventions to strengthen the dairy value chain are designed with these major consumption centers in mind.

2.3 ESTIMATED IMPACT OF REVIVING THE SCHOOL MILK PROGRAM

The Kenyan Government plans to revive and expand the School Milk Program (SMP), which collapsed with the liberalization of the dairy sector in 1991. Recent policy pronouncements and initiatives at both the national and county government levels have hinted at a revival of the SMP; the first of these is the Mombasa County's new initiative to supply milk to 6,000 nursery school pupils in the county (The Star, September 11, 2014). We expect more counties to emulate Mombasa. In the past, the SMP sought to have each primary school child consume about 0.4 liters of milk per week (16 liters per child during the 40-week school year) to improve their nutritional status, increase retention rates, and also

provide milk processors with a stable market. Of the 1.52 billion liters of milk produced in 1990, for example, the SMP absorbed an estimated 91 million liters (6% of total).

If revived, at the current enrollment of 10.2 million primary school pupils, the program would require about 163 million liters of milk annually; this would translate to 4 percent increase in total consumption. With primary school enrollment growing at 23% CAGR, the SMP would increase total demand by 1% per year. Although a relatively small amount, it is significant in the face of estimated and projected milk production surpluses/deficits (see Section 3: Supply Analysis and Production Potential). It would increase the 2017 deficit by 50 percent. Implementation of the SMP will therefore require either increased production, through higher yields, or increased imports of powder milk and butter oil for reconstitution.

2.4 ESTIMATED IMPACT OF PROCESSED DAIRY PRODUCTS

Dairy consumption in Kenya is predominantly in the form of liquid (raw/fresh) milk. The preference for raw milk cuts across all income groups, but pasteurized milk is more preferred among high-income households and in Nairobi (SDP, 2004a). While starting from a low base, production and consumption of processed dairy products has gradually increased over the past ten years, growing at about 5 percent per annum between 2006 and 2012. Consumption of dairy products such as yoghurt/buttermilk, dry skim milk, butter/ghee, and cheese is rising. Table 4 shows production of processed dairy products rose by 38 percent between 2006 and 2012, from 105,026 MT to 144,602 MT; this was equivalent to 139.7 million liters of liquid milk in 2012. In total, all processed dairy products used approximately 772 million liters of milk in 2012 (16% of total milk output). Processing of dairy products, other than fresh milk and cream uses about 3 percent of total milk produced annually. This impact is already factored into the estimates for milk consumption. Rising demand for these products is expected to be an important factor in dairy consumption demand in the near term.

Table 4: Production of processed dairy products in Kenya (2006-2012 in MT)

Product	2006	2008	2009	2010	2011	2012
Butter & Ghee	9,898	13,850	13,850	14,700	15,180	16,050
Cheese*	243	155	188	263	290	255
Condensed Milk	2,215	790	790	790	915	915
Dry Skim & Buttermilk	4,500	4,700	4,700	4,700	4,700	4,700
Liquid Milk Equivalent (LME)	***105,026***	***129,392***	***129,537***	***135,477***	***139,014***	***144,602***
Fresh cream	372,555	595,115	595,115	616,253	628,365	628,365
Total Processed LME	**477,581**	**724,507**	**724,652**	**751,730**	**767,379**	**772,967**

*Source: FAOSTAT data. * KNBS (2014)*

Due to unavailability and unreliability of data, the foregoing analysis is a 'best case scenario' based on extrapolation of observed trends, without specifying a mathematical relation of underlying causal factors. This limits the reliability of our estimates and projections. Different data and unexpected developments could generate divergent estimates. Overall, five major factors will drive the demand for dairy products in the near term:

- Continued growth and increased sophistication of the informal milk markets. Controlling about 80 percent of marketed milk, their dominance is unlikely to diminish in the near term.
- Changes in consumption habits and lifestyles, especially with increasing incomes and urbanization. Consumers will demand more milk and dairy products as their incomes increase and lifestyles change as a result of greater exposure.
- Preference for convenience due to urbanization and time and location constraints. Increased preference for convenience foods will drive consumers to dairy products.
- Changes in levels of demand. This analysis indicates that the levels of milk consumption will increase significantly due to increases in population and per capita consumption. Of specific

significance is the 45 percent of Kenyans under 15 years and the over one million children born in Kenya every year, who will increasingly rely on milk and dairy products for their nutrition.

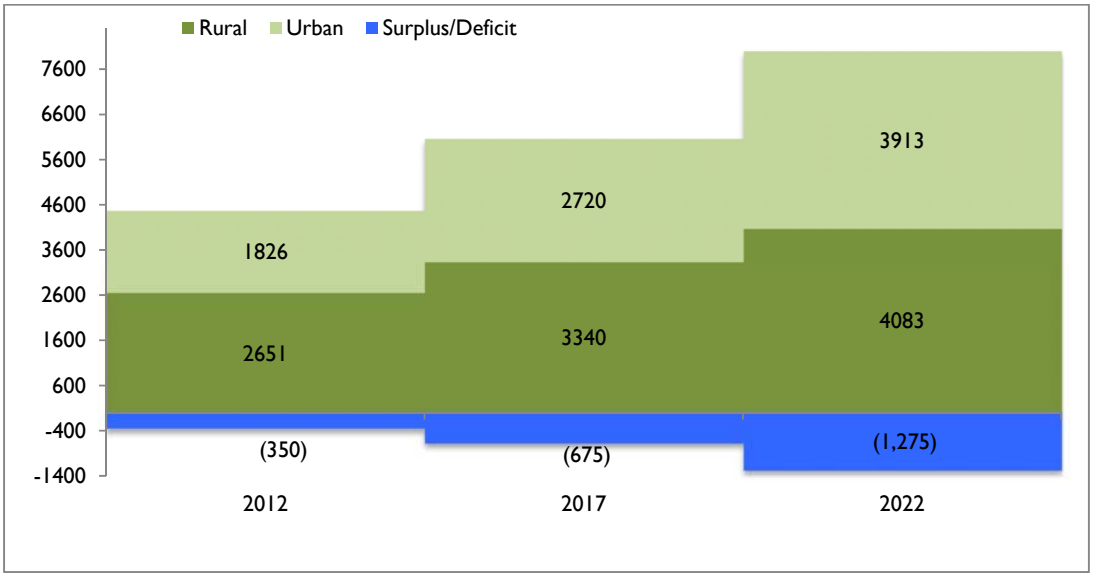
- Increased demand for quality, food safety and standardization as consumers become more sophisticated.

2.5 SUMMARY OF FINDINGS

Our estimates show the national per capita milk consumption was 106 liters in 2012 and is expected to increase to 139 liters by 2022, equivalent to 3 percent growth per year. National milk consumption will grow at 6 percent per year between 2012 and 2022 to reach 8.0 billion liters, as a result of increasing urbanization, population growth and growth in per capita milk consumption. With increasing urbanization, the evidence suggests that urban milk demand will grow at nearly double the rate of rural demand over the same period. From 177 liters per capita in 2012, urban consumption is projected to increase at about 2.5 percent per year to reach 227 liters per person by 2022.[3] Total urban consumption will increase to 2.72 billion liters and 3.91 billion liters in 2017 and 2022, respectively.

The projected higher demand for milk and dairy products will favor domestic production, given Kenyan consumers' strong preference for fresh (loose) milk. Figure 1 summarizes the demand scenarios between 2012 and 2022. Our projections indicate Kenya is in dairy supply deficits; domestic milk supply falls short of demand by approximately 675 million liters in 2017 and 1275 million liters in 2022, respectively. In the absence of significant increases in average yields and/or reductions in losses, imports will play an increasing role in Kenya's milk supply. Processed dairy products used about 16 percent of total milk output in 2012, and rising demand is expected to be an important factor in dairy consumption in the near term. Supply estimates and production potential are discussed in detail in Section 3.

Figure 1: Estimated and projected milk demand in Kenya (2012-2022 in million liters)



Source: USAID-KAVES estimates

[3] The World Health Organization recommends 220 liters per capita milk consumption for proper nutrition. Urban areas will have surpassed this threshold by 2017.

3. SUPPLY ANALYSIS AND PRODUCTION POTENTIAL

This section examines the growth of milk supply over the next five to ten years, and whether this will be able to keep pace with demand. We build supply and production scenarios to evaluate the future of the dairy industry in Kenya, including key drivers of production, trade patterns and supply constraints to project dairy supply into 2022.

The supply of milk and dairy products is influenced by the size and productivity of the national milking herd, particularly the dairy cowherd, access to feeds, inputs and support services, market and price dynamics, and climate variability. This analysis begins by estimating the national population of milking and dairy herds, production trends and its drivers, and price and seasonality trends. Milking and dairy herds are used to estimate the national average dairy productivity. The section also examines the other major drivers of supply, external trade patterns. We then use these parameters to make projections of future supply of milk and dairy products and analyze the constraints likely to militate against the attainment of the projections.

3.1 DAIRY CATTLE ESTIMATES

In Kenya, milk is produced from cows, camels, and dairy goats. Nobody knows the exact number of domestic livestock in the country. The State Department of Livestock (SDOL, formerly Ministry of Livestock Development) has been the sole source of livestock population in Kenya. Although it is claimed Kenya last conducted a livestock census in 1966, Wanyoike et al (2005) found no records of the national census. Estimates of livestock numbers therefore vary significantly from research, the Kenya government, to international organizations.

Further discrepancies occur in estimation of milking animals herd, especially those of cattle, camels and goats. From the cattle population, due to significant differences in the distribution of breeds (indigenous versus dairy) and average milk yields, as a results the actual milk production in Kenya cannot be accurately estimated.

Wanyoike *et al.* found the SDOL field officers used presumed base figures (oftentimes outdated and inaccurate) from which were adjusted annually (or monthly) using uninformed rates of change due to births, migration and deaths.[4] Inconsistencies in animal population estimates make it impossible to estimate national milk production accurately. Wanyoike *et al.* further show significant discrepancies in cattle types and numbers between sampling surveys of households and the SDOL data; and projects on average, an underestimation of dairy cattle by 400 percent and zebu cattle by 300 percent across the sampled areas. More so, the SDOL statistics tended to underestimate (overestimate) dairy (zebu) cattle populations in areas traditionally associated with indigenous cattle, and overestimate (underestimate) dairy (zebu) cattle population in traditional dairy regions.

The closest Kenya has come to a national animal census is during the Population and Housing Census, like that conducted in 2009. The 2009 census estimated the total cattle herd at 17.5 million, of which 3.36 million were exotic (improved) breeds (Table 5).[5] Other domestic animals included 27.74 million

[4] In most cases these base figures were captured during free or compulsory vaccination campaigns or from dipping registers maintained by the Veterinary department. These services having collapsed in most parts of Kenya since the liberalization of the livestock sector, the officers resorted to guesstimates based on dated statistics. All the Ministry field staff interviewed by Wanyoike et al. acknowledged the base figures and rates of change applied in their calculations were mere guesstimates.

[5] KNBS (2013), accessed at http://www.knbs.or.ke/censuslivestock.php, on January 28, 2014.

goats, 17 million sheep, and 2.97 million camels.[6] We use these census numbers as the basis of the analysis discussed in this section.

Table 5: Kenya Livestock Population in 2009

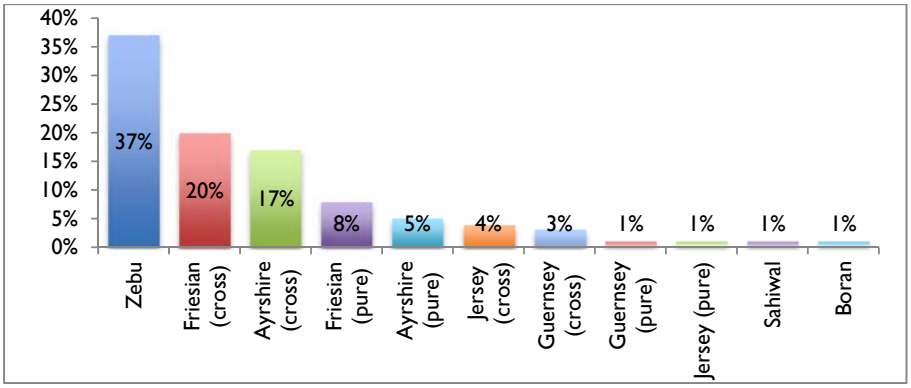
	Exotic Cattle	Indigenous Cattle	Sheep	Goats	Camels
Kenya	*3,355,407*	*14,112,367*	*17,129,606*	*27,740,153*	*2,971,111*
Rift Valley	1,560,222	5,919,585	9,079,380	11,750,521	968,192
Central	800,227	325,678	664,237	531,209	231
Eastern	373,307	1,886,854	1,890,898	4,729,057	248,634
Nyanza	221,670	1,527,000	495,055	961,269	59
Western	219,904	843,608	233,725	263,946	2,037
North Eastern	80,422	2,694,786	4,264,155	7,886,586	1,700,893
Coast	74,119	885,846	467,439	1,570,728	51,045
Nairobi	25,536	29,010	34,717	46,837	20

Source: Kenya National Population and Housing Census 2009 (KNBS, 2013)

Conventional thinking assumes indigenous breeds outnumber improved breeds in the milking cattle herd, but household panel surveys by Tegemeo Institute found farmers kept approximately 2.4 improved and 1.9 local breeds of cattle, on average (Wambugu et al., 2011). These results correspond to those from cattle population validation surveys conducted by the ILRI Smallholder Dairy Project (SDP) that found significant undercounting of dairy cattle in official statistics. Two characterization and validation surveys across the Kenyan Highlands found dairy cattle population was more than three times larger than government statistics (Wanyoike et al., 2005).

The ILRI studies estimated 6.8 million dairy cattle (2.8 million purebred and 4 million crossbred) and 3.7 million zebu cattle in these areas; which translates to about 3.2 million milking cows (2.4 million dairy and 0.8 million zebu).[7] Further cattle population estimates are provided by the FAOSTAT, which estimated Kenya's milking cow population at about 5.72 million in 2012 (See table 10). Calculations from the aforementioned studies imply dairy cattle constitute 55-65 percent (on average, 60 percent) of the cattle population in Kenya's main milk producing areas. The dairy herd includes (exotic) grade animals and their crosses, with the former predominantly consisting of Friesians, but also Jersey, Guernsey, Ayrshire, Sahiwal and other breeds. The USAID-KAVES baseline and panel surveys of 2013 corroborate these results. Fig. 2 contains the results and shows that improved breeds constituted about 60 percent of the cattle kept by households in FTF counties.

Figure 2: Percentage of cattle breeds in FTF zones



[6] In 2009, using FAOSTAT and KNBS (2013), the population of milking goats was 16 percent of the total goatherd and that of camels 40 percent of camel population.

[7] We assume approximately 35 percent of dairy cattle and 22 percent of zebus are lactating in any given year. Zebus outnumber dairy cattle in the ASAL areas.

Source: USAID-KAVES baseline survey, 2013

Dairy cattle are concentrated in the Rift Valley, Central, Eastern, Nyanza, and Western regions (Table 6). The Table shows the national dairy cattle herd grew at an average annual rate of 1.4 percent between 2000-2010, with Nyanza, Western, Coast, and Nairobi regions leading, while the Rift Valley and Eastern regions either remained flat or declined. By absolute numbers, Central region added the largest number of dairy cattle to the national stock during the period. The trend in Nairobi is particularly important; there is evidence of increased uptake of dairy farming in the suburban and peri-urban areas of Nairobi metropolitan area, especially in adjoining areas in Kajiado and Machakos counties, to serve the growing demand for milk in the city. Similar trends are emerging in other urban areas, such as Kisumu and Mombasa.

Table 6: Trends in improved dairy cattle population (in '000) by region, 2000-2010

Region	Major Production Areas	2000	2005	2010	CAGR (2005-2010)	CAGR (2000-2010)	2013 Estimate
Rift Valley	Trans-Nzoia, Uasin Gishu, Nandi, Bomet, Kericho, Buret, Sotik, Nakuru, Ngong	1,652	1,859	1,804	-0.6%	0.9%	1,869
Central	Nyeri, Nyandarua, Kirinyaga, Muranga, Kiambu	855	849	991	3.1%	1.5%	1,051
Eastern	Machakos, Embu, Meru	344	302	301	-0.1%	-1.3%	285
Nyanza	Kisii, Nyamira, Migori	216	196	255	5.4%	1.7%	273
Western	Lugari, Bungoma, Kakamega, Vihiga, Busia, Teso	152	182	199	1.8%	2.7%	222
Coast	Taita Taveta, Kilifi, Kwale	73	88	97	2.0%	2.9%	109
Nairobi		17	22	25	2.6%	3.9%	29
Total		3,309	3,498	3,789	1.4%	1.6%	3,838

Source: SDOL Animal Production Division Reports

Reports across the country however indicate dairy farmers are increasingly reducing herd sizes to cope with the high cost of production (largely animal feed and health services) and relatively lower and/or stagnant milk prices (Daily Nation Digital, 2013). This confirms Wambugu et al. (2011) panel data finding of general declining trends in the number of improved (high-grade and crossbreds) dairy cows kept by sampled households (Table 9). The Table shows the number of improved breeds declined at a compounded annual average of 0.6 percent per year in the period 2000-2010, and by 2.2 percent between 2007 and 2010. These are generally in line with FAOSTAT data that shows milking cow population declined at 0.9 percent per year between 2007 and 2012.

An explanation for this phenomenon of declining dairy cattle numbers is the tendency of smallholder dairy farmers not to replace all the cattle that exit the herd through natural attrition (sales, death or slaughter). Staal et al (1998) found the attrition rate is about 12 percent per year (11% among female cattle and 14% among males), with an overall mortality rate of 28 percent. Without concerted interventions to either increase or stabilize the existing dairy herd, any initiatives to increase milk production in Kenya will have to rely on increased productivity.

This report uses the 2009 census of livestock population, dairy cattle population growth rates in Tables 6 & 7, and FAOSTAT data to estimate national milking cattle population and average milk yields. The estimation is done in three steps, namely: 1) Estimate the national cattle and dairy population in 2012 by assuming constant growth rate for indigenous breeds (zebu) at the 2000-2010 (2003-2012) CAGR of 0.9 percent, the 2000-2010 dairy cattle CAGR by region in Table 6; 2) Calculate the annual growth rate in cattle population by tabulating the sum of proportional growth rates for each breed category in each region[8], assuming a decreasing rate of 10 percent (for explanation of this, see Staal et al., 1998 and Wanyoike et al., 2005); 3) Estimate the distribution of dairy and zebu cattle by region and generate the population of cows; 4) Calculate the number of milking dairy and zebu cows per region using estimated proportions of the total. Table 8 contains the parameters applied in the estimations.

Table 7: Estimated growth rates of cattle numbers at the household level in Kenya, 2000-2010

Year/Growth rate	Local breeds	Improved breeds
2000	1251	1957
2004	1515	1953
2007	1342	1978
2010	1374	1850
CAGR (2000-2010)	0.9%	-0.6%
CAGR (2004-2010)	-1.6%	-0.9%
CAGR (2007-2010)	0.8%	-2.2%

Source: USAID-KAVES estimates from Wambugu et al. (2011)

Our estimates of the cattle population for 2012 are contained in Table 9. It shows the population of total cattle, dairy cattle, zebu cattle and milking cattle. Kenya had approximately 18.14 million cattle in 2012, comprising 6.79 million dairy cattle and 11.34 million zebus.

Table 8: Estimation parameters for Kenya cattle population in 2012

Region	Dairy cattle (% of total cattle)*	Population growth rate**	Dairy cows (% of dairy herd)***	Lactating dairy cows (% of dairy cows)***	Lactating zebu cows (% of total zebu herd)***
Kenya	37%	1.3%	49%	76%	28%
R.Valley	48%	0.9%	48%	75%	25%
Central	95%	1.5%	48%	80%	22%
Eastern	30%	0.5%	52%	75%	30%
Nyanza	30%	1.2%	52%	75%	30%
Western	40%	1.7%	52%	80%	30%
Coast	15%	1.2%	52%	75%	30%
Nairobi	95%	3.8%	55%	80%	20%
NEP	2%	1.3%	52%	75%	30%

*Source: USAID-KAVES calculations from various data. * Estimates from various literature; ** Assumes 0.9% for zebus and 2000-2010 rates in Table 7; *** KAVES estimates from van der Valk (2008) and FAOSTAT*

Out of the total cattle population, approximately 10.4 million were cows (3.34 million dairy cows and 7.03 million zebus), and 5.744 million (32% of total) were in lactation during the year; about 44 percent of which were dairy cows. The population of milking cows is in line with FAOSTAT, which estimated Kenya's milking cattle herd at 5.72 million in 2012. Moreover, the numbers are nearly identical to Wanyoike et al. (2005), and imply that the size of the dairy herd may not have changed significantly over the past decade. It is important to note that our estimates are not definitive because they rely on several assumptions that may not be accurate; any variations in the parameters used could generate

[8] Annual growth rate per region = ∑(zebu cattle growth rate*percent share of zebus) + (dairy cattle growth rate*percent share of dairy).

different numbers. We use these cattle population parameters to estimate national milk production and average milk yields in Section 3.2.

