



USAID - KENYA CROPS AND DAIRY MARKET SYSTEMS (KCDMS) FEED AND FODDER VALUE CHAIN ASSESSMENT REPORT





USAID-Kenya Crops and Dairy Market Systems Activity

TECHNICAL REPORT: FEED AND FODDER VALUE CHAIN ASSESSMENT

Submitted September 30th, 2018

Cooperative Agreement No. AID-615-A-17-00006

Prepared for Harrigan Mukhongo <hmukhongo@usaid.gov> United States Agency for International Development/Kenya C/O American Embassy United Nations Avenue, Gigiri P.O. Box 629, Village Market 00621 Nairobi, Kenya

Prepared by International Livestock Research Institute (Authors: Joseph Auma, Immaculate Omondi, Julius Githinji, Elizaphan James Rao, Ben Lukuyu and Isabelle Baltenweck) Prepared for RTI International P.O. Box 12194 Research Triangle Park-NC 27709-2194 http://www.rti.org

USAID-Kenya Crops and Dairy Market Systems Activity (KCDMS) The Westwood Office Building, 8th Floor-Westlands P.O. Box 1181 Village Market, 00621 Nairobi, Kenya

Photo Caption

Front and Back Cover: KCDMS value chains crops photos

DISCLAIMER: This publication was produced by RTI International for review by the United States Agency for International Development. The authors' views expressed in this report do not necessarily reflect the views of the United States Agency for United States Government.

Table of Contents

EXE	CUT	VE SUMMARY	6
0.1	S	TATUS OF THE VALUE CHAIN	7
L	I G	ilobal	7
	1.1.1	Global status of compound feeds value chain	7
	1.1.2	Global status of the fodder value chain	8
L	.2 N	lational	9
	1.2.1	Compound feeds value chain	9
	1.2.2	Compound feed operators	
2.0	F	ODDER VALUE CHAIN	12
2	I Fo	odder	12
2	.2 C	ounties	13
	2.2.1	Compound feeds in KCDMS program's target counties	
	2.2.2	Fodder in the KCDMS program's target counties	15
3.0	V	ALUE CHAIN MAPPING, ACTORS AND THEIR ROLES	
3	IV.	alue chain mapping	19
	3.1.1	. Compound feeds (dairy meal) value chain actors	
	3.1.2	. Compound feed (dairy meal) value chain map	20
	3.1.3	. Fodder value chain actors and value chain maps	21
	3.1.4	. Efficiencies, Performance, and Margins	23
	Anal	ysis of performance in compound feeds (dairy concentrates) value chain	23
	3.1.5	Analysis of performance in fodder value chain	27
4.0	Ρ	RODUCTION AND SUPPLY	33
4	I P	roductivity by counties	33
	4.1.1	Compound dairy feeds	33
	4.1.2	Fodder	34
	4.2	Summary of key productivity opportunities	35
5.0	Μ	IARKET DEMAND	36
	5.1	Demand for Compound Feeds in KCDMS Counties	36
	5.2	Demand for Fodder and Forages in KCDMS Counties	36
	5.3	Market Channels	38
	5.4	Market channels for fodder	38
	5.5	Local/Regional/International Demand	
	5.6	Summary Key Market Opportunities	39

6.0	SUPPORT SERVICES	40					
6. I	Extension and Information Services	40					
6.2	Input Systems	40					
6.3	Financial Services	40					
6.4	Transport Services	41					
6.5	Marketing Services	41					
6.6	Other VC Services	41					
7.0	INSTITUTIONAL RULES, NORMS AND TRENDS	42					
7.I	Formal and Informal	42					
8.0	COLLABORATION AND LEARNING OPPORTUNITIES ALONG THE VALUE CHAIN	43					
9.0	INFORMATION SOURCES						
Ann	ex I: Methodology	46					
Ann	ex 2: List of key informant interviews and stakeholders consulted	49					
Ann	Annex 3: Description of Animal Feed Manufacturers Surveyed (March/April 2018)5						
Ann	ex 4: Assumptions in the Estimation of Feeds Production (Supply) Demand (Potential)	56					