Table 9: Estimated cattle population (Thousand heads) and shares (%) in Kenya, 2012

Region	Cattle population			Milking herd			Shares (%)		
	Total	Dairy	Zebu	Dairy	Zebu	Total	Dairy (% of milking)	Milking cows (% of cattle)	Zebu (% of cattle)
Kenya	***18,139***	***6,795***	***11,344***	***2,547***	***3,197***	***5,744***	***44%***	***32%***	***63%***
R. Valley	7,726	3,709	4,018	1,335	1,004	2,340	57%	30%	52%
Central	1,188	1,129	59	433	13	447	97%	38%	5%
Eastern	2,295	689	1,607	269	482	751	36%	33%	70%
Nyanza	1,824	547	1,277	213	383	596	36%	33%	70%
Western	1,131	453	679	188	204	392	48%	35%	60%
Coast	1,004	151	854	59	256	315	19%	31%	85%
NEP	2,906	58	2,847	23	854	877	3%	30%	98%
Nairobi	63	60	3	26	630	27	98%	43%	5%

Source: USAID-KAVES calculations from various references

As expected, dairy cows outnumbered other milking cows in the Rift Valley, Central, and Nairobi, but significantly trail zebus in Coast and NEP. Based on our calculations, the dairy cow population is projected to fluctuate between 3.3 million and 3.8 million for the next decade. These fluctuations will depend on sustained growth in dairy cow population in Central, Nyanza, Western, Coast and the Nairobi peri-urban regions, and whether or not recent declines in Eastern and Rift Valley regions can be reversed. With a largely stable dairy cow population, increased milk production will depend on making existing herds more productive. Specifically, the over 7 million zebu cows presents opportunities for upgrading or replacing the cowherd to improve productivity. An additional challenge will be finding better means to replenish the dairy herd to prevent population and genetic decline.

3.2 PRODUCTION TRENDS

Lack of reliable statistics of cattle populations in general, and milking cow numbers in particular, analyses of supply and productivity have relied on the estimates of the milking herd and the proportion of dairy animal breeds under section 3.1 and various definitions and other sources to estimate the amount of milk obtained from indigenous (zebu) cows and that from dairy cows.

3.2.1 Milk Production Areas

Human population density, climatic potential, and market access are the key factors affecting dairy cattle distribution in Kenya (Wanyoike et al., 2005). Based on annual rainfall patterns, agroecological zones are classified into high, medium, and low rainfall zones.[9] There is a trend of high population migration

[9] The high rainfall zone receives more than 1000 mm of rainfall annually, occupies less than 20 percent of the arable land, supports 50 percent of the population, and produces over 75 percent of domestic milk. The medium rainfall zone receives between 750 to 1000 mm of rainfall annually, occupies 30-35 percent of land area, and supports about 30 percent of the population. The low rainfall zone receives 200 to 750 mm of rainfall annually,

from the densely populated high rainfall areas to the medium rainfall areas, which support large commercial dairy farms, local cattle, sheep and goats on open pasture, and grow drought-tolerant crops (SDOL, 2010). Due to high population pressure, farmers in medium and high rainfall zones are increasingly forced to stall-feed animals on fodder, mainly Napier grass. The low rainfall zone is highly vulnerable to climate variations, including recurring droughts, unreliable rainfall, peak flooding, and outbreaks of climate-related Transboundary Animal Diseases (TADs). Milk production in this zone relies on indigenous cattle breeds, camels, goats and sheep in the pastoral, semi-pastoral or ranching systems. Milk marketing is limited, except for the growing camel milk marketing in urban areas.

3.2.2 Milk Production Estimates

Further to the challenges of existing data as mentioned above, projections on milk production estimates from official statistics appear to be smooth linear extrapolations from historical data and may thus not be presenting the correct position. In addition, the contribution of other dairy animals in milk productions is underestimated.

Nationally, milk production is no longer a preserve of cattle; camels and dairy goats have become important producers of milk. Specifically, production and consumption of camel milk has grown at 15 percent annually over the past ten years. Data from FAOSTAT shows the contribution of camel milk to total milk production increased from 8 percent in 2003 to 19 percent in 2012, and that of dairy goats from 4% to 7%. The data shows cattle accounted for 75 percent of the total milk production in 2012, down from 89 percent in 2005.[10] New estimates from IGAD show cattle contributed 76 percent of the national milk production, 17 percent came from shoats, and 7 percent from camels (IGAD, 2013). The analysis in this report focuses on cattle production systems, specifically dairy.

We find evidence that milk production has increased across the country over the past five years. When dairy sector stakeholders are interviewed, a general consensus emerges that indicate most regions have experienced either steady or increased milk production. In focus group discussions with various stakeholders across seven milk sheds sampled in USAID-KAVES surveys conducted in Uasin Gishu, Bungoma, and Tharaka Nithi counties, about 74 percent of FGD participants reported increased milk production over the 5 years preceding the survey year. These general trends are reflected in substantial increases in total milk production in the recent past. Several factors explain the recent growth in milk production, including:

- The adoption of better husbandry practices by smallholders and breed improvement through increased use of Artificial Insemination (AI).
- Increased access to markets and improved nominal producer prices. (The analysis in Section 4.3.6. shows prices have been flat in real terms.)
- Introduction of intensive systems and use of feed supplements and alternative feedstuffs that allowed smallholders to increase herd size without the need for additional land.

National milk production increased by about 50 percent between 2003 and 2012, from 3.2 billion liters in 2003 to 4.8 billion liters in 2012, with output from cows increasing at a slower pace (3% per year), from 2.8 billion liters in 2003 to 3.6 billion in 2012 (FAOSTAT database). However, new estimates from IGAD using the 2009 population census however suggest the reported total milk production are gross underestimates; it indicates that Kenya produced about 7.634 billion liters of milk annually, including 5.79 billion liters from cattle, 1.29 billion liters from shoats, and 0.55 billion liters from camels (IGAD,

and supports about 20 percent of the population, hosts 80 percent of livestock and 65 percent of Kenya's wildlife resources.

[10] These numbers are derived from FAOSTAT milk production statistics for the period 2003 to 2012 (Accessed September 30, 2014). The changing patterns are largely a result of better methods of estimating milk production from other animals, which is spearheaded by the FAO, and increasing commoditization of camel and shoat milk. According to Anderson et al. (2012), camels can produce from 10 to 20 liters of milk per day, even under the most distressful of conditions (e.g. after 10-15 days without water).

2013). Compared to SDOL and FAOSTAT data, this amounts to 60 percent more milk than the reported official total national production. Production estimates summary is contained in Table 10.

This report does not attempt to re-estimate the milk production data. The analysis in this section therefore applies FAOSTAT data and the analysis in Section 3.1 to calculate the volumes and average yields of milk produced by dairy cows. From various literature and data, dairy cows contribute between 60 and 65 percent of the national milk output, thus approximately 85 percent of cattle milk. Our estimates in Table 10 show Kenya had 2.54 million milking dairy cows in 2012, producing 3.1 billion liters of milk. The average annual milk yields for the period 2010-2012 amounts to 1265 liters per cow (about 4.9 liters per cow per day, over 260 days).

Table 10: Estimated milk production, milking cattle and milk yields in Kenya, 2006-2012

Year	Total milk (mn lts)*	Cow milk (mn lts)*	Milking cows ('000s)*	Milk yields (l/c/y)*	Milking dairy cows ('000s)**	Dairy milk (mn lts)***	Dairy yields (l/c/y)***
2006	4,043	3,575	6,200	577	2,749	3,039	1,105
2007	3,846	3,094	5,980	517	2,651	2,630	992
2008	4,086	3,100	5,147	602	2,282	2,635	1,155
2009	4,572	3,447	6,114	564	2,711	2,930	1,081
2010	4,659	3,516	5,002	703	2,218	2,988	1,348
2011	4,753	3,586	5,545	647	2,458	3,048	1,240
2012	4,800	3,607	5,720	631	2,536	3,066	1,209
CAGR (2003-2012)	*4.6%*	*2.9%*	*0.7%*	*2%*	*na*	*na*	*na*
CAGR (2006-2012)	*2.9%*	*0.1%*	*-1.3%*	*1.5%*	*-1.3%*	*0.1%*	*1.5%*

*Source: USAID-KAVES estimates from FAOSTAT & KNBS data. Notes: * FAOSTAT; ** Estimates from KNBS & Table 10; *** Assumes dairy cows account for 85% of cow milk and 76% are in lactation for 260 days in any given year*

Based on average milk prices of KSh31 per liter, the total value of milk produced in 2012 was KSh149 billion, up from KSh126 billion in 2011 and KSh79 billion in 2008; cow milk alone was worth about KSh112 billion in 2012. At average KSh60 per liter retail price, the milk produced in 2012 earned dairy farmers and traders about KSh216 billion in market value. Since the average unit cost of production is KSh16 per liter of milk (see Section 5.2 – Farmers Gross Margins), milk producers generated an additional KSh58 billion in rural earnings for inputs suppliers and service providers, including agro dealers, vet services, laborers, and transporters, among others. The milk/dairy value chain is therefore a powerful tool to increase rural incomes for all the actors along the value chain.

Only about 10 percent of the national milk output is processed in any given year, a proportion that has remained constant since 2007, despite substantial increases in processing capacity (Table 11). As a proportion of total marketed milk, processed milk accounts for 15-20 percent. Retailing at an average KSh80 per liter, processed milk was worth KSh40 billion in 2013, generating about KSh24 billion in additional value. **The total value of annual milk production from cows is about KSh200 billion.**

Table 11: Estimated amount and proportion of milk processed in Kenya

Year	Processed (mn liters)	As proportion of total output	As proportion of marketed milk
2003	197	6%	
2007	423	11%	17%
2009	407	10%	15%
2011	549	11%	18%
2012	495	10%	15%

Source: USAID-KAVES calculations from KDB data

3.3 KEY DRIVERS OF PRODUCTION

3.3.1 Dairy Production Systems

The most common cattle feeding systems are (i) pure grazing system where cattle graze freely on public land or on private land in paddocks or tethered, (ii) grazing with some stall-feeding where grazed cattle are supplemented with extra gathered feeds overnight in stalls, (iii) stall-feeding with some grazing where cattle are mainly confined but occasionally allowed to graze, and (iv) pure stall-feeding, also known as zero-grazing, where cattle are fed in total confinement (Lukuyu et al., 2011). The prevalence of these systems in Kenya depends on land size and other farms activities. Pure grazing with some stall-feeding is common in extensive and semi-intensive dairy production systems, while zero grazing is associated with intensive systems. Lukuyu et al. reported that pure grazing system is the most common in North Rift region largely because production of planted fodders is limited by the availability of labor. In contrast, central Kenya farmers are shifting away from extensive and less productive grazing systems toward more stall-feeding with Napier grass as the main feed resource.

Among the dairy households sampled in 2010, Wambugu et al. found 43 percent were practicing zero grazing, 32 percent open grazing, 10 percent tethering, and 15 percent semi-zero grazing. The typical dairy farmer across the USAID-KAVES counties normally: 1) keeps cross breeds, 2) openly grazes animals, with minimal supplemental fodder, 3) uses animal health services only when necessary, 4) uses a bull for breeding, 5) achieves about 250 days of lactation per cow, 6) experiences long calving periods of 18-24 months, and 7) keeps dairy animals longer before culling – eight to ten years, instead of the recommended five to seven years. These practices compromise on animal nutrition and health, depress productivity, and undermine animal genetics. Average daily productivity is therefore lower, about 3-5 liters per cow.

The degree of commercialization of dairy farmers is another feature of the Kenya dairy production system. According to Tegemeo, the proportion of households that sold milk increased from 51 percent in 2000 to 57 percent in 2010, but with wide variations across agro-regional zones (Wambugu *et al.*, 2011). For example, whereas over 65 percent of households in the Central Highlands (CH) and the High Potential Milk Zones (HPM) sold milk, only 44 percent sold milk in the Marginal Rain Shadow zone (MRS) in 2010, down from 82 percent in 2007. The uncertain rainfall patterns common in the MRS partly explain the variations, with milk sales patterns fluctuating with the availability of fodder and water.

A further measure of commercialization is the amount and proportion of total milk output sold by dairy farmers. Birechi (2006) found small-scale farmers produced 10.6 liters per day, and sold about 6.6 liters (62 percent), while medium-scale farmers produced 25.6 liters per day and sold about 10.4 liters (41 percent). These are corroborated in Wambugu et al. that found households selling milk sold 62 percent of the total daily milk output. Mulford (2013) grouped dairy households by the average daily milk sales (liters/day/household) into the following categories: (i) Highly sales (>20); (ii) Medium sales (10-20); (iii) Low sales (>0-10); and, (iv) No sales. The author found milk productivity increased in the levels of sales and was mainly driven by the number of improved cows owned, the amount invested in feed concentrates, and artificial insemination. **It therefore implies that dairy farmers who sell more milk also spend more on improving the dairy herd and feed supplementation.**

3.3.2 Production Technology

Smallholder dairy producers in Kenya apply different technologies to their operations, in largely low-input regimes. Animal feeding technology relies on open grazing and stall-feeding, with little nutrient or mineral supplementation. After the collapse of government animal breeding services, occasioned by liberalization of the sector, breeding technology predominantly comprised of bull schemes or contract mating services. Unorganized and inadequate animal health services lead to deterioration in animal health and breed condition, thereby compromising reproduction and productivity. Furthermore, poor animal husbandry practices lead to longer calving intervals (up to 18 months) and long culling periods (up to 12 years, rather than the recommended five to eight years). The smallholder dairy sector is

therefore characterized by poor animal condition and genetic erosion that undermine the productivity of dairy enterprises, increase unit cost of production and diminish returns to farmers. Kimenchu, Mwangi, Kairu and Macharia (2014) found that farmers in Central Kenya owned cattle with good genetics, but which produced low yields (9.2 kg per cow per day) because of overstocking, underfeeding, poor housing and poor animal husbandry. We briefly highlight the feeding and breeding technologies commonly used among Kenyan smallholder dairy farmers.

Adoption of fodder crops and trees

Feeding constitutes the largest portion of the costs of milk production in market-oriented dairy farming. Generally, dairy animals in Kenya are underfed, resulting in low milk yields, with a majority of smallholders feeding dairy cattle on natural forage, cultivated fodder, and crop by-products (FAO, 2011a). The feed/forage used by farmers includes maize stovers, dried poultry waste, hay (purchased pure Lucerne, grass, or Lucerne/grass mix), silages, homemade rations of locally available grains and other ingredients, and grazing (the most common feed source).

Scarcity and low quality of feed resources constitutes one of the major constraints to improving productivity. Concentrates are often expensive or not regularly available, and low quality crop residues make up the bulk of feed resources. This scenario leads to cyclical production patterns that are heavily dependent on rainfall, and related crop and fodder production. Crop breeding to improve digestibility and palatability of staple crop residues is seen as one option for partially overcoming this constraint (McDermott et al., 2010). High-protein feed legumes offer another less expensive alternative to concentrates.

Farm surveys by the KDSCP in Central Kenya and Rift Valley regions from 2008 to 2013 show that Napier grass is the most commonly grown fodder, followed by other fodder crops such as Rhodes grass, oats, maize, and fodder trees (Table 12). The Table shows growing of fodder maize has taken off quickly, from virtually nothing in the baseline survey year 2008 to 33 percent in 2011 wet season. This emerging trend makes the maize and dairy value chains intricately linked. Several commercial dairy producers now grow maize for animal feed. Other emerging crops include fodder sorghum and hydroponics barley.

Commercial dairy feeds include dairy meal, dairy cubes, calf pullets, maize germ, maize bran, molasses, cottonseed cake, wheat pollard, and wheat bran. Annual commercial feed production was approximately 470,664 MT in 2012, growing at 18 percent per year since 2008 (see Section 2.2. in the USAID-KAVES Maize Value Chain Report 2014). Due to relatively low demand, cattle feed constitutes less than 20 percent of total value of animal feed manufactured annually (KNBS, 2014). The main sources of energy used in feed include locally produced maize and its milling by-products. Other nutrient sources are mostly imported, including high protein ingredients such as sunflower and cottonseed cakes and premixes from Switzerland, Korea, China, South Africa and Israel.

Table 12: Proportion (%) of farmers establishing fodder crops in Central and Rift Valley

Fodder crop	Baseline	2009	2010	2011 Dry season	2011 Wet season	2013 Dry season	Moving average
Napier	79.5	81.6	82.1	88.2	83.5	88.5	83.9
Desmodium	2.1	4.0	0.6	5.	10.7	11.5	5.7

Rhodes grass	7.3	13.9	21.1	25.0	18.4	19.3	17.5
Lucerne	3.7	2.1	4.8	3.2	5.3	5.4	4.1
Fodder trees	2.1	1.3	1.9	6.5	4.9	2.2	3.2
Sorghum	1.0	1.7	3.2	3.5	3.2	3.1	2.6
Caliandra	1.7	2.8	2.2	6.8	4.5	3.8	3.6
Oats	14.1	6.4	12.5	12.6	-	-	7.6
Maize	N/A	2.7	4.2	6.0	32.9	-	7.6

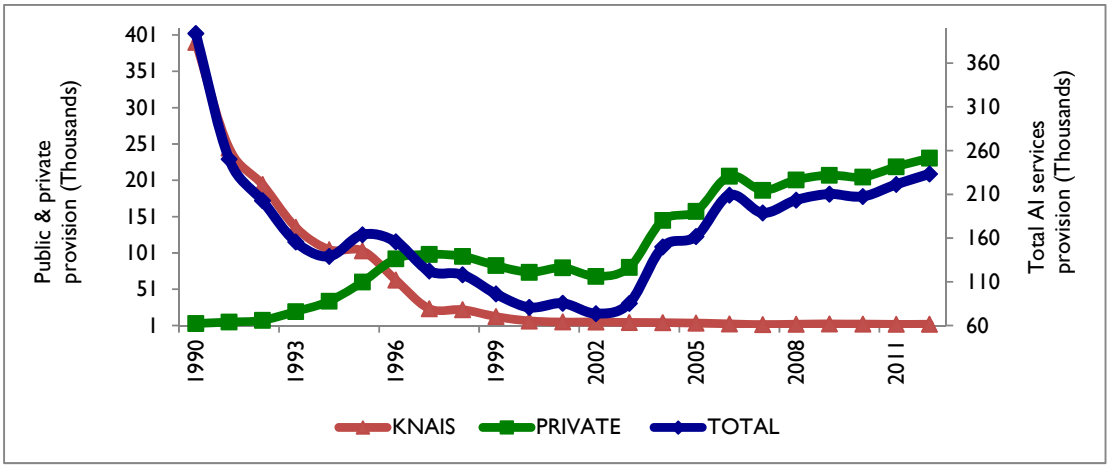
Source: KDSCP 2013

Animal Breeding Services

Government provision of subsidized AI and animal health services in the post-independence years resulted in widespread adoption of improved cattle breeds. However, the provision, adoption and use of AI either stagnated or declined, and vary significantly across the country, in the aftermath of liberalization of the dairy sector in 1991 (Mulford, 2013). The provision of AI services nearly collapsed after liberalization and, although showing a recovery from 2004, has not regained its 1990 levels (Fig. 3). In 2012, only 233,384 inseminations were administered (c.f. 393,922 in 1990). Collection of data on inseminations provided by the private A.I service providers is however a challenge and therefore the actual inseminations provided during the period could be much higher than reported. Existing AI services usually offer semen from bulls that have not been appropriately selected, have high delivery charges, and achieve low conception rates (McDermott et al., 2010). Mudavadi et al (2001) identified several problems constraining the proper delivery and expansion of artificial insemination services, including:

- Lack of proper transportation and poor road networks limiting accessibility to farmers;
- Poor access (not readily available or too expensive) to AI infrastructure, especially nitrogen semen containers;
- Challenges in the procurement of A.I resources (semen) from the KAGRC and other private suppliers in Nairobi, due to high information and transport costs;
- Insufficient knowledge on management of fertility of dairy cows by the farmers and shortages of technically competent inseminators.

Figure 3: Artificial Inseminations administered in Kenya (1990-2012 in numbers)



Source: SDOL

Surveys by the KDSCP found wide disparities in the levels of AI adoption across major milk sheds of Kenya, with central Kenya areas recording the highest rates and Rift Valley the lowest (Table 13). Although the private providers have filled the gap in supply, insufficient AI infrastructure facilities, such as nitrogen storage tanks, lead to high losses of semen. Breeding services provided by the Kenya Animal

Genetic Resources Center (KAGRC) remain too centralized to facilitate efficient semen distribution. Due to these inefficiencies, many smallholder dairy farmers increasingly resort to other methods of breeding. The most common alternatives are bull schemes and contract mating:

- *Bull Schemes*: A number of bull schemes established by the government through the Livestock Development Project helped improve the genetic potential of animals for increased milk production. These schemes are no longer in operation; farmers are using any bulls available, which lead to inbreeding and thus compromise the genetic integrity of dairy animals.

Table 13: Proportion (%) of farmers using AI in Central and Rift Valley regions

Respondent	2010	2011	2013
Baseline – Aug. 2008	39.9	39.9	39.9
KDSCP beneficiaries	70.3	87.0	81.8
Milk shed			
Nyeri	96.3	94.1	97.5
Gatanga	93.7	91.1	96.7
Kabete	95.3	90.4	97.0
Lessos	44.6	52.2	54.9
Trans Nzoia	59.9	78.6	66.4
Kericho	30.0	43.9	50.9
Nakuru	46.8	68.3	83.2
Kinangop	89.2	95.4	96.7

Source: KDSCP 2013

- *Contract Mating*: Several farms with purebred cattle operate contract-mating schemes with semen mostly imported from the United States, Germany and South Africa through KAGRC in Nairobi. The imported semen is used for specially selected contract-mating dams. Other private sector providers of imported AI semen serve mostly the medium and large dairy farmers. Due to high cost of the semen, poor infrastructure, and limited national coverage, providing these services to smallholder rural farmers is difficult.

Emerging breeding methods include the use of Assisted Reproductive Technology (ART) that includes Sexed semen and Embryo Transfer. ART is being promoted by the Kenya State Department of Livestock (SDOL), through the Eastern Africa Agricultural Productivity Project (EAAPP), and has so far recorded rapid gains in adoption. Use of the technology has proven a faster way of inseminating heifers. Through the expansion of liquid nitrogen distribution infrastructure, the SDOL hopes to improve semen handling and distribution and hence improve efficiency. SDOL is setting up liquid nitrogen plants in Meru, Kirinyaga, Nyandarua, Eldoret, Sotik and Voi. The Government is also establishing a second bull station at Kitale to improve semen output and reach more dairy farmers and service providers.

Poor breeding management practices among smallholder dairy farmers form a key constraint to dairy development. Whereas good management requires that cows be served within 60 days after calving, dairy farmers take up to eight months. KDSCP baseline study in the Rift Valley and Central Kenya found dairy farmers waited an average 6.5 months to service their cows after calving. This led to lengthy calving intervals of up to 600 days (486 days in the Rift Valley, 463 days in Central), instead of the recommended 365 days. Kimenchu et al. (2014) found average calving intervals in Central Kenya was 588 days, ranging from 370 to 1300 days; it was higher in Embu East at 606 days and lower in Igembe South at 547 days. **Poor breeding management (long service periods) is a major contributing factor to the low dairy productivity in Kenya, and should constitute the first line of intervention to improve productivity.**

3.3.3 Productivity Trends and Estimates

Findings in the preceding sections indicate milk production has largely depended on milking herd size and composition. Given the evidence of a general slowdown, or decline, in the growth of improved dairy cattle herd size, initiatives to increase milk production will have to rely on improvement of and increased productivity of existing dairy herd. This section addresses productivity issues to isolate key challenges and intervention opportunities. It first reviews existing literature on milk productivity, focusing on estimates of milk yields, and then performs an analytical exercise on options and possibilities available to USAID-KAVES.

International comparisons: The Kenya smallholder dairy sector is mostly comprised of low-input and low-yield production systems. In 2005, average yields were 1,672 liters in Vietnam, 1,787 liters in Peru, and 1,749 liters in Thailand. Kenya's production system compares well to India, the world's largest milk-producing country, where yields averaged 956 liters/cow/year in 2005 (FAO, 2010). Globally, according to the International Farm Comparison Network (IFCN), 122 million dairy farms keept about three cows per farm and yielded an average 2,100 kg milk ECM (2,033 liters) per milking cow in 2012; this translates to 6.8 liters per cow per day for 300 days. The rest of the analysis in this report adopts this yield as the global average.

Annual Milk Yields: Since milk production is reported in terms of per cow per day, the calculation of annual yields depends on assumptions about the number of dairy cows, milking cows and lactation period. Different production systems, agro zones and cattle breeds record vastly different lengths of lactation, from as low as 200 days among indigenous cows to 300 days among the most advanced farmers.

The national average lactation period for the typical dairy farmer is approximately 250 days, 290 days for improved management systems, and 300 days for the most advanced farmers. Typically, with average 18 months calving cycle, the lactation period could take as long as 540 days among the least advanced farmers. Assuming Kenya's dairy farmers comprises of 78 percent basic (typical) production system, 12 percent improved and 10 percent advanced, **the average national lactation period is approximately 260 days.**

Reported national average yields have increased only modestly over the past ten years. Table 10 in Section 3.2.2 shows the estimated national average milk yield grew at 1.5 percent CAGR between 2006 and 2012 to about 631 liters per milking cow, and from about 1105 liters to 1209 liters per milking dairy cow in 2012. Between 2010 and 2012 the average yield per milking cow was 660 liters for all cows and 1265 liters for dairy cows. These results are largely in line with Mulford (2013), who found the average annual dairy milk yields of 1371 liters in 2007, and Wambugu *et al* (2011) yield of 1344 liters in 2010. Wambugu *et al.* show a generally modest growth in average yields, with average annual growth rates of 2.2 percent for the period 2004-2010 (Table 14). Recent data from FAOSTAT however indicates national yields of cow milk declined by 5.3 percent per year during the period 2010-2012, as a result of adverse climatic conditions (drought) experienced in 2011 and 2012 (KNBS, 2014).

An important factor driving milk productivity is the agro-ecological zone (AEZ). Average milk yields vary significantly across the major AEZ in Kenya, largely because of different climatic conditions that can support different cattle breeds. Historically, high-yielding dairy breeds have concentrated in the highlands and high potential milk zones. Wambugu et al (2011) capture these regional yield differences in household panel surveys for the 2000-2010 period, as shown in Table 14. The Central Highlands (CH) achieved the highest productivity followed by the High Potential Milk (HPM) and the Marginal Rain Shadow (MRS), with the Western Lowlands (WL) recording the lowest productivity. The authors attributed these to the fact higher proportions of households in the high potential areas keep improved cows and maintain larger herd sizes than those in the low potential areas.

Table 14: Annual milk yields across agro-ecological zones (2000-2010, liters/cow)

AEZ/Year	2000	2004	2007	2010	CAGR (2007-10)	CAGR (2000-10)	Yield Gap in 2010*

Western Lowlands (WL)	372	359	365	498	10.9%	3.0%	-63%
Coastal Lowlands (CL)	418	207	700	607	-4.7%	3.8%	-55%
Eastern Lowlands (EL)	864	785	890	853	-1.4%	-0.1%	-37%
Western Highlands (WH)	1,005	1,071	836	898	2.4%	-1.1%	-33%
Western Transitional (WT)	662	812	1,019	940	-2.7%	3.6%	-30%
Marginal Rain Shadow (MRS)	618	1,480	1,434	1,482	1.1%	9.1%	10%
High Potential Milk (HPM)	969	1,292	1,680	1,603	-1.6%	5.2%	19%
Central Highlands (CH)	1,974	2,234	1,985	2,036	0.8%	0.3%	51%
National Average	1,086	1,287	1,362	1,344	-0.4%	2.2%	

Source: USAID-KAVES estimates adapted from Table 4.4 in Wambugu et al. (2011); * c.f. the sample average

The Table shows milk yields stagnated in the later parts of the series, with annual growth across the AEZ either negative or flat between 2007 and 2010. Coastal lowlands experienced the steepest decline in yields (4.7%) during the same period, after the fastest growth (20%) between 2004 and 2010. The choice and intensity of the grazing system, as well as favorable climate for rearing dairy cattle, also explain the relatively higher productivity in the CH, HPM and MRS zones. Mulford (2013) corroborates these results showing the central highlands recorded the highest yields.

With appropriate animal husbandry practices and improved breeds, some of the Kenyan producers have attained yields above the global average. Survey results from the USAID-Kenya Dairy Sector Competitiveness Program (KDSCP) in Central Kenya and Rift Valley regions show most milk sheds surveyed already produce at near or above the global average (Table 15). The Table also shows considerable fluctuations in average milk yields depending on seasonal patterns (wet or dry), which is an indication of the effect of feed availability. Milk yields during wet seasons are, on average, 17 percent higher than those during dry seasons. Whereas some milk sheds, such as Kericho, Kinangop and Nakuru, experience small declines in yields, the drop in yield in others areas, like Nyeri and Trans Nzoia, can be as high as 60 percent. Stabilizing milk yields through the seasons is therefore fundamental to increasing dairy productivity and milk production. **This can be achieved through adequate feed and water availability throughout the year. The KDSCP results indicate improved feeding practices during the dry season could increase average yields by an average 9 percent, ranging from 2 percent in Kericho to 31 percent in Nyeri.**

Table 15: Average milk yields (liters/cow/year) in Central and Rift Valley dairy sheds

Respondent	Average 2011 Dry Season	Average 2011 Wet Season	Mean 2011 Dry season	2013 Dry season	Seasonal Gap	Effect of improved dry season feeding	>15 l/c/d (%)
	A	B	C	D	(B/A)-1	(C/A)-1	
Baseline	1,690	1,690	1,690	1,690			
Full Sample	2,132	2,496	2,314	2,496	17%	9%	14.2
Milk shed:							
Nyeri	1,872	2,990	2,444	2,730	60%	31%	13.9
Gatanga	1,950	2,730	2,340	2,860	40%	20%	17.3
Kabete	3,042	3,666	3,354	2,964	21%	10%	27.4
Lessos	2,782	1,768	2,288	2,262	-36%	-18%	15
Tr. Nzoia	1,248	1,976	1,612	1,872	58%	29%	0.6
Kericho	1,586	1,638	1,612	1,846	3%	2%	6.5
Nakuru	1,846	2,054	1,950	2,444	11%	6%	12.7
Kinangop	2,808	3,068	2,938	2,886	9%	5%	18.9

Source: KDSCP Baseline (2013). Milk yields were recorded per day. We assume 260 days lactation, on average

3.3.4 Analysis of Productivity in FtF Target Counties

Having established average milk yield levels, we now use USAID-KAVES Baseline Survey of 2013 to analyze the situation in FtF target counties. Table 16 contains summaries of the average yields, herd size, and yield gaps across counties. The mean for the selected FTF counties show dairy farmers kept about 1.7 cows per household and produced an average 1418 liters of milk per cow per year (equivalent to 5.5 liters daily), which is identical to the consensus national daily yield estimate (5.6 liters). Average productivity per cow ranges from 975 liters in Vihiga to 1854 liters in Trans Nzoia. Benchmarked against comparable production systems (India, Peru, Thailand, etc.) discussed in preceding sections of this report, the average yield across the FtF counties is near or above the averages in these countries. These findings depict the Kenya smallholder dairy farmers as relatively productive but performing below the potential.

Compared to the global yield average, the yield gap for dairy farmers in all the FtF counties surveyed is 43 percent. Vihiga (108%) and Kakamega (89%) registered the largest gap, while Meru and Trans Nzoia the smallest. Nationally, the yield gap across the counties was 6 percent (16% for those below the sample average). The Table illustrates how small increases in average yields could bring many FtF target counties near the national levels. A 16 percent increase in yields across the counties would increase the national average annual yields by 13 percent, to 1600 liters per cow. The highest level of effort will be required for Vihiga, Kakamega, and Nyamira counties, and the least effort in Meru, Trans Nzoia, and Siaya. The latter should focus on attaining the global yield average. From the estimated 2.54 million milking dairy cows, this would translate to milk output of 4.1 billion liters. As discussed in preceding sections, there is tremendous opportunity to increase yields through breed improvement and better management practices, specifically improved breeding and feeding management among smallholder dairy farmers. Interventions that target increased yields are discussed in Section 7 on Upgrading Interventions.

Table 16: Dairy milk yield, yield gaps and changes required to attain national average

County	Herd size	Yield*	Global gap**	National gap***	Effort to attain national yield	Projected yields****
Kitui	3.4	1,387	-32%	-2%	2%	1,605
Machakos	1.8	1,248	-39%	-12%	14%	1,444
Nyamira	2.7	1,203	-41%	-15%	18%	1,392
Bomet	1.6	1,321	-35%	-7%	7%	1,528
Vihiga	1.0	975	-52%	-31%	45%	1,128
Siaya	1.8	1,658	-18%	17%	-14%	1,918
Meru	1.4	1,816	-11%	28%	-22%	2,101
Makueni	2.0	1,257	-38%	-11%	13%	1,454
Kisii	1.6	1,387	-32%	-2%	2%	1,605
Kakamega	1.7	1,077	-47%	-24%	32%	1,247
Bungoma	1.8	1,246	-39%	-12%	14%	1,442
Kericho	1.4	1,374	-32%	-3%	3%	1,591
Nandi	1.5	1,578	-22%	11%	-10%	1,826
T. Nzoia	1.6	1,854	-9%	31%	-23%	2,145
E. Marakwet	1.5	1,300	-36%	-8%	9%	1,505
U. Gishu	1.9	1,430	-30%	1%	-1%	1,655
Sample Average	**1.7**	**1,418**	**-30%**	**-7%**	**6%**	**1,599**

Yields (liters/cow): Kenya 2012 (1,209); World 2012 (2,033); Others (2005): India (956); Vietnam (1,672); Peru (1,787); Pakistan (1,256); Bangladesh (676); Thailand (1,749); China (3,575); Morocco (937).

*Source: Calculated from KAVES baseline survey; FAO (2010); IFCN (2013). * Liters per cow per year. Assumes 260 days lactation; ** Against world average yield; *** Against sample average (1418 liters): **** Assumes 16% increase in yields across all counties*

3.3.5 Milk Handling and Storage Losses

Milk losses in Kenya are highest at the farm level as a result of spoilage, lack of market and rejection at market. Significant losses occur with evening milk, when collection cease and farmers do not have proper milk preservation techniques. Rejection at market is a result of poor handling and the time taken to reach markets due to distances and the condition of roads. Rejections are higher during the wet season, when production is high and roads are impassable. Few studies have documented the losses along the milk value chain. Milk loss estimates at the farm level range from 3 percent to over 6 percent of the total production (FAO, 2011a).

Table 17: Kenya milk producer prices (1990-2012, in KSh/liter)

Year	Nominal Price	Real Price
1990	2.80	25
2003	13.53	23
2007	19.32	24
2008	21.26	23
2009	28.28	28
2010	22.00	21
2013	32.29	23
CAGR (2011-13)	*10%*	*3%*
CAGR (2009-13)	*3%*	*-4%*
CAGR (2004-13)	*9%*	*0%*

Source: USAID-KAVES estimates from FAOSTAT & KNBS (2013, 2014)

New findings by FAO (2014) estimate the national milk loss at 7.3 percent; most of it (5.7%) at the farm level due to spoilage of evening milk. Results of RRA surveys conducted in December 2013 by USAID-KAVES in Bungoma, Uasin Gishu, and Kisumu corroborate the FAO finding. They show a typical dairy farmer in these areas lost 7 percent of total milk produced per year, on average. Respondents interviewed reported negligible losses in Kisumu, 3 percent in Bungoma, and 10 percent in Uasin Gishu. At the market level, USAID-KAVES field surveys found milk handling losses at the bulking/trading level averaged about 1.1 percent, with most cooling plants reporting between 0.2 and 1.1 percent.

Milk losses vary by month and rainfall patterns, with the highest on-farm losses incurred during high-rainfall months of March and April. The KNBS FBS for 2012 and 2013 applied between 6 and 8 percent as national average loss. Consequently, this report adopts 7 percent as the national milk loss average. At the 2012 milk production levels, these losses amounted to 336 million liters of milk worth about KSh23.5 billion (at KSh70 per liter). **Reducing milk losses is therefore straightforward – find ways of preserving milk during the rainy season and in the evenings to make it available for the next marketing cycle, calf feeding or consumption.** These would include technologies for processing milk on the farm to extend shelf life or serve alternative markets.

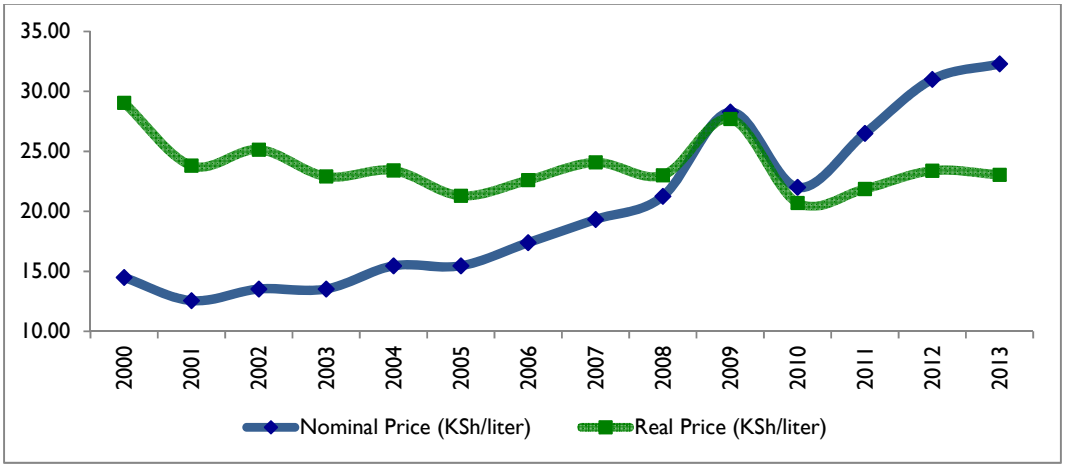
3.3.6 Price Seasonality Trends

Domestically, the nominal producer price of raw milk has steadily increased over the years. In the period 2004-2013, the average price increased at an annual average rate of 9 percent (Table 17). For example, the 2013 nominal price was 79 percent higher than the 2005 average. Several factors explain the upward trend in Kenya's producer milk prices, including price inflation, supply constraints due to climatic fluctuations, low productivity, political unrest, faster growth in demand due to urbanization and population growth, and greater competition for marketed milk.

The period 2007-2009 is particularly noteworthy. After a decade of only modest price increases, the producer price rose by 33 percent in 2008, and another 17 percent in 2009. These are some of the consequences of the post-elections violence (PEV) that affected mostly dairy producing areas of the Rift Valley and hence suppressed national supply. While milk production grew by 32 percent in 2006 and 21 percent in 2007, it fell by 15 percent in 2008, and did not regain pre-PEV growth levels until 2012. When corrected for inflation, however, the Table shows producer prices have either been flat or declined during the same period. Real prices declined at 4 percent per year over the period, 2009-2013, and remained flat during 2004-2013. While there are signs of recovery in the last three years, real producer prices remain below their 2007 levels.

Figure 4 depicts the overall trend in prices. Nominal and real prices only converged in during the period, 2008-2010, in the aftermath of the PEV. Caution, however, should be exercised in interpreting these prices. First, they are reflecting the formal (processing) milk market, a small share of the total milk market. Section 5.2 – Farmer Gross Margins shows producers selling milk through alternative (mostly informal or direct consumer) channels received higher prices, sometimes double what the dairy processors offer.

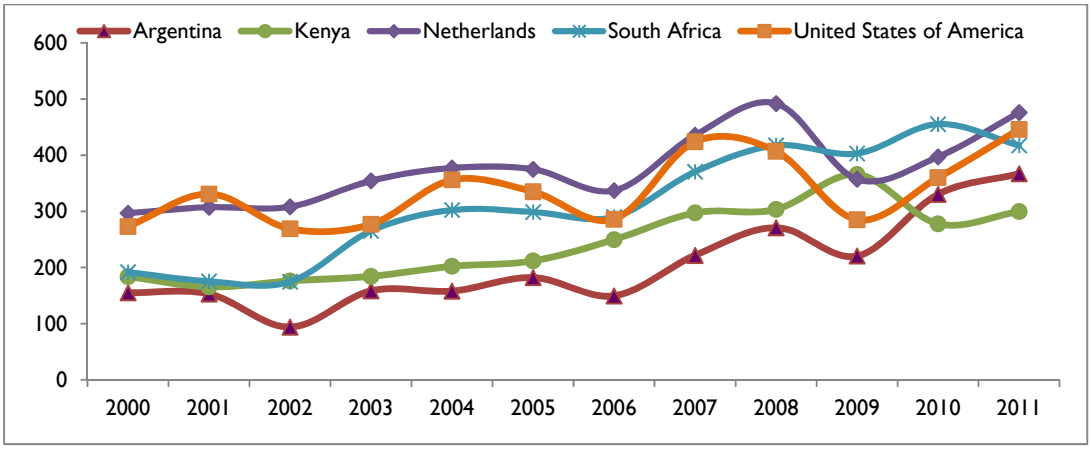
Figure 4: Prices paid to Kenyan milk producers (2000-2013, in KSh/liter)



Source: FAOSTAT; KNBS (2013, 2014)

The rise in nominal prices in Kenya seems largely consistent with rising trends in global milk prices, as illustrated in Figure 5. There was a general upward trend in producer milk prices globally in the period between 2000 and 2011. These trends depict Kenya as relatively competitive producer vis-à-vis major global producers. Increasing international milk prices present export opportunities, as global dairy manufacturers look for alternative sources of affordable milk. In light of current domestic supply deficits, however, Kenya will have to pay more for imports required to bridge consumption shortfalls. Either way, it is incumbent upon Kenya to increase domestic milk production to mitigate the effects of rising international prices and take advantage of expanding global markets.

Figure 5: Whole fresh milk producer prices (US$ per ton) across selected countries



Source: FAOSTAT

With nearly stagnant yields and prices over the past decade, real earnings of the Kenyan dairy farmer appear to have either stagnated or declined. Despite important developments and interventions in the

dairy sector, a lot of the average dairy farmer has not improved significantly. To rely on dairy as a source of livelihood, farmers will have to increase their productivity without significant increase in the cost of production. **The most impactful interventions along the dairy value chain will be those that find innovative ways to increase real producer returns through higher productivity and lower cost of production.**

3.4 TRADE PATTERNS

3.4.1 Milk Imports

Competition from milk and dairy products imports, especially milk powder, has been blamed in the past for depressing producer milk prices. Our analysis however demonstrates that these imports have been negligible compared with national production and therefore are not likely to have exerted significant influence on farm-gate prices for milk (see Table 18). In 2012, the Table shows about 22,964 MT of liquid milk equivalent (LME)[11] was imported, constituting less than 0.5 percent of total domestic production and consumption requirements for the same year. Importation of milk and dairy products has nonetheless increased in the recent past, with total imports in 2013 about 2.6 times the levels in 2009.

Kenya currently imports dairy products equivalent to about 5 percent of the total processed milk supply, mostly from the East African Community region (specifically Uganda). The rest of the imports are of specialty dairy products to satisfy the preferences of tourists and expatriates in the country. The demand for milk and dairy imports is expected to grow significantly for various reasons: i) there has been a sharp increase in milk and dairy products imports in the recent past (see Table 18); ii) there are expanding local markets for milk powder and butter oil for reconstitution as domestic demand continues to outstrip supply; and, iii) other producers in the EAC are becoming more competitive. Without significant increases in domestic production, imports will play an ever-increasing role in national milk supply over the next ten years. Imports are projected to constitute 2.5 percent of total milk and dairy consumption in 2022. Scenarios of this are built in Section 3.5.

Table 18: Kenya imports of dairy products (MT of LME), 2003-2011

	2003	2006	2007	2009	2012	2013
Milk and cream	710	3,442	4,178	8,108	19,711	22,839
Butter/ghee	628	365	299	562	1,248	942
Whey/natural milk products	0	30	88	252	1,030	262
Cheese and curd	436	528	532	581	730	0
Buttermilk and yogurt	22	42	44	4	244	1,206
Total (MT LME)	1,795	4,407	5,142	9,507	22,964	25,249
Total (million liters LME)	1.73	4.26	4.97	9.20	22.20	24.39

Leading sources of Kenya imports of milk and cream (MT)

Sources	2005	2006	2007	2008	2009	2010	2011	CAGR (2005-2011)
World	942	2016	2672	3012	4827	8382	10258	49%
EAC	293	608	1162	1790	2475	7074	8900	77%
Uganda	293	514	229	580	2462	7074	8900	77%
Tanzania	0	94	933	1210	13	0	0	0

Source: ITC TradeMap; FAOSTAT; KNBS (2013); ITC TradeMap

[11] Factors to convert different dairy products into whole liquid milk equivalents (LME): Fresh milk (1.0); Dry milk - skim or whole (7.6); Milk, condensed or evaporated (2.0); Cheese and curd (4.4); Butter (6.6); Butter-oil (8.0); other products (2.0).

3.4.2 Milk Exports

Rising global milk prices are an indication of expanding opportunities in the global market as some buyers seek alternative sources of less expensive milk. The potential market for Kenyan exports of milk and dairy products is large, with much of Eastern and Central Africa, including Tanzania, Rwanda, Burundi, Somalia, DRC, South Sudan, and Zambia all net importing countries. In 2008, the estimated market for milk in sub-Saharan Africa is 35 million metric tons, while demand within the COMESA region was at 14 million metric tons against supply of only 12 million tons (KDSCP, 2008). Total imports to COMESA were $362 million, of which only 7 percent is from the region. Kenya has not significantly penetrated these export markets despite having the largest regional production volumes outside South Africa. Table 19 shows exports have stagnated over the past seven years, fluctuating between 12 million liters and 20 million liters. Approximately 11,000 MT was exported in 2012, which was much lower than previous years (FAOSTAT, 2013). This amounted to approximately 0.4 percent of the total milk produced in the country.

Table 19: Dairy exports (MT of LME), 2003-2012

	2003	2006	2007	2009	2011	2012
Milk and cream	3684	9591	12714	9479	12614	8438
Butter/ghee	562	226	788	1365	6570	1913
Buttermilk and yogurt	480	2228	3612	1376	752	706
Buttermilk and yogurt	240	1114	1806	688	376	353
Cheese and curd	66	136	106	123	268	123
Whey	10	102	514	2	2	0
Total (MT)	4,802	12,284	17,734	12,345	20,206	11,180
Total (million liters)	4.6	11.9	17.1	11.9	19.5	10.8

Source: ITC TradeMap

3.5 SUPPLY PROJECTIONS

Applying trend analysis to the data presented in the proceeding sections, we have made estimates of Kenya's national supply of milk five and ten years into the future. We use production growth rates, milk losses and trade to estimate future milk supply. The 2012 production year is treated as the base year and our key assumptions include constant yields, output growth at the CAGR (2007-2012) of 4.5 percent, and normal climatic conditions. Total domestic milk production is projected to increase to 6.3 billion liters in 2017 and about 7.8 billion liters in 2022 (Table 20). If the national average milk losses remain at about 7 percent[12] and calf feeding at 7 percent, the milk available for consumption will be 5.4 billion liters and 6.7 billion liters in 2017 and 2022, respectively, leading to national milk deficits in both years.

Table 20: Projected Milk Supply (Million liters), 2012-2022

Supply Source	2012	2017	2022	CAGR
Domestic production	4800	6261	7814	4.5%
Availability from production (adjusted for losses - 7% PHL + 7% calf feed)	4128	5385	6720	5%
Surplus (Deficit) from production – compared to Table 3	(350)	(675)	(1275)	14%
Imports	22	74	201	25%
Exports	11	20	32	11%

[12] Postharvest loss estimates vary widely. Supply projections use loss estimates based on USAID-KAVES field surveys (2013) and FAO (2014).

Total Surplus (Deficit)	(328)	(602)	(1074)

Source: USAID-KAVES calculations

This report projects imports will grow at 25 percent per year into 2022, supplying ever larger proportions of the total demand. If the growth trend persists, it is expected imports will reach 201 million liters equivalent of milk by 2022. This will not be enough to meet the projected supply deficit in the same year. We therefore expect exports to slow down, growing at 11 percent annually to 32 million liters equivalent in 2022. Whether these projections materialize will depend on how Kenya dairy farmers respond to expanding market opportunities through increased production and productivity. We examine the possible scenarios below.

Kenya could become self-sufficient in milk without increasing the milking cattle herd by increasing yields and/or reducing postharvest handling losses. We present the scenarios in Table 21 using projected production and consumption levels for 2017.

- If milk losses were to be reduced by at least 30 percent in 2017 (to 5 percent under Scenario 1), an additional 125 million liters of domestic milk would be available on the market, reducing the supply deficit to 550 million liters.
- If yields increased 20 percent by 2017 (to 1520 liters per cow), an additional 880 million liters of domestic milk would be available for consumption, as shown under Scenario 2, and thereby eliminating the projected deficits and generating a surplus of 206 million liters.
- If yields were 20 percent higher and losses 30 percent lower, Kenya would have a surplus of 351 million liters by injecting an additional 1.03 billion liters to supplies – or 19 percent more milk than would actually be available in 2017, with yield increases accounting for 86 percent of the change.

The scenario analysis illustrates how modest increases in yields or reductions in losses can have a significant impact on domestic production and supply.

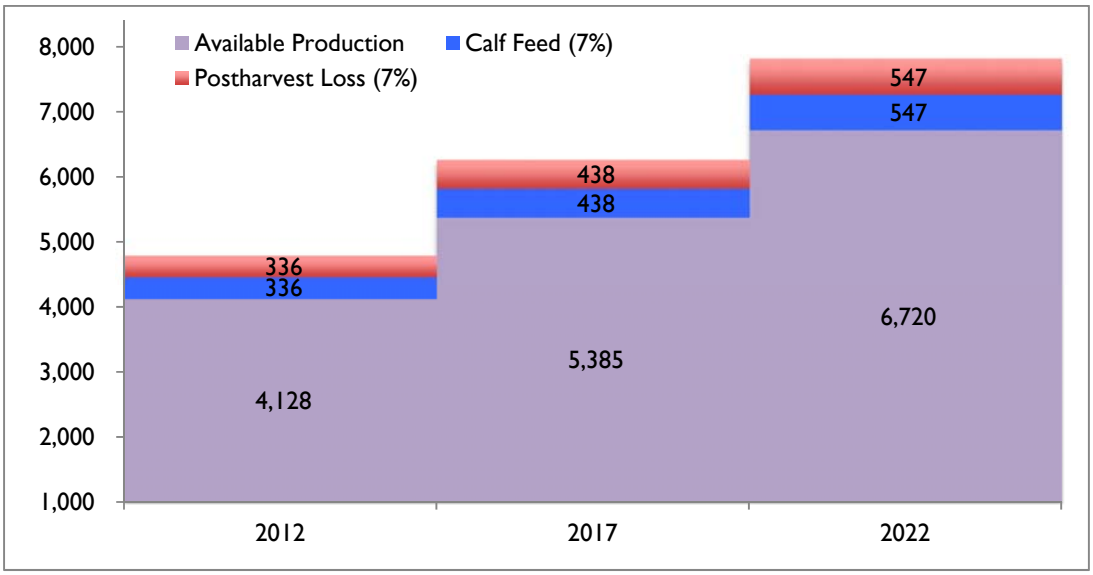
Table 21: Scenarios with 2017 National Milk Production (Million Liters)

Scenarios	A	B	C	D	E
	Production	Handling Losses + Calf Feed	Available Supply [A+B]	National Demand (Table 3)	Surplus (Deficit) [C-D]
Baseline/Actual: Yield; 7% handling losses; 7% calf feed	6,261	(877)	5,385	6,060	(675)
Scenario 1: Baseline with 30% reduction in milk losses (to 5%)	6,261	(751)	5,510	6,060	(550)
Scenario 2: Baseline with 20% higher yield (1520 liters/cow/yr)	7,286	(1,020)	6,266	6,060	206
Scenario 3: Baseline with 30% reduction in losses AND 20% increase in yield	7,286	(874)	6,411	6,060	351

Source: USAID-KAVES estimates

Analyses in preceding sections of this report show the yield increases envisaged here are attainable in most FTF counties through the narrowing of the average yield gap (estimated at 16 percent). Table 16 (Section 3.2.4) shows a 16 percent yield increase could increase average annual yields to 1600 liters per cow. The yield potential is further demonstrated in Section 5.2 – Farmer Gross Margins, Table 23 & 24, where average yields from selected FtF counties already surpass this target. Interventions to increase cow yields are explored in Section 7. Fig. 6 summarizes the supply situation today and the next ten years.

Figure 6: Milk supply estimates and projection (2012-2022 in million liters)



Source: USAID-KAVES calculations

3.6 SUPPLY CONSTRAINTS AND THREATS

Our conclusion from the demand analysis is that smallholders have substantial opportunity to thrive in the market as national demand remains on par with domestic production. The main challenge lies in ensuring the financial viability of dairy enterprises and reducing the cost of production relative to the average household income. Cost reduction measures could further strengthen the competitiveness of the industry and potentially lead to increased exports. Although many of the 22 target USAID-KAVES counties have marginal conditions for improved dairy production, counties in the Rift Valley, Eastern, and Western regions make up for a large percentage of national dairy production.

Productivity constraints entail gaps that reflect the difference in the knowledge farmers possess and the recommended knowledge at any point of time:

- *Technology Gap*. There are significant gaps in feeding, breeding, and animal healthcare, with most farmers relying on inadequate and low quality feed and breeding materials. Poorly fed, unhealthy low quality animal breeds, compromise dairy productivity. This entails additional investment and higher recurring costs for fodder and breeding management techniques.
- *Management Gap*. Poor animal husbandry, dairy enterprise management, milk handling, and marketing practices impose higher unit costs and lower gross margins. In some regions, poor breeding, animal healthcare, and feeding have led to the deterioration of animal breed quality, animal health and therefore low productivity. Poor milk handling and storage lead to losses in output, lower prices due to poor milk quality, and, in some cases, total loss of entire evening output. Program interventions that include extension, education and training should offer low-cost means of raising productivity and reducing milk losses by applying improved management practices.

> For many years, farmers in Ndumberi, Kiambu County, have been struggling to feed their dairy cows in the dry season. With the usual green fodder unavailable at this time, farmers are forced to pay large sums or money and travel long distances for feed. "We have been purchasing hay from the Delamere Farm, which is about 100 km away, at a cost of KSh180-250 per bale (15kg)", says Jane Muya, a dairy farmers and the general manager of Ndumberi Dairy Cooperative.

Biophysical and socio-economic constraints limit the productive and reproductive potential of the dairy herd on smallholder farms in most regions, despite favorable soil and climatic conditions. Dairy is largely practiced under rain-fed systems. This means that climatic conditions are the main determining factor underlying the variability and seasonality of production and yields. In many parts of Kenya, the availability of pasture or fodder diminishes significantly in dry seasons. Dairy farmers are forced to rely on low quality agricultural by-products, which lead to reduction in milk yields, loss of animal body condition, and delayed calving (KALRO, 2005). Feed constraints include inadequate feed quality and quantity, poor storage facilities for feed conservation, and insufficient water. Without intensification, fodder conservation, and breed improvement, the scope for significant increases in average milk yields narrows even further. Fodder production and conservation is particularly critical for dry season feeding.

Natural Fodder Production and Conservation by the Kavatini Pasture and Livestock Improvement Group (KAPALIG), Makueni County

A small group of farmers in Makueni County is smiling all the way to the bank by planting grass. For nearly a decade, KAPALIG has been growing indigenous grasses, such as Buffalo grass, African foxtail, Horsetail, Bush eye, Maasai love grass, and Rhodes grass for their own livestock fodder and sale as hay.

In addition to producing fodder, they also seed grass seed, which has a ready market both locally and internationally. The African Wildlife Foundation (AWF), FAO-Kenya, FAO-Somalia, World Vision, and Care International are some of the ready markets for grass seeds. Grass seeds are sold at KSh1000 per kilogram for most species, while rare grasses, such as bush rye, are fetching as much as KSh1800 per kilo. In 2009 alone, KAPALIG made 1 million shillings profit from the sale of grass seeds, at a time when many farmers were abandoning agriculture for other income generating activities because of prolonged droughts.

"When I first started growing grass, people thought I was crazy because grass grows naturally. But with time and because of the progress I have made, my neighboring farmers have joined me", saying KAPALIG founder Mr. Jeremiah Ngaya. Mr. Ngaya founded KAPALIG in 2004, when a severe drought resulted in mass deaths of livestock due to lack of available forage. Mr. Ngaya exported 1.5 tons of grass seeds to Somalia in 2010, and 1.1 tons to Sudan in 2011.

Climate Variability and Change: Kenya's dairy production is highly vulnerable to climate variability and change. Farmers experience significant fluctuations in milk production and yields throughout the year and across years. Such weather variations are the leading drivers of dairy production volumes by influencing the availability of grass, fodder and water for animals, and outbreak of animal diseases.

Farm size is a serious constraint to significantly increasing household incomes. Counties with larger average land sizes (e.g. Uasin Gishu, Tharaka Nithi, and Makueni) provide better opportunities for expanding milk production and increasing household incomes through fodder crop production and conservation and improved grassland management (see Table 22). Examples of interventions in these counties include promoting optimal herd sizes suitable for the available land. In other counties (e.g. Kisii, Bungoma, Meru and Homa Bay), the average land sizes are small, putting considerable constraints and pressure on land. For dairy farmers in these counties to earn a decent income they would need to engage in much more intensive production systems and value addition, such as zero-grazing, fodder conservation and mixed farming.

Table 22: Average Land Size for Selected FtF Counties

County	Acres
Bungoma	1.8
Kisii	1.0
Makueni	2.5
Meru	1.6
Homa Bay	1.8
Tharaka Nithi	3.3
Uasin Gishu	3.8

Source: KAVES field surveys (2013)

In addition to fodder conservation, dairy farmers are investing in fortification and compounding of total home rations (TMRs) through the utilization of crop residues and agro-industrial by-products, such as maize stover, rice husks, cottonseed cake, molasses, soybean cake, and minerals, among others. Embracing this technology will address feed shortages especially during the droughts and effectively integrate dairy farming into the mixed enterprises agricultural systems.

Milk handling and marketing constraints negatively affect the total volume and quality of milk reaching markets across Kenya. Losses at the farm level are a result of spillage, lack of market, and milk rejection at the market. Rejection at market tends to be the result of poor handling and the time it takes to reach markets due to long distances and bad roads. Rejections are higher during the wet season, when production is high and roads are largely impassable. Poor handling and storage practices at the farm and primary markets result in both financial losses and wastage. USAID-KAVES surveys found milk-handling practices at the production level include weighing, filtering, and packaging. Milk storage is limited due to the short shelf life of raw milk and liquidity and capacity constraints of small-scale farmers that precludes investment in on-farm preservation and storage technology.

Factors Limiting Milk Processing and Marketing

- Infrastructure bottlenecks caused by poor road networks and lack of appropriate cooling and storage facilities. Poor road infrastructure in production areas affects the transport of milk from farmers to collection centers and processors. As a result, particularly during the flush period from March to June, surplus milk cannot reach the domestic market.
- Low and irregular producer payments that coincide with peak milking season investment in productivity enhancing inputs in the dairy industry.
- The lack of electricity in most areas has limited the establishment of cooling plants. Moreover, the rising cost of electricity increases the processors' cost of production and hence the consumer price for processed dairy products.
- A majority of dairy processors operate below capacity and face still competition for milk from a highly effective informal market.
- Seasonal fluctuations in quality of milk delivered also affect profit margins.

Poor transportation and marketing infrastructure is a common feature in most milk producing areas. Due to poor market accessibility, especially during the rainy season, dairy farmers sometimes lose their entire afternoon/evening milk production. Birechi (2006) found it took farmers in Nyandarua and Nakuru counties an average of about 5.7 hours to sell milk after milking, ranging from zero (immediately) to 17 hours. Without proper on-farm storage and cooling equipment, the higher estimates pose increased risk of milk spoilage. Delays in delivering milk to bulking and cooling centers lead to substantial spoilage and poor quality. This is discussed further in Section 6.3 – Transport Infrastructure.

Milk quality and safety concerns: Because of historical problems of delayed payment by formal buyers, dairy farmers find local informal markets more attractive than formal markets. There tends to be little regard for quality standards across local markets due to a lack of knowledge, as well as a lack of testing technology. The milk is exchanged "as is" in spot markets with high variability in quality across market centers. Risk of milk spoilage, contamination, and adulteration is relatively high and, if it enters the formal market channels, increases downstream processing and marketing costs. Public health risks have been a major concern among dairy sector regulators. Of greatest concern is the potential risk of diseases such as brucellosis and tuberculosis, also known as zoonoses (Omore *et al.,* 2005). The threat from zoonoses has been variously used by the KDB to ban informal milk trading.

Other concerns include drug and chemical residues, especially antibiotics, even in the processed milk. An SDP study by Omore *et al.* (2005) found informally traded milk to be low in bacteriological quality, with variable prevalence levels of brucellosis and zoonosis TB. However, the study noted that nearly all consumers boil milk before consumption, which virtually eliminates the risks of infection from bacterial health hazards. Additionally, the presence of excessive aflatoxin levels in milk has emerged as a major problem in the industry – this is attributed to contamination of animal feeds. This is an issue that will require close attention especially with increasing use of on-farm feed ration mixes in dairy feeding.

Another major concern is the lack of a cold chain to preserve the freshness of the dairy. Given the thin margins in milk handling and the fierce competition from multiple market actors, the cost associated with developing a cold chain widely discourages market actors from doing so. In the past, the government provided coolers to coop societies/groups, but their utilization remained low. Cooling is only attractive where a premium price is paid for the cooled milk.

3.7 SUMMARY OF FINDINGS

Kenya produced 4.8 billion liters of milk in 2012, with 75 percent coming from cattle and the rest from camels and shoats, but currently experiences milk deficits, especially in years of severe drought. The dairy sector is characterized by low-input, low-yield systems that produce below their potential. It relies on about 6.8 million poor quality and undernourished cattle producing about 3 billion liters of milk annually, with average annual yields per cow (1265 liters) well below global averages. In the FtF counties, each dairy cow produced 1418 liters in 2012, translating to an average yield gap of 43 percent below the global average.

Our projections in Section 3.6 indicate that, without any gains from increased yields and output, domestic milk supply will fall short of demand by approximately 675 million liters in 2017 and 1275 million liters by 2022. These deficits would be equivalent to 11 percent and 16 percent of total consumption, respectively. Our analysis of demand and supply indicate that market opportunities for smallholders are substantial. Growth in domestic production must outpace the rate of increase in consumption to satisfy future milk demand. The main challenge lies in ensuring the financial viability of dairy enterprises by increasing yields and reducing the cost of production relative to the average household income. Cost reduction measures could further strengthen the competitiveness of the industry and potentially lead to increased exports.

Significant opportunities exist to improve yields through animal breed improvement, better animal husbandry practices, and greater availability of water and feed/fodder year round. Scenarios built in Section 3.5 show the projected milk deficits in 2017 can be eliminated by modest (20 percent, to 1520 liters) increases in average yields. These can be realized through interventions to narrow the management gap, specifically feeding and reproduction management. The latter should constitute the first line of intervention, to assist dairy farmers in shortening cow service periods from 6.5 months to 60 days after calving and shorten the calving intervals from 600 days to 365 days.

Other priority interventions should emphasize bridging the technology gap, including promoting forage conservation to address feed scarcity and ensure feed availability during dry spells. This would not only increase annual average milk yields by about 9 percent but also improve animal condition. Interventions targeting suitable forage materials, fodder crop diseases management, increased availability of seed and planting materials, and forage management skills will be the most impactful. Moreover, increased utilization of crop residues in on farm feed formulation and increasing water supply through rainwater harvesting and water storage technologies can increase yields and reduce the cost of production.

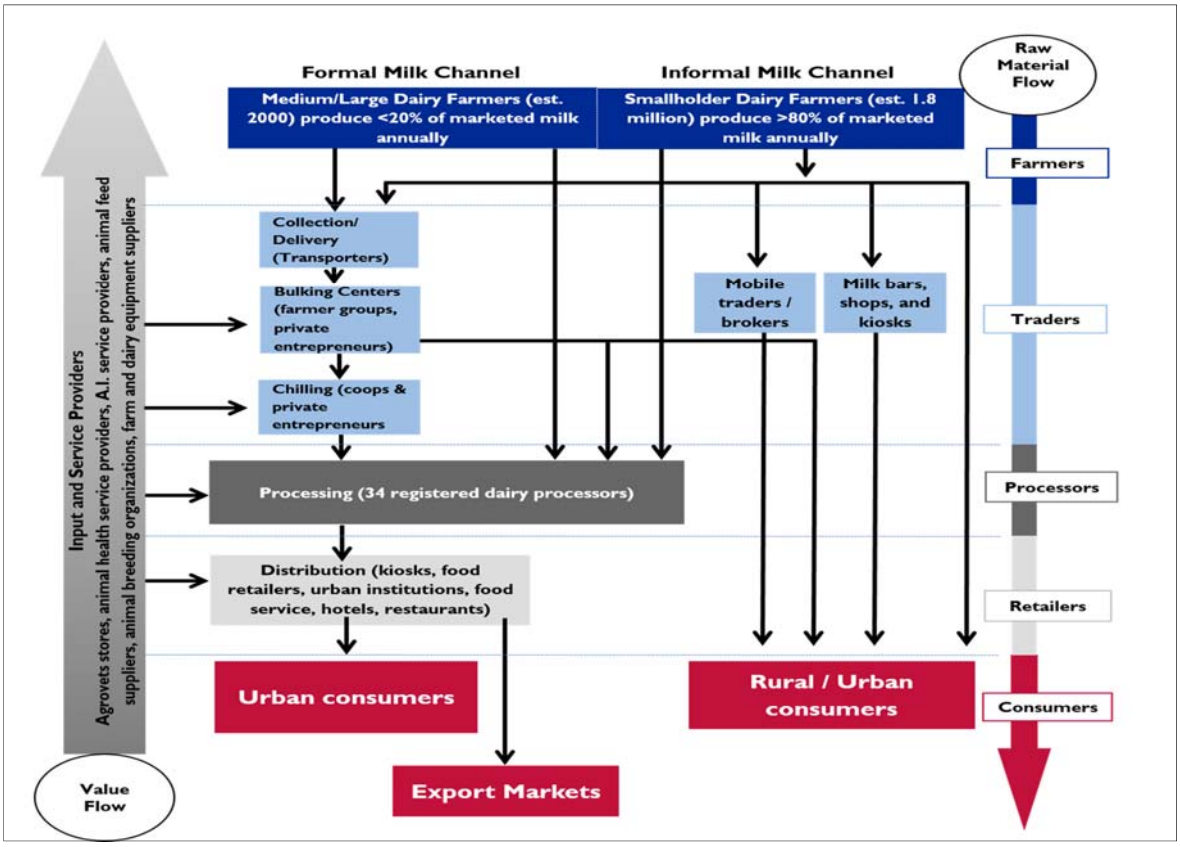
4 THE MILK/DAIRY VALUE CHAIN MAP

In this section, we look at the milk value chain in detail, highlighting key actors and their interactions, critical constraints and gaps, as well as opportunities for USAID-KAVES interventions.

The Kenyan milk supply chain can be categorized into two: the cold chain and the warm chain. Milk delivered to the main processing firms constitutes the 'cold chain' or the pasteurized milk system, while milk used in an unprocessed form constitutes the 'warm chain' (Birechi, 2006). These chains differ in terms of size, geographical distribution, degree of licensing, relative rewards, quality perceptions and long term potential, but both have an important role to play in the Kenyan dairy industry. The warm chain is categorized as informal and includes mobile (itinerant) traders, milk bars and kiosks, dispensers, and cooperatives. The formal chain include milk processors, cooperatives, supermarkets, and retail shops and kiosks, milk bars and any other actor that handles processed milk products.

Figure 7 provides a simplified diagram of the Kenyan milk/dairy value chain, showing the basic flow of milk from farmers through marketing agents and processors to the end consumer, as well as input and service supplies to the farmer.

Figure 7: The Dairy Value Chain Map



Source: Adapted from GATES EADD project and other sources

The notable players in the industry include input suppliers (feeds, animal drugs, artificial insemination service providers), animal breeders, the Kenya Livestock Breeders Association, researchers, policy makers, producers (small scale and medium and large scale), milk bulking enterprises (cooperatives, producer groups and private owned), transporters, processors and retailers (milk bars/dispensers,

supermarkets, retail shops and kiosks). Supply of dairy products to the end consumer originates along two distinct channels: industrial dairy processors supplying pasteurized milk and dairy products, and farmers, hawkers and traders selling raw milk.

Rural households and a number of low-income urban consumers generally buy via a short value chain from local farmers selling to small-scale traders with minimal processing. In urban lower income areas, SNV (2013) found raw milk was sold in 80 percent of kiosks, 43 percent of general shops, and 37 percent of supermarkets. Large-scale processors who receive, pasteurize and package milk from dairy farmers increasingly serve middle and high-income urban consumers. The emergence of milk dispensing enterprises, for example, represents one of the major innovations in the industry in recent memory. The milk dispensing units started operating in supermarkets but have since spread to smaller stores and independent businesses. They provide cheaper alternatives to packaged milk. For example, while a liter of packaged milk retails at KSh80-100, the milk sold through dispensers for KSh70 per liter.

4.1 INPUT SUPPLIERS

Input suppliers include agrovet stores, animal health service providers, AI service providers, animal feed suppliers, animal breeding organizations, and farm and dairy equipment suppliers. A number of dairy producer cooperatives that are operating milk cooling plants have also expanded their services to include other dairy related services such as provision of inputs including AI, feed and credit. In Kenya, feed manufacturing is linked to maize milling enterprises as the by-product forms a large part of animal feed production.

Across much of Kenya, including the geographic area covered by USAID-KAVES, these input suppliers are limited in their ability to provide appropriate services to farmers. A lack access to finance and technical expertise severely limit the quantity and quality of services they can provide to farmers. Long distances between input suppliers and the farmers they serve further limits the ability of input suppliers to effectively service smallholder farmers and adds substantial cost to the goods and services that are offered.

4.2 FARMERS

4.2.1 Smallholder Farmers

Across Kenya there are an estimated 1.8 million smallholder dairy farmers with 1-5 cows, supplying more than 80 percent of all milk consumed in Kenya (Wanyoike et al, 2005; Wambugu et al, 2011). These farmers practice open grazing, semi-zero grazing, and pure zero grazing. In some areas the farmers keep purebred animals, however, the majority keeps crossbreds. Small-scale dairy farmers sell their milk through three channels: 1) direct to consumers in rural areas, mostly neighbors, and low-income urban dwellers; 2) through local traders/hawkers; and, 3) through dairy cooperatives and producer groups. Van der Valk (2008) found about 30 percent of total milk produced (42 percent of total marketed milk) is marketed through this channel. Direct sales to neighbors in particular provides a ready market and saves the farmer costs related to long distances to markets.

Key challenges facing small-scale dairy farmers include availability, cost and quality of feeds, access to AI and veterinary services, and markets during the flush period.

4.2.2 Medium/Large Scale Dairy Farmers

An estimated 5,000 farmers operate medium and large-scale dairy production systems that produce at least 100 liters of milk per day (FCI, IFC and KDPA, 2007). A majority of these farms are located within 50 kilometers of urban centers and deliver their milk to formal markets through processing firms or their own processing and dispensing enterprises. Among the USAID-KAVES target counties, only Nandi and Uasin Gishu have significant numbers of these large-scale dairy producers.

4.3 MARKETING ACTORS

The dairy value chain is relatively short (i.e. has relatively few intermediaries between farmer and consumer) due to the perishable nature of milk. Traders (formal and informal), dairy producer cooperatives, milk bulking/cooling centers and transporters are the main market intermediaries.

4.3.1 Domestic Consumers

Domestic consumers consist of households in urban areas and rural town centers, as well as institutions (hotels, restaurants, schools, hospitals and others) that purchase milk for daily consumption. A majority of consumers purchase raw milk either directly from dairy producers or from retailers and hawkers.

4.3.2 Milk Traders and Retailers

Milk is primarily sold through small-scale traders or supermarket chains. Key milk retailers include:

- *Fixed*: supermarkets, kiosks, and chain stores;
- *Informal traders*: A large number of vendors collect milk from dairy farmers and supply it directly to consumers in urban areas using motorbikes, bikes or foot; others sell processed milk products as mobile traders;
- *Milk bars*: Sell a range of milk products including fresh milk, yogurt, milk shakes, and maziwa lala;
- *Milk dispensers* located in supermarkets and also as stand-alone businesses in urban areas.

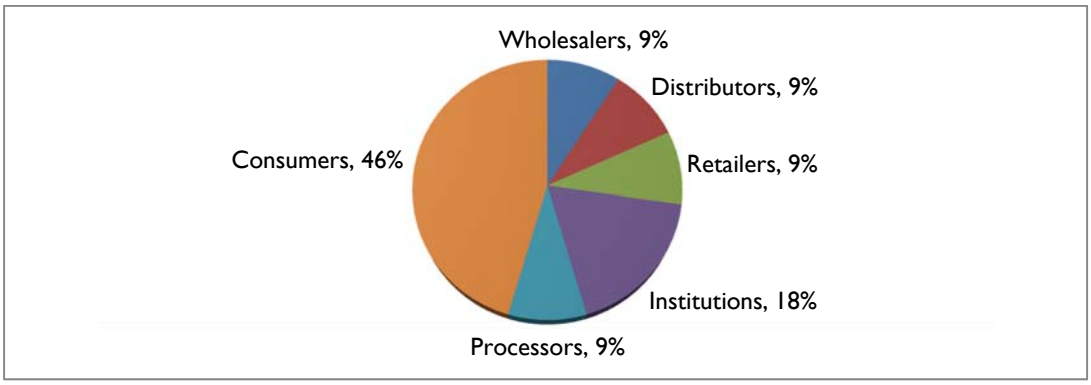
Small-scale retailers are important targets for training in hygiene, safety, and quality in milk handling to curb widespread sale of poor quality or unsafe milk products

Informal traders purchase milk directly from producers and mostly transport it by bicycle, packed in plastic containers of 5-20 liters. These small retailers are often mobile, making any estimate of their numbers imprecise. Their role in the milk value chain cannot be understated, as they handle 70-80 percent of marketed milk (Birechi, 2006; FAO, 2011a; SDOL, 2010; van der Valk, 2008; SNV, 2013). They operate in rural and urban centers, selling an average of 50 to 100 liters a day at about half the price of processed milk. They pay cash on collection and usually do not bother much with quality checking beyond freshness and wholesomeness. A relatively insignificant number of small-scale milk retailers are licensed through milk bars, comply with safety and quality requirements, and may sell over 400 liters a day (SDOL, 2010).

Traders sell mostly to final household and institutional consumers. Interviews during the USAID-KAVES baseline survey in June 2013 indicated that direct sales to consumers account for 46 percent of total sales and formal institutions absorbed another 18 percent. Processors, distributors, wholesalers and retailers shared 9 percent each (Fig. 8). By implication, the milk value chain is relatively short, involving traders who source from farmers and sell the largest share of their product directly to end consumers. Farmers also reported selling directly to consumers, cooperatives or directly to processors through organized collection points at pre-agreed terms. However, traders have become even more competitive by offering services such as picking up milk directly from the farm gate.

A major challenge at this point in the value chain is food safety and quality assurance. **Reliable quality testing is virtually non-existent for the portion supplied directly to consumers or to milk bars/hotels/shops by these traders.** The equipment used for handling and transportation of milk by most traders does not satisfy the minimum food safety standards as required by the industry regulators, including the Kenya Dairy Board (KDB), Kenya Bureau of Standards (KEBS) or the Ministry of Public Health.

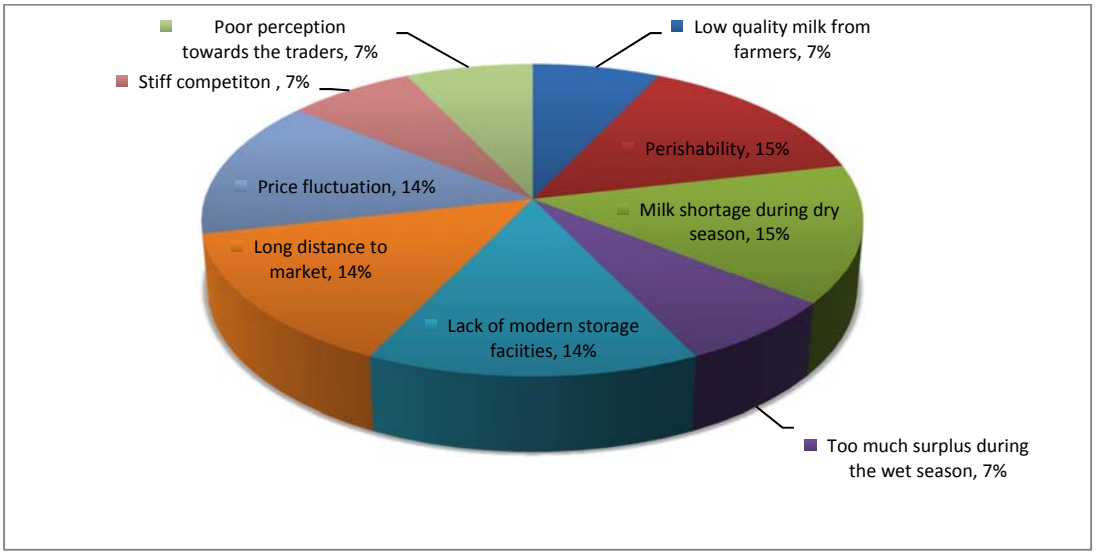
Figure 8: Target customers for informal milk traders



Source: USAID-KAVES, 2013

Focus group discussions conducted for this report revealed the major constraints facing informal milk traders include perishability, milk shortage during the dry season, lack of modern cooling facilities, distance to markets, and price fluctuation (Fig. 9). Traders also indicated they face unfavorable perceptions from other actors across the value chain, especially farmers who view them as exploitative. Supermarkets, stores, and kiosks in all urban centers retail processed dairy products. The distribution systems between the processor and retailer are well developed and the greatest challenge currently is the state of road infrastructure. **The introduction of direct milk dispensing machines in supermarkets and shopping malls is providing larger dairy cooperatives with an opportunity to compete with processors for this segment of the fresh milk market**.

Figure 9: Challenges faced by informal milk traders



Source: USAID-KAVES, 2013

4.3.3 Collection, Bulking and Chilling Enterprises

In the recent past, there have been major investments in milk bulking and cooling facilities by donor-funded projects, the private sector, and also by farmers' cooperatives. The bulking centers provide an important link between producers and the processors, while at the same time preserving the quality of the milk. Milk bulking/chilling centers play an integral role in maintaining the cold chain, which is necessary for preserving the quality of milk. Milk centers have emerged as important business hubs for

the dairy farmer from which a host of services are provided through a check off system[13]. The centers also save processing companies the cost of collecting milk from small, scattered producers.

Investment in milk cold chain will help reduce milk losses especially the evening milk most of which does not reach the market. This would enable the bulking of evening milk at central points and onward transportation to markets. There are an estimated 200 cooling plants in the country (118 are in KAVES target sub-counties), including 53 plants owned by the New KCC (NKCC). Most of the plants are owned by producer groups and supported by international NGOs. Heifer Project International (HPI), for example, has supported installation of about 60 chilling plants in the country, which are also run as business hubs (Cruse, 2012). The SDOL through the Eastern Africa Agricultural Productivity Project (EAAPP) has provided eight coolers (2000-3000 liters and 600-1000 liters capacity) and two pasteurizers to dairy groups in Nyandarua, Emuhaya, Mathira, Nyamira, Imenti South, Nakuru and Keiyo North. Three additional coolers of 5000 liters are under procurement, to be distributed to dairy cooperatives in Nakuru[14], Uasin Gishu[15] and Nyamira[16] counties (SDCP, 2014).

The bulking and cooling centers have been used to develop alternative market outlets, especially for raw milk. The EADD, for example, has utilized them to increase access to undeveloped consumer milk markets, especially in the urban and peri-urban centers (DTS, 2012). Milk collection centers sponsored by HPI typically try to start with a milk chilling and holding capacity of about 6000 liters per day, which is considered the breakeven level of operation (Cruse, 2012). Given the average smallholder farmer delivers less than five liters of milk per day, a plant would need more than 1200 suppliers to reach the minimum daily capacity. Assuming an average of 6500 liters per cooler, 1.3 million liters of milk go through collection centers per day. This translates to 475 million liters per year, which is near the total annual milk uptake by major processors (495 million liters in 2012).

Due to rapid spoilage and poor rural roads, all milk must be delivered to the plant within two hours of milking; ideally, producers should all be located within 15 kilometers of a cooling center. The processor who buys from collection centers tests the milk for adulteration and spoilage before purchase and rejects any milk that does not meet their standards. The amount of time needed to collect the small volumes of milk, long distances to collection centers, and poor road infrastructure complicates the milk delivery process and lead to high rejection rates. Most cooling plants face losses because of insufficient management capacity of the producer groups that run them. Suppliers of cooling plants, such as TetraPak, maintain ties with established plants to supply equipment and provide technical support and services (Cruse, 2012). The cost of the cooling plants is however beyond the reach of most producer groups, and hence the dependence on donors or other external funding sources. The main constraint to setting up coolers in the rural areas is lack of or unreliable connectivity to electricity supply (issues of electricity are discussed in Section 6).

4.3.4 Processors

Kenya has about 92 dairy processors; 35 large, 30 medium, and the rest small scale (KNBS, 2013). A majority of the processors produce a wide range of products including fresh milk, yoghurt, ghee, cheese, and milk powder. In addition to the processors, there are over 128 registered mini-dairies and 173 cottage industries. KDB (2013) data show the average milk intake by registered milk processors increased from 319 million liters in 2003 to 478.5 million liters in 2013, representing a 3% decline over

[13] Under the check-off system, farmers deliver milk to their dairy cooperative and secure inputs (feeds, drugs) and services (credit, AI, veterinary) on account of their deliveries. The cost of the inputs and services is then deducted from their milk income at the end of the month when collecting payment.

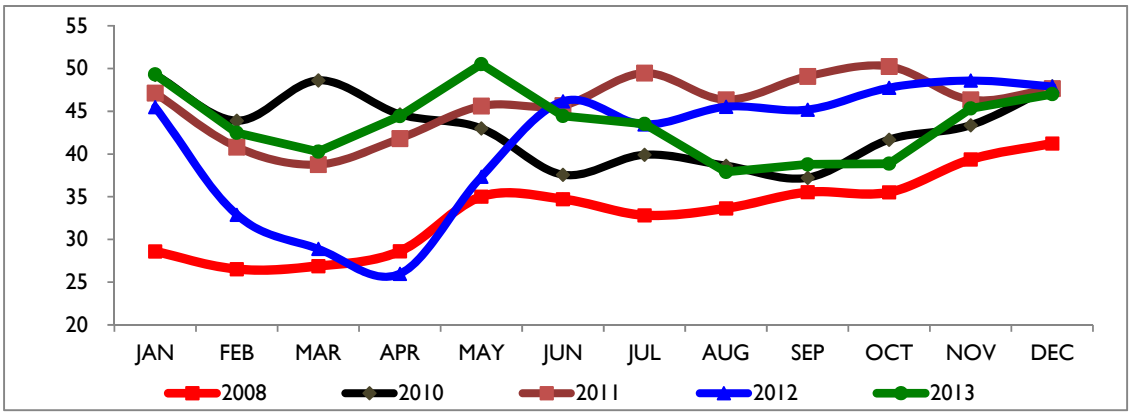
[14] Rongai Dairy Commercial Cooperative Society Ltd

[15] Chepktet Farmers Cooperative Society Ltd

[16] Borabu Dairy Cooperative Society Ltd

the 2012 levels (Fig. 10).[17] Between 2007 and 2013, processed milk constituted an average of 10 percent of total milk production and about 18 percent of total marketed milk (KDB, 2014).

Figure 10: Milk Receipts by Processing Plants (million liters)



Source: Kenya Dairy Board

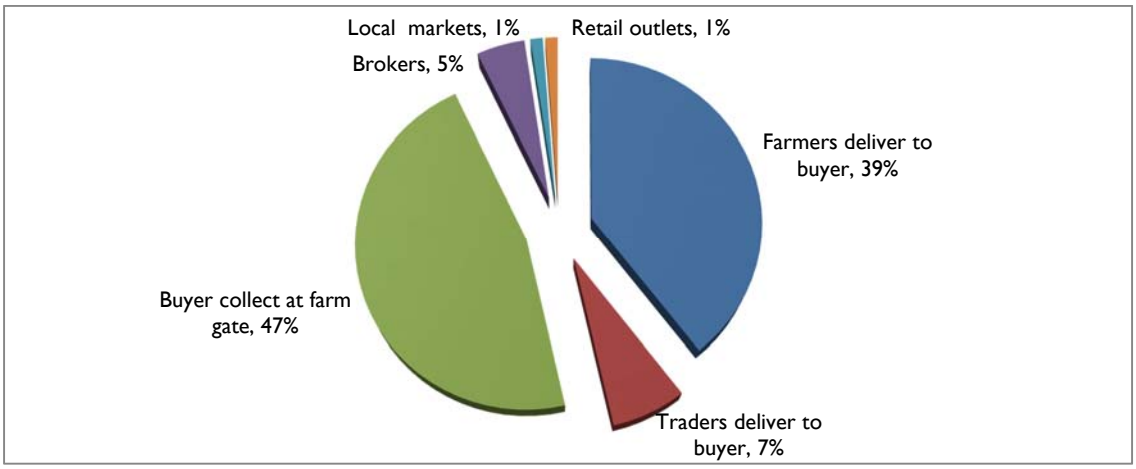
Six large processors dominate the processed milk and dairy products segment of the value chain, namely: Brookside Dairies, New KCC (NKCC), Githunguri Dairies, Sameer Agriculture, Meru Central Coop, and Kinangop Dairies. The processing industry has experienced consolidation recently with a number of high-profile mergers and acquisition. Brookside Dairies bought Spin Knit Dairy (the third largest processor), Ilara Dairies, and Delamere Dairies (Daily Nation, 2013). From these moves, Brookside dislodged NKCC as the milk market leader, with approximately 38 percent of the market. In 2012 Brookside handled 154.6 million liters of milk, compared with NKCC at 84.9 million liters, Githunguri at 67.9 million, and Buzeki at 30.2 million (KDB database). With the acquisition of Buzeki Dairies (the fourth largest processor) in 2013, Brookside increased its market share to at least 45 percent, with NKCC second at 20 percent.

All the processing companies currently operate well below installed capacity, with volumes largely dictated by projected demand of processed milk and not the supply of raw milk. Technoserve (2008) observed that the dairy processing industry in Kenya was operating at 40 percent of installed capacity (the NKCC and Spin Knit at 30-40 percent and Brookside at 60-70 percent). Most processors only purchase the morning milk, especially during the flush period when there is excess supply of milk in the market. The NKCC, Brookside and Sameer Agriculture (through its Uganda subsidiary) currently have the capacity to produce dry skim milk powder.

Processors prefer to buy on credit, usually through formal traders, organized groups or cooling centers, and will always check quality and reject any milk that doesn't meet their standards. Most of the farmers in the USAID-KAVES Rift Valley counties and some counties in the Eastern region supply milk to these processors. Processors do not collect milk from the other target counties due to the scattered and limited production, and associated cost of logistics. Approximately 47 percent of the dairy processors interviewed during USAID-KAVES surveys in 2013 indicated they mainly collect fresh milk from farmers (Figure 11). Additionally, 40 percent of farmers deliver directly to buyers.

[17] KDB website reports 520 million liters, but summing up their monthly intake data falls short of this by over 40 million liters. The KNBS (2014) provisional figures show 523 million liters.

Figure 11: Sources of Milk Supplies to Dairy Processors



Source: USAID Kenya Agricultural Value Chain Enterprises (KAVES), 2013

Expanding markets for processed dairy products (including pasteurized milk, long life milk, cheese, butter, ghee, fermented milk, yoghurt and milk powder) both domestically and for export is critical to increasing the utilization rate of existing processing infrastructure.

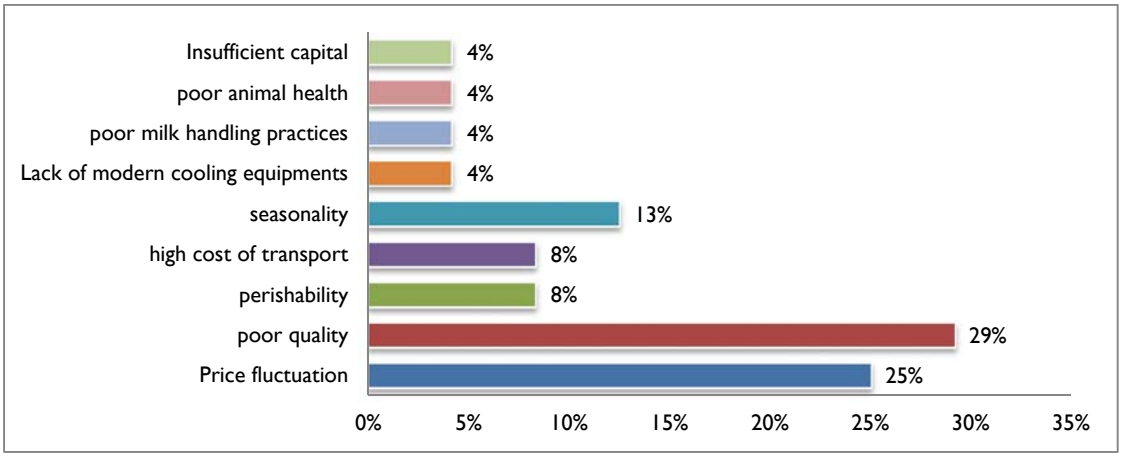
4.3.5 Small-scale Processors

Small-scale processors take milk on contractual arrangements with farmers, but responsible business practices, contract enforcement, and dispute resolution mechanisms in the sector are lacking. Frequent cases of processors violating contract terms with farmers include past due payments and non-collection of milk. Farmers can also violate contract terms frequently by receiving farm inputs on loan but diverting milk deliveries to avoid meeting their loan repayment obligations (MOALF, 2010). However, there are a number of successful examples of small-scale processor groups that have been able to overcome these potential constraints. An exemplary case is the dairy co-operative unions in Meru, Nyeri, Muranga and Kiambu that developed extensive and orderly milk collection infrastructure complete with collection routes, vehicles, sheds, testing, grading and weighing equipment (MOALF, 2010).

4.3.6 Formal Milk Traders

Formal traders purchase milk directly from producers or dairy cooperatives and transport it in aluminum containers and sell either directly to consumers, milk bars or milk processors. They are licensed to trade in milk by KDB and use the recommended transportation and packaging equipment. Their cost structure is straightforward and consistent across buyers, including purchase price at farm-gate, transport cost, KDB levy, council levies and selling price to the cooling plant or processor. USAID-KAVES FGDs with formal milk buyers indicated a number of constraints faced by the buyers, including poor quality of milk, flowing through outdated cooling facilities and treated with subpar handling practices (Fig. 12). Seasonality driven price fluctuation is another key constraint for formal milk buyers.

Figure 12: Key constraints faced by formal milk buyers



Source: USAID Kenya Agricultural Value Chain Enterprises (KAVES), 2013

4.3.7 Milk Dispensers

Most of the milk marketing groups sell raw milk directly to consumers, a practice at odds with KDB rules requiring milk pasteurization. The concept of milk dispensing has emerged as a popular alternative source of milk, providing low-income consumers with quality milk at affordable prices. Milk sold through dispensers is becoming a popular and compliant alternative for consumers in urban areas because it is cheaper than packed milk and pasteurized before being transported to the dispensers. As pasteurizers, milk dispensers can reduce wastage and enhance quality. The majority of dispensers are located in the supermarkets in Nairobi and its suburbs, but the innovation has spread rapidly to private entrepreneurs and farmer groups. The safety of dispensed milk requires greater attention. There is need to identify safety issues and facilitate investments in more dispensing units, especially in small urban areas, to improve producer markets and provide competitive consumer prices.

4.3.8 Transporters

There are three types of milk transporters: i) formal licensed transporters with specially build trucks for milk transportation, ii) licensed transporters/traders who use open trucks but carry milk in authorized aluminum cans, and iii) informal transporters/trades who transport milk using bicycles and motorcycles but using unapproved containers. Hawkers/informal traders who transport milk using banned plastic Jerri cans are prone to arrest, prosecution and/or confiscation of their milk. Milk transportation takes place at two levels: transportation from the farmer to bulking/cooling centers and transportation from bulking/cooling centers to the processor. Either the farmer or a formal/informal trader who bulks the milk undertakes the first level of transport. The challenges at this level of the chain include poor/inappropriate transport systems, such as open trucks and use of plastic Jeri cans and poor road infrastructure. Handling at this level could lead to heavy losses, as bacteria growth could affect the milk due to lack of cooling and also inappropriate containers. Formal transporters and large processing firms undertake the second level of transportation, and this requires specially built trucks with refrigerated tanks to maintain the temperature of the milk at acceptable levels.

4.4 SUMMARY OF FINDINGS

Input Suppliers: Across much of Kenya input suppliers are limited in their ability to provide appropriate services to farmers. Long distances to input provision stores make procurement costly and inconvenient to producers. Additionally, input suppliers have inadequate finance and technical knowledge to effectively serve producers. Intervention projects should target working with agro-dealers to establish mobile services, build the technical capacity of agrovets in providing appropriate

drugs, and support producer groups to provide services such as joint fodder production, and reproduction and animal health services.

Small-scale farmers: There are about 1.8 million dairy households in Kenya with 1-5 cows and supplying more than 80 percent of the total national annual milk consumption. These farmers practice open grazing, semi-zero grazing, and to a limited extent pure zero grazing, with the majority keeping crossbred animals. They sell milk either directly to consumers, through local traders/hawkers, or to dairy cooperatives and producer groups. They face challenges ranging from difficulties in accessing feeds, fodder, and water that lead to poor feeding practices, poor animal reproduction, to fluctuations in milk production. This provides an avenue for interventions to promote proper feeding practices, fodder production and conservation, water harvesting, and support for community-based feed formulation to cut down on feed costs.

Informal milk traders: While informal traders are the single most important marketing actor, controlling over 80 percent of the marketed milk, regulatory issues around quality and milk safety pose considerable constraints. Reliable quality testing is virtually non-existent for direct sales to consumers or to milk bars/hotels/shops and the equipment used for handling and transportation of milk does not satisfy the minimum food safety standards set by industry regulators. Whereas official policy of the Kenya Dairy Board (KDB) is to formalize the informal market segment to ensure quality milk, more practical interventions should work to organize informal traders, build their capacity in food safety and safe milk handling, and help them scale up their operations to serve dairy farmers better.

Milk bulking and cooling centers: Milk bulking centers have emerged as important business hubs for producers, minimizing the cost of collecting milk from small, scattered producers by the major processing firms. While there are an estimated 200 chilling plants in the country, poor management and a lack of proper operations systems lead to prohibitive start-up costs and massive losses. This provides an intervention opportunity to strengthen the governance and managerial capabilities of cooling plant operators and foster public-private partnerships to establish more centers.

Processors: There are 92 dairy processors in the country, about 35 of which are large-scale companies producing a wide range of dairy products. Besides the processors, there are 128 registered mini-dairies and 173 cottage processors. Since the bulk of milk produced is channeled through the 'warm chain' and Kenyan consumers predominantly prefer unprocessed milk, most processing companies are operating well below capacity with volumes dictated largely by fluctuations in demand for processed milk. Expanding markets for processed dairy products both domestically and for export is critical to increasing the utilization rate of existing processing infrastructure.

Milk-dispensing enterprises: The concept of milk dispensing has emerged as a popular alternative source of milk, providing low-income consumers with quality milk at affordable prices. However, its penetration is still limited and the safety of dispensed milk requires greater attention. Dispensers present significant opportunities to develop the dairy value chain but requires interventions to identify safety issues and facilitate investments in more dispensing units, especially in small urban areas and urban lower income classes. This will ensure consumers get a fair price, as well as guaranteeing producers better markets.

5 MARGINS ANALYSIS

In this section we look at gross margins along the value chain. In order to do this, we conducted a rapid rural appraisal (RRA) of rural producers, assemblers, wholesalers and retailers, and used data collected on farmer respondents from the USAID-KAVES Baseline Survey (2013). The surveys considered a number of variables in calculating cost of production for milk, including animal health services, breeding services, cost of labor, and cost of feeding.

5.1 OVERVIEW OF THE MARKETING AND COST STRUCTURE

The Dairy Master Plan (2010) shows that there have been changes in the proportion of milk marketed and consumed at home, including the channels through which milk is sold. While there has been an increase in marketed milk, it is increasingly reaching consumers directly in raw form through informal markets, reflecting the greater market orientation of the smallholder dairy enterprise that dominates production in the country. Raw milk is cheaper than pasteurized milk and this endears itself to the majority of the consumers. The DMP also shows that milk marketed through formal channels has declined from 55 percent in 1990 to about 15 percent, as a result of competition from cheap raw milk.

5.2 FARMERS GROSS MARGINS

Dairy producers in Kenya use either zero grazing, semi-zero grazing or open grazing technologies. Each of the technologies implies different costs for the farmer. For example, costs of feeds and supplements, labor and AI are higher for zero grazing technologies compared with open grazing systems. Studies conducted by various authors on dairy production gross margins show that feeds/salts and labor constitute the highest cost elements in dairy production (SDOL, 2010: p. 38). Focus group discussions conducted in 2013 as part of the USAID-KAVES value chain validation exercise in Bungoma, Uasin Gishu, Kiambu, and Kisii counties found feed and labor accounted for 44 percent and 43 percent of the cost of production, respectively.[18] These results show the cost structure for dairy production has remained almost the same over the last 14 years, with labor and feed constituting the largest cost outlays.

Our analysis of gross margins using the USAID-KAVES baseline data (Table 23) shows dairy farming is profitable, with average gross margins of KSh32 per liter, ranging from a high of KSh38 reported in Kisumu to a low of KSh21 in Uasin Gishu. These are significantly higher than margins of Sh2 per liter for zero-grazing systems and Sh4 for non zero-grazing systems in Kiambu, reported in Wambugu et al. The difference between our margins and Wambugu et al. is largely explained by the differences in sales price. Whereas they observed a price of KSh21 per liter, our observed average producer price was KSh43 per liter, and our average variable cost per liter of KSh11 is not significantly different from theirs (KSh13). The unit cost of production ranges from a low of KSh8.46 in Meru to a high of KSh14.73 in Uasin Gishu, with a median of KSh12.43.

For these dairy enterprises to be viable however, we calculate that each farmer would require about 3 cows to meet annual minimum household consumption expenditures. These would vary from 2 cows in Meru to 4 cows in Uasin Gishu. Gross margins and issues of economic viability for selected counties are further analyzed in Table 24.

[18] Kashangaki (2008) estimated the cost of feed to be 60 percent of the total cost of milk production. In a different study conducted by Tegemeo Institute (2001), feeds and salts constituted 60.3 percent under zero grazing system in Kiambu and only 17.6 percent under a free grazing system in Nandi.

Table 23: Producer gross margins per cow for selected FtF counties

County	Average		Uasin Gishu		Meru		Makueni		Kisumu		Kisii		Bungoma	
Cows (No.)	2		2.3		1.5		2		3		2		2.3	
Daily yield (l/c)	5.2		5.5		7.0		4.8		3.5		5.3		4.8	
Lactation (days)	260		270		270		250		260		260		250	
Annual yield (l/c)	1,345		1,485		1,885		1,208		910		1,386		1,200	
Price per liter	43		36		37		50		50		40		45	
Cost detail:	Amount	% share	Amount	% share	Amount	% share	Amount	% share	Amount	% share	Amount	% share	Amount	% share
Acaricides	1,406	10%	2,394	11%	1,253	8%	3,401	22%	468	4%	499	3%	419	3%
Health services	1,997	14%	1,888	9%	2,408	15%	1,462	9%	1,769	16%	1,806	13%	2,650	17%
De-worming	603	4%	1,083	5%	382	2%	658	4%	219	2%	803	6%	477	3%
Labor	5,717	39%	4,840	22%	6,000	38%	6,310	41%	6,300	57%	3,353	23%	7,500	49%
Grown fodder	1,469	10%	3,221	15%	3,533	22%	-		-		1,228	9%	833	5%
Purchased fodder	1,024	7%	-		-		2,586	17%	-		2,065	14%	1,496	10%
Insemination	1,581	11%	3,560	16%	1,120	7%	645	4%	1,000	9%	1,826	13%	1,337	9%
Vaccination	797	5%	886	4%	1,239	8%	488	3%	1,294	12%	330	2%	547	4%
Other	1,083	7%	4,000	18%	0		0		0		2,500	17%	0	
Total cost	14,596		21,871		15,936		15,549		11,050		14,410		15,258	
Cost per liter	10.85		14.73		8.46		12.88		12.14		10.40		12.72	

Total revenue	57,856	53,460	69730.2	60,375	45,500	55,432	54,000
Total gross margin	43,260	31,589	53,794	44,826	34,450	41,022	38,742
GM per liter	32.15	21.27	28.54	37.12	37.86	29.60	32.28
Number of cows required for minimum household expenditure	2.6	3.6	2.1	2.5	3.3	2.8	2.9

*Source: USAID-KAVES Baseline Survey, 2013. *Based on the average prices reported by farmers interviewed*

Table 24 also shows gross margins for dairy producers in Uasin Gishu, Bungoma and Kisumu counties, where USAID-KAVES conducted RRAs among six selected farmers using different forms of dairy enterprise and keeping different breeds. Gross margins are calculated for milk production, as well as for the entire dairy enterprise, including sales of manure, heifers and culled animals.

Table 24: Detailed gross margin analysis for dairy farm enterprises in three counties

Item	Uasin Gishu (n=6)	Bungoma (n=6)	Kisumu (n=6)	Average (n=18)
Average number of cattle	9	4	3	5
Average number of cows	6	3	2	4
Number of lactating cows	3	1	2	2
Feeding cost (KSh):				
Dairy meal	46,667	20,733	14,217	20,733
Mineral supplements	20,173	9,300	3,203	9,300
Purchased Fodder/Hay	12,167	5,600	11,100	11,100
Own produced fodder	17,433	6,600	7,833	7,833
Water	12,733	1,200	3,000	3,000
Sub-total Feeding Costs	***109,173***	***43,433***	***39,353***	***51,966***
Operational costs (KSh):				
Acaricides	5,520	3,433	3,580	3,580
Deworming & antihelminths	4,467	1,263	3,432	3,432
Vaccinations	1,300	720	5,133	1,300
Veterinary (animal health) services	3,533	2,933	3,983	3,533
Breeding (insemination) services	7,667	717	1,833	1,833
Milking hygiene supplies	2,007	702	1,138	1,138
Cleaning Cloth	2,633	1,633	0	1,633
Sub-total operational costs	***27,127***	***11,401***	***19,099***	***16,449***
Purchase of cows/heifers (KSh)	45,833	7,500	0	17,778
Labor (KSh):				
Hired full time for dairy operations	42,750	27,600	38,000	38,000
Part time for temporary operations	5,500	4,167	6,000	5,500
Sub-total cost of labor	***48,250***	***31,767***	***44,000***	***43,500***
Total Costs (excl. cost of cows)	**184,550**	**86,601**	**102,452**	**111,915**
per head of cattle	20,506	21,650	34,151	20,984
Milk production and sales:				
Milk produced (lts)	10,851	5,311	6,411	6,411
Yield per cow (lts)	*1,809*	*1,770*	*3,206*	1,748
Yield per lactating cow (lts)	*3,617*	*5,311*	*3,206*	3,617
Milk consumed at home (lts/year)	1,680	2,171	487	1,680
Total milk fed to calves (lts/year)	2,353	492	913	913
Total spoiled milk (lts)	1,119	168	0	168
Total milk sales (lts)	5,699	2,480	5,011	5,011
Average milk sales price (KSh/lt)	38	46	61	46
Production cost per liter	***17.01***	***16.31***	***15.98***	***17.46***
Sale of culling animals (KSh)	41,667	13,167	24,667	24,667
Sale of manure (KSh)		1,400	8,900	5,150
Value of milk sales (KSh)	216,562	114,080	305,671	230,506
Value of home consumption (KSh)	38,010	59,455	27,533	69,086
Value of lost milk	42,522	7,728	0	20,735

Total milk revenue (KSh):	254,572	173,535	333,204	299,592
per cow	*42,429*	*57,845*	*166,602*	*81,707*
Total value of milk production	297,094	181,263	333,204	307,320
Total milk revenue (sales + home)	254,572	173,535	333,204	253,770
Total farm sales revenue (sales + home + animals + manure)	296,239	188,102	366,771	283,704
Gross margin for the farm enterprise	111,689	101,501	264,319	171,789
Gross margin from milk only	70,022	86,934	230,752	141,855
Gross margin for milk sales only	32,012	27,479	203,219	118,591
GM per cow	*11,670*	*28,978*	*115,376*	46,852
Enterprise GM %	38%	54%	72%	61%
GM from milk as % of milk value	28%	50%	69%	56%
% Milk losses	14%	4%	0%	3%
Number of cows required for minimum household consumption expenditure	***6.1***	***3.4***	***0.9***	***2.4***

Source: USAID-KAVES estimates from purposive RRA data for 2013 production cycle

The results show dairy farmers in this sample spent an average KSh17.46 to produce a liter of milk, with labor and feed costs accounting for about 84.2 percent (feed 50.1 percent, labor 34.1 percent) of the average total production cost. **Given near-stagnant real producer prices, effort to increase returns should be directed at reducing the cost of feed and labor.** In terms of profitability, dairy farmers in the sample earned an average KSh171789 in gross margins from the enterprise; equivalent to 56 percent of total value of production. Kisumu farmers are responsible for the relatively high average margin; they earned the highest margins at 72 percent. When gross margins are computed on the value of milk alone, the average gross margin is KSh141855 (51 percent); milk sales alone generated about KSh118591 (41 percent). These results largely mirror those obtained from the USAID-KAVES baseline survey analysis in Table 23.

An important determinant of profitability of dairy enterprises is the level of milk losses. The median milk losses for the sampled farmers amounted to 3 percent of the total milk output, and ranged from none in Kisumu to 14 percent in Uasin Gishu. This is in line with the national average milk losses reported in preceding sections of this report, where farm level losses amounted to about 5.7 percent. The effect of milk losses on returns is partly evident in the better gross margins reported by Kisumu farmers, compared to Uasin Gishu, for example. While Kisumu dairy farmers lost no revenue because of milk losses, Uasin Gishu farmers lost about KSh43000 in revenue from the milk lost. Had they reduced losses to the levels obtained in Bungoma, dairy farmers in Uasin Gishu would have earned an additional KSh35000 from milk. **Reducing milk losses is therefore critical to increasing farmer returns.**

As an income-generating activity, the average dairy enterprise in this sample easily meets the minimum annual consumption expenditure requirements of individual rural households (KSh114000 for 5 people). **To be economically viable, an average dairy-farming household requires at least three cows to meet the minimum expenditure requirements, ranging from one cow in Kisumu to 6 cows in Uasin Gishu.** This translates to a dairy herd of about four animals, on average.

5.3 BULKING/CHILLING CENTER MARGINS

As part of this analysis, USAID-KAVES collected gross margin analysis for various chilling center operations across purposively selected and representative FTF counties. This analysis indicates that a majority of centers are barely breaking even, with high cost of labor and other operational expenses identified as the main challenge (Table 25).

Table 25: Monthly Gross Margins for Bulking and Cooling Plants in Selected FTF Counties

County		Uasin Gishu				Bungoma	
Sub-County	Wareng	Wareng		Moiben		Bungoma North	
Name of Bulking Plant	*Plant 1*	*Plant 2*		*Plant 3*		*Plant 1*	
	Amount	%	Amount	%	Amount	%	Amount	%
Milk handled (lts)	7,221		131,714		12,853		73,000	
Milk spoiled (lts)	*180*	*1*	*1,500*	*1*	*1,500*	*5*	*250*	*0.2*
Purchase price per liter (KSh)	28		35		34		33	
Cost (KSh):								
Electricity	10,000	18	35,000	13	10,000	11	9,000	9
Water	1,500	3	16,000	6	3,000	3	-	0
Labor	16,500	29	160,000	59	21,000	23	35,000	34
Cleaning	2,500	4	10,000	4	5,000	6	1,200	1
Laboratory services	1,000	2	18,000	7	1,500	2	5,000	5
Equipment maintenance	10,000	18	7,000	3	4,500	5	-	0
Management	5,000	9	15,000	6	15,000	17	5,000	5
Transport to the cooler, if applicable	-	0		0		0	40,000	39
Licenses, fees and levies	8,300	15	8,000	3	5,600	6	6,550	6
Manager's license	2,100	4	2,100	1	2,100	2	1,500	1
Vehicles O&M	0		0		23,000		0	
Total variable cost	***259,088***		***4,881,090***		***90,734***		***2,512,250***	
Sales price to processor (KSh)	39		39		40		34	
Total sales revenue (KSh)	**274,599**		**5,078,346**		**329,237**		**2,473,500**	
Gross margin	**15,511**		**197,256**		**238,503**		**(38,750)**	

Source: USAID-KAVES, 2013

Table 25 cnt'd

County	Meru		Machakos				Makueni			
Sub-County	South Imenti		Mwala		Mwala		Kathonzweni		Mbooni	
Name of Plant	*Plant 1*		*Plant 1*		*Plant 2*		*Plant 1*		*Plant2*	
	Amount	*%*	*Amount*	*%*	*Amount*	*%*	*Amount*	*%*	*Amount*	*%*
Milk handled (lts)	56,547		35,330		45,000		19,821		26,036	
Milk spoiled (lts)	*505*	*1*	*200*	*1*	*120*	*0.3*	*100*	*1*	*63*	*0.2*
Purchase price per liter (KSh)	31		40		33		42		42	
Cost (KSh):										
Electricity	25,000	8	20,000	6	26,000	5	17,000	21	4,000	3
Water	5,000	2	-	0	12,000	2	6,766	8	4,000	3
Labor	35,000	11	120,000	38	130,000	25	40,581	50	75,000	49
Cleaning			1,500	0	6,500	1	1,238	2	7,000	5
Laboratory services			1,500	0	14,000	3	-	0	10,000	7
Equipment maintenance			5,000	2	5,000	1	3,333	4	30,000	20
Management	116,700	36	10,000	3	22,000	4	3,436	4	6,000	4
Transport to the cooler, if applicable	135,350	41	0	0	0	0	0	0	5,600	4
Transport to processor, if applicable			150,000	48	268,000	52	20,627	25	-	0
Licenses, fees and levies	9,300	3	4,383	1	26,997	5	8,853	11	11,615	8
Manager's license	2,100	1	0	0	0	0	0	0	0	0
Total variable costs	***2,081,407***		***1,725,583***		***1,995,497***		***934,316***		***1,251,934***	
Sales price per liter	34		50		46		59		48	
Total sales revenue	**2,018,522**		**1,756,500**		**2,064,480**		**1,163,539**		**1,246,704**	
Gross margin	**(62,885)**		**30,917**		**68,983**		**229,223**		**(5,230)**	

Source: USAID Kenya Agricultural Value Chain Enterprises (KAVES), 2013

Three of the analyzed chilling centers, for example, had negative gross margins for operations in January through November 2013. These centers had high operational expenses, including labor, transport, and management expenses, pointing to potential weaknesses in management. The cost of collecting and transporting milk is particularly significant. Maina et al (2011) and Kashangaki (2008) estimate transport cost at Sh2 per liter and Sh3 per liter to bulking/cooling centers and from bulking/cooling centers to processing centers, respectively. The high cost of transport to bulking centers is partially explained by low economies of scale and poor feeder roads. Other factors contributing to negative margins of the centers include very thin mark-ups charged on collected milk. Our analysis show the price margin was only KSh1 per liter, on average, which is hardly enough to cover the cost of running the centers. The reasons behind these thin margins are unclear and thus require further analysis.

5.4 MARGIN ANALYSIS FOR MILK DISPENSERS

USAID-KAVES interviewed four milk-dispensing points in Nairobi and its suburbs to estimate the gross margins. The firms interviewed included: Firm 1 (Thigiri Ridge), Firm 2 (Kitengela), Firm 3 (Kangemi), and Firm 4 (Nairobi West). Gross margin analysis shows milk dispensing is a profitable business (see Table 26). For example, one of the dispensers had a gross margin of KSh15.74 per liter (22.5 percent), while the lowest margin found was KSh5.67 (8.7 percent). Firm 4 posted the highest gross margin (26 percent) due to a significantly lower purchase price for its milk. The technology is not only profitable, but also offers lower prices to consumers compared to processed (packaged) milk; the price differential is between KSh10 and KSh26 per liter.

Table 26: Gross Margins Analysis for Milk Dispensing Enterprises (per month)

	Firm 1	Firm 2	Firm 3	Firm 4
Milk volume (liters)	10,500	29,275	4,500	24,544
Cost (KSh):				
Purchase price per liter	53	55	55	39
Labor	12,000	12,000	8,000	20,000
Rent			10,000	
Electricity	450	1000	500	
Lab services			80	1000
Cleaning	100	200	100	100
License fees	716	716	716	11,000
Maintenance		1000	100	3000
Sales price per liter	70	69	65	54
Total cost of milk	***556,500***	***1,610,125***	***247,500***	***957,216***
Total variable cost	***569,766***	***1,625,041***	***266,996***	***992,316***
Total sales revenue	735,000	2,019,975	292,500	1,325,376
Gross margin	165,234	394,934	25,905	333,060
GM per liter	15.74	13.49	5.67	14.00
GM %	22.5%	19.6%	8.7%	25.9%

Source: USAID-KAVES analysis of field data

5.5 INFORMAL MILK MARKETS AND TRADERS

Informal milk markets function effectively and provide substantial opportunities for profit. The main costs to informal traders include the cost of milk and transport (this is mainly through bicycles and now trader-owned motor cycles). Traders may also incur other costs such as milk loss (if caught by the KDB) and spoilage. They operate on small volumes and thin margins of between 10-20 percent. The margins are higher in areas with milk supply deficits and lower in surplus areas.

5.6 SUMMARY OF FINDINGS

Using KAVES baseline data and sample data from milk bulking and dispensing enterprises collected in December 2013, this report estimates that dairy farmers received the highest share of the final price, at 35 percent, followed by milk dispensers at 33 percent. **The results show dairy farmers in this sample spent an average KSh17.46 to produce a liter of milk, with labor and feed costs accounting for over 84 percent of the average total production cost. Analysis of gross margins shows dairy farming is profitable, with margins as high as KSh32 per liter, ranging from a low of KSh21 in Uasin Gishu to KSh38 in Kisumu.**

Dairy farmers earned an average KSh171789 in gross margins from the dairy enterprise; equivalent to 56 percent of total value of production. As an income-generating activity, the average dairy enterprise easily meets the minimum annual consumption expenditure requirements of individual rural households. **To be economically viable, however, an average dairy farmer requires at least three cows to meet the minimum expenditure requirements, ranging from one cow in Kisumu to 6 cows in Uasin Gishu.** This translates to a dairy herd of about four animals, on average. Along the value chain, milk producers realized 56 percent margins per liter of milk, bulking centers 15 percent, traders 10-20 percent, and dispensers 30 percent.

6 ENABLING ENVIRONMENT

6.1 INSTITUTIONAL ACTORS AND SUPPORTING ORGANIZATIONS

Kenya's institutions, especially farmers' and traders' associations and public institutions, are not adequately developed to provide effective support to the milk value chain. Public regulatory institutions are weak because of limited resources. Their ability to regulate and enforce quality standards is limited. The legal institutions regulating rural commerce are weak, thus making for less efficient markets. Difficulties in contract enforcement pose a major problem through the value chain and have specifically hindered the growth of contract farming, where produce "poaching" is common.

6.1.1 Implementing Institutions

Kenya has several ministries handling agriculture-related issues, including the State Departments of Agriculture, Livestock, Lands, Environment and Mineral Resources, and Devolution and National Planning, among others. The Agricultural Sector Coordination Unit (ASCU) and the National Stakeholder Forum play a crucial inter-ministerial role in formulating milk-related policies in consultation with various stakeholders. The Ministry of Livestock is the apex body for regulation, policy formulation, and policy coordination. It also provides most of the extension and training services. It also generates market information through the Agricultural Information Resource Center (AIRC).

The Kenya Dairy Board (KDB) is the government agency with the mandate to develop and regulate the dairy sector. A recent report by SNV (2013) highlights technical and financial constraints to the effective functioning of KDB. In addition, role of the KDB to both participate in and regulate the sector was highlighted as a major constraint to achieving its mandate.

6.1.2 Private Sector Associations

There are a number of producers associations in the dairy sector, including the Kenya Livestock Breeders Organization (KLBO), Kenya Dairy Producers Organization (KENDAPO), Kenya National Federation of Agricultural Producers (KENFAP), and the Kenya Dairy Farmers Federation (KDFF). The Kenya Dairy Processors Association (KDPA) is the apex body representing dairy processors, while the Dairy Traders Association (DTA) represents dairy traders. The Association of Kenya Animal Feed Manufactures (AKFEMA) coordinates and promotes self-regulation in feeds quality.

Overall, the institutional capacity of the industry associations is weak. These organizations are not proactive in contributing a vision for the development of the sector and there is a need to rationalize these producers associations to be more effective advocates of the sector (SNV, 2013).

6.1.3. Research, Extension, and Information Institutions

Kenya has one of the most developed networks of public and private milk research institutions in Africa, with several public and donor-funded national and multinational breeding and research programs. ILRI, KALRO, KEVEVAPI and SDOL are presently the main players in research and technology transfer for the dairy industry and work closely with other organizations in the sector:

- *Kenya Agriculture Research Institute (KALRO)* – responsible for research and breed improvement.
- Local universities and colleges, mostly Egerton University and the University of Nairobi – research on animal breeding and health, animal feeding and nutrition, and training in animal husbandry and farm management.
- *International Livestock Research Institute (ILRI)* – livestock production systems, dairy policy and value chain analysis.
- *Kenya Veterinary Vaccines Production Institute (KEVEVAPI)* – research and production of veterinary vaccines and diagnostic kits for various existing and emerging livestock diseases.
- *The Kenya Livestock Breeders Organization (KLBO)* is a body of animal breeders in Kenya under the Agricultural Society of Kenya whose major function includes, livestock registration through the Kenya Stud Book and maintenance of central database of registered stock, (ii) performance recording of registered stock, and (iii) extension services.

- *The Kenya Livestock Producers Association (KLPA),* formed in 2004, is a body that represents livestock producers in the country. Its main activities include lobbying for policy and advocacy on livestock related issues, promotion of livestock production and their products, drought mitigation and early warning systems, and support for registration and upgrading of breeds.
- Private agribusiness companies, including dairy processors, regional centers for multinationals – foreign breeding supplies companies, and agrovets are engaged in limited research and extension.

Technology transfer to smallholders has been slow, particularly in the customization, promotion, and adoption of animal breeds appropriate for different ecological conditions. The provision of dairy extension services remains woefully poor. In Central Kenya, for example, Kimenchu et al. found only 33 percent of the sampled dairy farmers obtained any form of extension service, mostly public livestock extension officers. The authors estimated the farmer to extension provider ratio at 1:4000, which is extremely low by recommended minimum standards. Since Central Kenya is among the leading dairy regions in Kenya, a majority of dairy farmers across the country do not have access to extension services. Major milk processors, such as NKCC and Brookside, provide some extension services but their reach remains limited.

6.1.4 Financial Service Providers

Providers of finance, accounting and business development skills, insurance, quality testing/certification play a critical role in the development of the dairy value chain. Linkages to these providers and the capacity to engage with them is lacking for most of the smallholder dairy farmers in USAID-KAVES target counties.

It is estimated that 36 percent of rural Kenyans have no access to any form of financial services. High risks connected to drought, floods and the inability of small scale farmers to provide collateral for their loans have resulted in farmers getting the lowest levels of credit compared to other sectors in the economy. There are a number of Micro-finance Institutions and SACCOs, banks, and insurance companies providing various support services to dairy farmers and other value chain actors. Farmers, however, are often not aware of the agricultural loans available to them. The Program for Rural Outreach of Financial Innovations and Technologies (PROFIT), funded by IFAD, aims to deepen financial access to small-scale farmers. The facility has two main components, rural financial outreach (risk sharing, credit facility and innovation facility) and technical assistance (business support services and financial graduation). The credit facilities are available through deposit taking micro finance institutions and banks, such as Barclays, Cooperative, K-Rep, AFC, KWFT, Faulu, Rafiki, and SMEP. Additionally, Juhudi Kilimo, a micro finance institution officers dairy farmers credit facilities backed with insurance cover to purchase dairy animals with a three month grace period.

There are banks that have facilities for the small-scale farmers and advise them on various ways of investing in their farms. Some of the financial services available to livestock farmers include:[19]

- *Kenya Livestock Finance Trust (K-Lift)* is a microfinance institution that offers credit to farmers and businesses in the livestock sector up to a maximum of Sh1.2 million upon payment of Sh250 application fee, completing a business proposal, and presenting collateral or securities.

- *Equity Bank:* Supports all categories of farming activities through the provision of financing for agricultural inputs and equipment at affordable interest rates. Although requirements in terms of security and payments are flexible, it is only available to account holders. The bank also offers various products with varying lending amounts and repayment periods depending on the farmers needs.

- *Family Bank:* The bank runs a Dairy Products loan facility designed for dairy farming. One must maintain an account with the bank to qualify for a loan. Other conditions include the farmer delivering milk to known milk processors only. The amount of milk delivered determines the

[19]See http://www.livestockkenya.com/index.php/livestock-development/294-some-credit-facilities-available-to-livestock-farmers-in-kenya, accessed January 26, 2014

amount of loan a farmer can get. It can advance up to Sh100000 unsecured, to be paid within a year.

- *Agricultural Finance Corporation (AFC)*: Provides loans to individuals or groups involved in agricultural activities. In livestock they finance dairy and beef production, sheep and goat production, beekeeping, piggery, poultry and fish production. Repayment period ranges from 2 to 5 years, and farmers must provide collateral and present a viable business proposal.

- *Faulu Kenya:* has a product called "Ufugaji Bora" meant for livestock farmers. Farmers can use this loan to purchase dairy cows, animal feeds and expand dairy farming. They also offer training to livestock farmers.

- *Kenya Women Finance Trust: The Kenya Women Finance Trust (KWFT)* has a livestock loan product designed for rural women to start or improve dairy farming. Animals are identified by the women and inspected by veterinary personnel and KWFT team. If cleared, Jubilee Insurance insures the animal and KWFT pays. Other aspects of livestock financing covered by KWFT are purchasing goats and acquisition of biogas digesters.

- *Brookside Dairy Ltd:* Supplies farm inputs and animal feeds on credit to dairy farmers, and also run a farmers loan facility through the Kenya Commercial Bank.

- *New Kenya Cooperative Creameries (NKCC):* With Mobipay, operates AGrilife platform enabling 11 financial institutions to provide credit and services to value chain players working with NKCC suppliers.

- *Jamii Bora Bank:* Operates banking solutions specially tailored for the agribusiness sector, including farmer accounts and loans. The facilities include the Dairy Herd Improvement Loan (KSh100000 to KSh5 million for up to three years), available to small and medium scale farmers to purchase improved dairy breeds.

6.2 REGULATORY AND POLICY FRAMEWORK[20]

Milk safety is enforced through food safety standards and regulations, principally governed by the Dairy Industry Act (CAP 336) and the Public Health Act (CAP 242). However a number of other laws and regulations affect dairy activities and milk trading. Regulations include certification, licensing, permits and authorization. CAP 336 gives the Minister in charge of the dairy industry powers to provide for regulation. CAP 242 also empowers the Minister in charge of public health to regulate the dairy industry to ensure health safety from the consumption of dairy products. It is required that primary producers are registered, permits are obtained for conveying or transporting milk from one point to another, licenses are obtained for the sale of milk and dairy products, the equipment used is of specified materials and standards, premises for milk sales are certified by public health officials, the people handling milk meet public health requirements, and dairy managers are licensed after meeting specific education standards. There are charges for the various permits and licenses, and a cess (levy) is charged on all marketed milk.

Milk quality and health standards follow the EAC quality specifications. There are more than 20 standards for milk and dairy products in Kenya, and efforts are being made to harmonize standards across the East Africa, COMESA, and SADC regions (Trademark, 2013). The institutional and regulatory framework governing the supply of dairy inputs and service provision is almost nonexistent, leaving dairy farmers vulnerable to unscrupulous market actors including animal feeds providers.

[20] Five Acts and Bills related to agriculture are pending before Parliament. They include: (a) Agriculture, Fisheries and Food Authority (AFFA) Act (No. 13 of 2013) that commenced on 25th January 2013; (b) Kenya Agricultural and Livestock Research Act (No 17 of 2013); (c) Pyrethrum Act (No. 22 of 2012); (d) Crops Act (No. 16 of 2013); and, (e) The Kenya Plant Health Inspectorate Service Bill, 2011. All these laws remain contentious and currently under review.

6.2.1 Policy Regime

At the national level, some of the agricultural sector policy reforms and interventions relevant to the dairy sector include the following: Agricultural Sector Development Strategy (2010-2020), the National Agriculture Sector Extension Policy (NASEP), National Agricultural Research System Policy, and the National Agribusiness Strategy. A review of these policies is covered in more detail in the USAID-KAVES Maize Value Chain Report of 2014.

The primary policy document for the dairy sector is the National Dairy Master Plan (DMP), 2010. The DMP provides the overarching policy framework for transforming the dairy sector. Its vision is to "*transform milk production and trade into an innovative, commercially oriented and globally competitive dairy value chain by 2030*". The primary objectives of the plan are to improve productivity and competitiveness, improve small-scale producer livelihoods, increase domestic consumption, increase processing of long life dairy products and transform the industry into a net exporter. In addition, the National Livestock Policy (2008 – draft) and the Livestock Development Bill (2008) are policy reforms related to livestock. These reforms aim to improve existing breeds, establish a coordination mechanism for self-sustaining breeding programs, regulated breeding services, diversify the feed base, and strengthen the livestock and extension services (SNV, 2013)

According to a study of dairy sector policy by SNV (2013), implementation of both the DMP and the National Livestock Policy has been constrained by limited funding and technical resources. Additionally, the devolution of the agricultural sector in line with the New Kenya constitution further compounds the problem of implementation according to KAVES observations.

Dairy policy and regulations are mainly implemented through the KDB. Others are the state Department of Livestock, the Ministry of Health and the Kenya Bureau of Standards. To date, most KDB actions have tended to protect the interests of large-scale processors; despite the fact informal milk marketing remains the dominant marketing channel handling over 80 percent of marketed milk. As a result, bureaucratic pressures, as well as commercial and political biases, have threatened informal trade. In 2004, there was a policy to support small-scale milk traders and KDB licensed over 4,000 traders who sell raw milk through milk bars. However, in a circular issued by the KDB in January 2013 citing public health safety concerns, traders were required to only trade in processed milk and milk hawking was banned. Most of the traders in the USAID-KAVES target counties sell raw milk. This policy is therefore a major hindrance to dairy development in these counties, unless measures are put in place to address the quality and safety concerns raised by KDB.

6.2.2 Devolution of Agricultural Policy

Emerging county agriculture policies and regulations will significantly reshape Kenya's livestock policy regime.[21] The devolved units entail the reorganization of the agriculture sector, particularly in the areas of extension and education, inputs marketing policies, and production support strategies. County agriculture and business policies and regulations will significantly reshape Kenya's agricultural policy regime. Of specific importance will be production and marketing levies already being proposed across the country. The impact of these policies will vary depending on whether a county is a net producer or net consumer of potatoes.

The legal framework consists of the County Government Act of 2012 and the Public Financial Management Act (2012). These call for the preparation of County Integrated Development Plans (CIDPs). The CIDPs must be aligned to the Kenya Vision 2030 and the second MTP 2013-2017 to align County development with National goals. County government policies/strategies, institutions, levies

[21] Five Acts and Bills on devolution related to agriculture are either operational or pending before Parliament. The two new laws most relevant to dairy development are: (1) the Agriculture, Fisheries and Food Authority Act (No. 13 of 2013) that commenced on 17th January, 2014 and created the Agriculture, Fisheries and Food Authority (AFFA); (2) Kenya Agricultural and Livestock Research Act (No 17 of 2013), which commenced in January 2013 and created KALRO as the successor to the Kenya Agricultural Research Institute (KARI), the Kenya Marine and Fisheries Research Institute (KEMFRI), the Kenya Trypanosomiasis Research Institute (KETRI), the Kenya Forestry Research Institute (KEFRI), the Coffee Research Foundation, the Tea Research Foundation of Kenya, the Kenya Sugar Research Foundation (KESREF), and all livestock research institutes.

and taxes, priority value chains and facilitation of value chain actors must be understood within the broad legal framework established to support county governments.

The potential effect of devolution on the dairy industry is not yet clear, especially with respect to County government policies/strategies, regulations, and institutions, and concurrence of county priorities and goals with those of the central government. A number of functions formerly in the domain of the Ministries or state corporations have now been devolved per the constitution. In practice, however, the impact of some policy reforms and their implementation and coordination arrangements[22] remain unclear. There is a growing concern among traders and agricultural officers that the charges are higher than the margins generated from commodity sales, and the multiplicity of governing, licensing, and regulatory bodies affecting medium to large scale investors are likely to pose major impediments to investment.

6.2.3 Price Control and Taxation

The Price Control (Essential Goods) Act No. 26 of 2011, an Act of Parliament, commenced on 19th September 2011 and aims to provide regulation of the prices of essential commodities in order to secure their availability at reasonable prices. The Minister from time to time may determine the maximum prices of the commodities with consultation with the industry. However, the list of the prices for the essential commodities was never announced. In addition, the Consumer Protection Act of 2012 came into force on March 14, 2013 and provides for punishment of businesses that knowingly sell sub-standard goods and lie on pricing, prohibits the use of misleading information to sell goods and services. With outstanding issues of quality and market malpractices, these two statutes are particularly relevant to milk and milk products marketing.

Under the new Value Added Tax Act of 2013 (CAP 476) that commenced in September 2013, the supply or importation of milk (unprocessed and infant formula), animal breeding material (semen), animal health and veterinary products and services, and agricultural and animal husbandry services are classified as exempt from tax. Maina (2013) analyzes the differences between exempt and zero-rated status, and concludes that the difference in the price of exempted supplies are no different from those charged 16 percent VAT. This is a result of the fact that businesses supplying exempted goods/services have no mechanism to claim back input VAT, which then must be converted into a cost, while those under the 16 percent VAT category do.

Reclassifying dairy services and inputs as exempt makes them more expensive. The biggest hit will come from increased cost of other services such as transportation and distribution, which are not exempt. The dairy sector, being heavily dependent on transportation and distribution, will most likely suffer higher cost of operations. The 16 percent VAT on distribution will increase the cost of production inputs, transportation costs, and ultimately milk prices. Since the cost of raw milk constitutes 75-90 percent of the cost of milk products, milk bulking and cooling plants, dispensers and milk bars, and processors costs will rise, which will be transferred to consumers in the form of higher milk prices. Informal mobile traders will however become more competitive.

6.2.4 Trade Regulation

The following regulations govern regional cross border trade (MOALF, 2012):

- *Import duty*: goods from EAC member states are exempted from import duties.
- *Import Declaration Form (IDF)*: pegged at 2.75 percent of the value of all imported products.
- *Certificate of Origin* to show the commodity is from the EAC to qualify for tax exemption.
- *Certificate of Conformity (CoC)* – applicable for commodities from outside the EAC.
- *Import and export application and permit*: issued by KDB at Ksh1,600
- *No objection permit*: issued by the Department of Veterinary Services at Ksh1000
- *Import levy payable*: due to KDB by non-EAC partner states at the rate of 7 percent CIF

[22] Information on the implementation and coordination arrangements under the devolution policy, based on rapid appraisal surveys, is included in the USAID-KAVES Maize Value Chain report (2014)

- *Import duty: 60 percent for select dairy products from non-EAC countries, among them milk powder and liquid white milk, and* 25 percent for butter, cheese, and fermented milk

Tariff Reduction: The East African Community Customs Union (EAC/CU) was officially launched in July 2009 to increase competition, expand markets, ease cross border trade through harmonization of national trade policies, and enhance trade by removal of tariff and non-tariff barriers (NTBs). Imports from the East African Community (EAC) are free of duty and subject only to regulatory fees and levies according to the respective trade protocols. The impact of the CU on trade in dairy, however, is negligible because regional trade in most agricultural products was already zero-rated under EAC and COMESA protocols.

Technical Barriers to Trade (TBT): With the steady elimination of tariffs, technical requirements are increasingly becoming the biggest impediment to trade in agricultural products. This includes sanitary and phytosanitary measures (SPS) and standards. To address these emerging concerns, EAC standards for processing of milk and handling of fresh milk have been developed and are operational. Under Article 81 of the EAC Treaty, the Partner States recognized the importance of standardization, quality assurance, metrology and testing for the promotion of trade and investment and consumer protection. The EAC partner states enacted the East African Standardization, Quality Assurance, Metrology and Test Act 2006 (EAC SQMT Act 2006) to harmonize requirements on quality of products and services and reduce trade barriers. The SQMT Act regulates trade in products produced or originating in a third country to facilitate industrial development and trade as well as promote health and safety and environmental protection. The EAC partner states have also agreed on the following:

- Facilitate trade by simplifying, standardizing and harmonizing trade information/documentation.
- Anti-dumping measures elaborated in the EAC/CU Protocol.
- Competition policy and law is being implemented to deter trade-distorting practices.
- Re-exports are exempted from the payment of import or export duties.
- Agreements to removal all existing NTBs and not introduce new ones, under Article 13 of the EAC/CU.

Non-Tariff Trade Barriers (NTBs): Several NTBs persist despite concerted efforts aimed at fast-tracking customs unions. The NTBs comprise a wide range of trade policy practices applied by governments, whose main aim is usually to restrict trade flows in order to achieve specific objectives such as protection of infant industry, reduction in domestic supply of a staple foodstuff or consumer protection. NTBs can arise from unofficial actions of public officials (due to inefficiency or corruption in administration of customs duties) or from the state of technology (e.g. inability to innovate in terms of telecommunication and management and information systems) or simply due to poor roads and marketing infrastructure. The existence of NTBs have undermined efforts to free trade and is proving a major challenge for policy makers and small traders, who often suffer high transactions costs and reduced gains from trade. Some of the typical NTBs affecting cross border traders include:

- *Physical infrastructure:* Poor road network impose high costs on traders and transporters in terms of delays and breakdown of trucks. It also limits entry by potential service providers, and thus encourages monopolistic tendencies.
- *Non-tariff fees and taxes:* The various agencies in charge of trade levy various fees on agricultural products. These include VAT, warehousing fees, commodity/institution specific development levies (e.g. roads, rail, County governments and Kenya Airports Authority in Kenya). Several unofficial fees are corruptly paid to government officials in the form of "goodwill". Additionally, administrative procedures related to trade regulation constitute impediments to trade.
- *Insecurity and movement restrictions:* Despite efforts by COMESA to harmonize transit trade requirements, border security officials still restrict movement of goods and people across-borders. Local regulations and culturally motivated discrimination restrict non-nationals from engaging in trading activities in the local markets, or make it expensive for foreigners to open new businesses. Examples include: insecurity along the Kenya/Ethiopia and Uganda/South Sudan borders, with traders especially from Uganda experiencing harassment from South Sudanese customs and immigration officials; and roadblocks mounted along the highways for various reasons. Kenya and Uganda have

the highest number of roadblocks in the region. For example, for every 190-km distance, Kenya erects ten roadblocks and Uganda 14, while Tanzania has only 5 roadblocks for an average distance of 278 km.

6.3 INFRASTRUCTURE

By virtue of its bulkiness and high perishability, the quality of storage and transport infrastructure, including cooling (chilling and refrigeration), roads, rail and port facilities, are major price and quality determinants in the milk industry. Most Kenyan dairy smallholders are inadequately served by such facilities. The state of Kenya infrastructure is analyzed in detailed in the USAID-KAVES maize value chain analysis report of 2014.

6.3.1 Transport Infrastructure

Road infrastructure has an important influence on the returns to smallholder dairy production, especially in the informal market that dominates the dairy subsector. Farmers far from large demand centers tend to receive lower returns for milk than those closer to the demand centers. For instance, farmers 75 kilometers or more from Nairobi get 22 percent less for their milk, on average, than farmers close to the city. Each additional kilometer of poor access road to the main road reduces milk price by some 0.50 shillings per liter, or about 3 percent per kilometer. Importantly, the impact of road infrastructure becomes more significant during the rainy seasons, when heavy rains and flooding render most access roads impassable. This greatly affects the prices offered to farmers and the cost of delivering milk off the farm.

6.3.2 Electricity

Kenya does not generate enough electricity to meet demand, and the national monopoly, Kenya Power fails to distribute the available electricity efficiently. National electric grid coverage remains woefully low, power shortages and outages are the norm, and electricity is too expensive for most households and businesses. The Kenya Rural Electrification Program was supposed to alleviate some of these bottlenecks but, due to financial constraints and inefficient power distributors, progress has been slow. Without adequate and reliable electric power, primary milk processing, storage and value addition in most rural areas will remain difficult and expensive. In addition, lack of reliable electricity makes the storage and preservation of animal health (medicine, vaccines, etc.) and breeding (semen) supplies more expensive to service providers.

6.3.3 Storage Facilities

Rural milk storage (cooling) and pasteurization facilities are largely nonexistent. Milk produced by smallholders must be disposed of immediately to avoid losses through spoilage. Installed bulking and cooling capacity is inadequate, with a cooler installed capacity of 2.7 million liters against a daily production of 14.2 million liters. The level of utilization is fairly good at 95 percent. Those not currently being utilized have challenges of breakdowns, and inaccessibility to most smallholders. Given the poor infrastructure and high cost of installation and operation, the additional cost of bulking and cooling milk makes it unattractive to most smallholders in the price-competitive market.

Overall, the poor state of storage facilities and roads contributes to high production costs, low sale prices, and high milk handling losses. The decline in investment in rural infrastructure after trade liberalization, such as rural access roads, has affected rural marketing organization and limited the ability of smallholder farmers to negotiate better market prices. The debate over the exact impact of rural accessibility on milk markets remains unresolved but is believed to be substantial, especially during the rainy season when milk supply is highest. The effect of remoteness could be more manifest in the access to input markets and animal services. Since animal health and breeding are time-sensitive activities, private input and service providers must locate within their areas of operation. Low financial returns may dissuade them from setting up in certain regions.

7 UPGRADING INTERVENTIONS

Milk presents many new commercial opportunities for smallholder farmers, especially because the value chain for milk is relatively short and not characterized by high levels of brokerage. This means that farmers are able to deal directly with buyers, both informal wholesale traders and processors, and have more access to market and product information. The table below presents three components for a USAID-KAVES intervention strategy to upgrade the smallholder dairy industry, supported by six specific strategic interventions and twenty objectives that will increase on-farm productivity, streamline milk aggregation, leading to improved milk quality, a wider range of dairy products and growth in market demand for milk. Interventions have been selected that will contribute directly to the goals and objectives of the KAVES project and are highly scalable through private sector partnerships, with varying levels of public sector support. The interventions all rely heavily on the mass adoption of new technologies, supported with specialist training and extension; new sources of investment and credit to unlock value chain constraints; and engagement of private sector partners for market development and sustainability.

Recommended intervention	Specific upgrading objectives	Challenges	Expected outcomes
Strategic component 1: Increase Milk Productivity			
1. Improve the quality of dairy breeds	1 Farmers have access to qualified A.I service providers 2. Farmers have increased knowledge of animal breeding 3. Farmers able to purchase semen in bulk at discounted rates 4. County governments have dairy strategic plans	• Shortage of veterinary technicians • Poor distribution of AI service providers • Few facilities for semen preservation and poor quality control of semen	• Increase in numbers of high-yielding dairy cows • Higher incomes from milk sales • Increase in household consumption of milk
2. Increase year-round availability of quality feeds and water	5. Major increase in fodder production 6. New technologies adopted 7. Increased use of on-farm feed formulation, and supplements 8. Feed preservation technologies adopted including silage and hay making 9. Farmers organized to purchase animal feed in bulk for better prices	• Inadequate supply of seeds for fodder crops • Cost of introducing new technologies • Poor regulation of animal feed quality	• Improved cow nutrition and fertility • Increased milk yields • Higher incomes from milk sales • Fluctuation in milk prices reduced
3. Train animal health providers	10. Farmers have increased access to private and public service providers 11. New technologies for animal pest control adopted	• Low capacity of county governments • Few qualified animal health technicians	• Higher milk yields • Better quality milk • Greater health benefits for milk consumers
Strategy component II. Milk Bulking, Processing and Cold Chain Development			
4. Increase level of milk bulking, cooling, and collection	12. Milk collection groups have stronger capacity for product aggregation including finance, business planning, and conflict management skills 13. No. of dairy hubs increased 14. More bulking and cooling centers established	• Strength of informal milk marketing systems • Groups have weak business skills • Cost of investment in new facilities	• Improved milk quality • Increase in milk production • Higher consumption and market growth in non-traditional dairy areas

	15. Milk collection systems improved and cost of aggregation reduced		
Strategy component III: Improve Market Efficiency and Value addition			
5.Improve Market Access	16. Facilitate investments in milk dispensers by entrepreneurs and producer groups 17. Link farmer groups to existing and new markets, particularly institutions	• High cost of capital Lack of regulatory framework for innovation	• Higher prices and returns • Increased access to markets • Stronger and more sustainable market relationships
6.Increase range of value addition products	18. Feasibility studies completed for new product development 19. Groups linked to equipment suppliers, investors and credit providers 20. Groups develop marketing plans and product branding and bar-coding	• High cost of initial capital • Low capacity of farmers to meet market standards and requirements	• New income generated from dairy products such as yoghurts • Small-scale dairy groups more sustainable • Growth in market demand for milk

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ANNEX II: LIST OF ACRONYMS

ADC	Agriculture Development Cooperation
ADSP	Agribusiness Development Support Project
AEZ	Agroecological Zone
AFC	Agricultural Finance Corporation
AFFA	Agriculture, Fisheries and Food Authority
AI	Artificial Insemination
AIRC	Agricultural Information Resource Center
AKFEMA	Association of Kenya Animal Feed Manufactures
ART	Assisted Reproductive Technologies
ASAL	Arid and Semi-Arid Lands
ASCU	Agricultural Sector Coordination Unit
AU	African Union
CAGR	Compounded Annual Growth Rate
CH	Central Highlands Zone
CIF	Cost Insurance and Freight
CL	Coastal Lowlands
COMESA	Common Market for Eastern and Southern Africa
DMP	Kenya Dairy Master Plan
DRC	Democratic Republic of the Congo
DTA	Dairy Traders Association
EAAPP	Eastern Africa Agricultural Productivity Project
EAC	East African Community
EADDP	Eastern Africa Dairy Development Program
EL	Eastern Lowlands
FAO	Food and Agriculture Organization
FAOSTAT	FAO Statistics Database
FCI	Farm Concern International
FtF	Feed the Future
HPM	High Potential Maize Zone
HPI	Heifer Project International
ICBT	Informal Cross-Border Trade
IFAD	International Fund for Agricultural Development
IFCN	International Farm Comparison Network
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
ILRI	International Livestock Research Institute
KAGRC	Kenya Animal Genetic Resources Center
KALRO	Kenya Agricultural and Livestock Research Organization
KAPALIG	Kavatini Pasture and Livestock Improvement Group
KDB	Kenya Dairy Board
KDFF	Kenya Dairy Farmers Federation
KDPA	Kenya Dairy Processors Association
KDSCP	Kenya Dairy Sector Competitiveness Program

KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Institute
KEMFRI	Kenya Marine and Fisheries Research Institute
KNAIS	Kenya National Artificial Insemination Services
KENDAPO	Kenya Dairy Producers Organization
KENFAP	Kenya National Federation of Agricultural Producers
KEPHIS	Kenya Plant Health Inspectorate Services
KESREF	Kenya Sugar Research Foundation
KETRI	Kenya Trypanosomiasis Research Institute
KEVEVAPI	Kenya Veterinary Vaccines Production Institute
kg	Kilogram
KLBO	The Kenya Livestock Breeders Organization
KLPA	The Kenya Livestock Producers Association
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company
KSDCP	Kenya Smallholder Dairy Competitiveness Program
KSh	Kenyan Shilling
KWFT	Kenya Women Finance Trust: The Kenya Women Finance Trust
LME	Liquid Milk Equivalent
MOALF	Ministry of Agriculture, Livestock and Fisheries
MRS	Marginal Rain Shadow Zone
MT	Metric Ton
NGO	Non-governmental organizations
NKCC	New Kenya Cooperative Creameries
NTB	Non-tariff Trade Barriers
PCPB	Pest Control Products Board
PHL	Post Harvest Losses
ppb	Parts Per Billion
RRA	Rapid Rural Appraisal
SA2	Semi-Arid 2
SACCO	Savings and Credit Cooperative Society
SDOL	State Department of Livestock
SDP	Smallholder Dairy Program
SSA	Sub-Saharan Africa
TAD	Transboundary Animal Diseases
TBT	Technical Barriers to Trade
TMR	Total Home Ration
USAID	United States Agency for International Development
USAID-KAVES	Kenya Agricultural Value Chain Enterprises
VAT	Value Added Tax
WL	Western Lowlands

ANNEX III: LESSONS LEARNED FROM PAST INTERVENTIONS

USAID-KAVES will build on the past initiatives and lessons learned of development partner projects, including:

The Kenya Market Assistance Program (MAP) is a M4P (Making Markets Work for the Poor) program financed by DFID, the Gatsby Charitable Foundation and the Dutch Government, and implemented by a consortium led by Adam Smith International. MAP has supported two cooperatives, Ndumberi in Kiambu and Nyala in Laikipia counties, to establish a limited liability partnership named Hay and Forage. Through this partnership, the cooperatives have leased 1,200 acres of land in Nyahururu with the objective of producing and baling hay. The land has the ability to produce as much as 240,000 bales of hay from the existing grass. By the end of October 2012, Ndumberi Cooperative had already sold 10,000 bales of hay to its members. Hay from the cooperatives costs only KSh120 (c.f. KSh180-250 from other sources) and this, together with its guaranteed quality has made it very popular among the farmers. (The Guardian, 2014)

The Smallholder Dairy Commercialization Program, funded by IFAD and the Government of Kenya, covers dairy commercialization areas in nine districts, namely; Nakuru, Bungoma, Bomet, Central Kisii, Lugari, Nandi North, Nyamira, Trans Nzoia and Uasin Gishu, The program was to run from June 2006 to March 2013, but has been extended to March 2016. Its overall goal is to increase the income of poor rural households that depend substantially on production and trade of dairy products by:

- Improving the financial returns of market-oriented production and trade activities by small operators through improved information on market opportunities, increased productivity, cost reduction, value addition, and more reliable trade relations; and
- Enabling more rural households to create employment through, and benefit from, expanded opportunities for market-oriented dairy activities, in particular as a result of strengthened farmer organizations.

The program has supported commercial forage production, establishment of milk bars, breed improvement, linkages with financial institutions, milk bulking, and installation of coolers. During the 2012/2013 financial year, supported farmers were able to produce 178,472 tons of silage, 105,122 bales of hay, and 47,000 kg of on farm feeds.

The East Africa Dairy Development Program (EADDP), funded by the Bill and Melinda Gates Foundation, was implemented in Kenya, Uganda and Rwanda by a consortium of agencies (ILRI, ICRAF, ABS TCM ltd and TechnoServe) led by HPI over a period of five years. The program was designed to boost milk yields and incomes of small-scale farmers in Africa to cut hunger and poverty. It championed the dairy hub model. In its first five years, EADD provided extensive training on dairy husbandry, business practices and operation, and marketing of dairy products to the 179,000 farming families in the program. HPI and its partners also developed 27 milk collection hubs, strengthened 10 existing hubs, and formed 68 farmer business associations to manage the plants. The program was recently re-funded for a second phase and will be implemented in Kenya, Uganda and Tanzania to work with more than 200,000 farmers to improve dairy production and access to markets over the next four years.

The Kenya Dairy Sector Competitiveness Program (KDSCP): was a five-year USAID-funded program to improve Kenya's dairy industry competitiveness. The program employed a market driven value chain approach, utilizing the Business Development Services (BDS) methodology, to help transform the dairy industry into a globally competitive, regional market leader, with the overall goal of increasing smallholder household income from the sale of quality milk. The goal of the KDSC Program was to increase smallholder household income from the sale of quality milk. The program was implemented in milk sheds in the Central and Rift Valley provinces of Kenya and had three main objectives:

- Increased competitiveness of the Kenyan dairy sector resulting from collaboration among sector stakeholders and increased capacity of public sector agencies to serve the needs of the sector;

- Increased marketing of milk meeting quality standards by producer-owned milk bulking/cooling businesses; and
- Greater access to market-linked business development services and technologies by male and female dairy farmers and farmers producing dairy-related inputs.