LIST OF ACRONYMS AND ABBREVIATIONS

AKEFEMA	Association of Kenya Feeds Manufacturers
ASALs	Arid and Semi-Arid Lands
AVCD	Accelerated Value Chain Development
CAGR	Compounded Annualized Growth Rate
CAN	Calcium Ammonium Nitrate
CBOs	Community-Based Organizations
CECM	County Executive Committee Member
CIAT	International Center for Tropical Agriculture
DAP	Diammonium Phosphate
DMI	Dry Matter Intake
EAC	East Africa Community
FAO	The Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussions
GM	Gross Margin
Ha	Hectare
ICIPE	International Centre for Insect Physiology and Ecology
IFAD	The International Fund for Agricultural Development
IFIF	International Feed Industry Federation
ILRI	International Livestock Research Institute
K-LIFT	Kenya Livestock Finance Trust
KALRO	Kenya Agricultural and Livestock Research Organization
KCDMS	Kenya Crops and Dairy Market Systems
KE	Kenya
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenyan Shillings
KII	Key Informant Interview
KMT	Kenya Market Trust
KNBS	Kenya National Bureau of Statistics
MD	Man-Days
MMT	Million Metric Tons
MoALF	Ministry of Agriculture, Livestock and Fisheries
MT	Metric Tons
NGOs	Non-Governmental Organizations
PALWECO	Programme for Agriculture and Livelihoods in Western Communities
SDCP	Smallholder Dairy Commercialization Programme
TARDA	Tana and Athi Rivers Development Authority
TMR	Total Mixed Ration
ТоТ	Training of Trainers
TZ	Tanzania
UAE	United Arab Emirates
UG	Uganda
USA	United States of America
USAID	United States Agency for International Development
USAID-KAVES	USAID-Kenya Agricultural Value Chain Enterprises
VAT	Value-Added Tax
VCA	Value Chain Assessment

Livestock feed includes fodder, forage, and compound feeds, and consists of roughages, concentrates, minerals, and vitamins. Commercial production or sale of manufactured feed products takes place in more than 120 countries and directly employs more than a quarter of a million people. There was a 2.57% growth in global feed production in 2017, up from the previous year, with dairy being one of the few sectors that saw growth across all regions; Africa's dairy feed production rose by 10%. Nearly half of the 36.13 million tons of feed produced in Africa was manufactured in South Africa and Egypt. Kenya is a country with the largest and the most dynamic animal feed industry in the East Africa region. The country produced less than a million metric tons (MT) of compound feeds in 2016, with an estimated compounded annualized growth rate (CAGR) of 4.7%. The demand for compound feeds in the country outstrips supply, even though the installed capacity to produce compound feeds could adequately meet the demand.

In Kenya's 2018/19 financial budget, the country removed the value-added tax (VAT) from animal feed ingredients, with the objective being twofold - to make feeds affordable to farmers and to attract investment in the sector. Consequently, the availability of comparatively cheaper raw materials and the high cost of finished compound feeds by formal feed millers should motivate the importation, trade, and formulation of animal feeds by informal, small-medium businesses, including farmers. Information gathered from primary data collected for this study revealed that, apart from major millers, several small feed manufacturers with the capacity of at least half-ton feed mixers exist in the project counties, even though most of them operate below capacity due to marketing challenges. Commercial compound dairy feeds include dairy meal, dairy cubes, calf pellets, maize germ, maize bran, molasses, cotton seed cake, wheat pollard, and wheat bran. However, the most commonly used compound feed is dairy meal and calf pellets. Based on an index computed from the information gathered during focus group discussion (FGD) interviews, about 40% of the farmers in the Kenya Crops and Dairy Market System (KCDMS) target counties use dairy meal as a feed supplement for their milking herds. The index is much higher in some counties (e.g., Kisii, Kakamega, and Taita Taveta), and much lower in other counties (e.g., Kitui and Makueni).

Fodder, on the other hand, is the backbone of the industry, largely because dairy cows are ruminants, making them highly dependent on forage for milk production. The development of a high-quality innovative forage sub-sector will minimize farmers' production costs and seasonal fluctuations in milk supply and improve operational profits since a significant proportion of livestock nutrition can be met using appropriate quality and quantity forages. Kenya suffers large deficits of livestock feeds, particularly forage for dairy cattle. With the demand for fodder and the inability of many farmers, owing to their small-scale enterprises, to establish and preserve enough fodder on-farm, a commercial fodder sector is emerging in Kenya. However, individual smallholder dairy farmers producing and selling surplus fodder to their neighbors and through the market is common. There are various fodder types grown in Kenya, but the most common and widespread are Napier grass, Boma Rhodes grass and natural pastures. Hay (from Boma Rhodes grass) and Lucerne are the most commonly traded, while Napier grass dominates localized sales between farmers within proximity.

While compound feeds have a relatively similar value chain map across all the KCDMS project counties, the fodder value chain generally varies by region, fodder type, and the kind of fodder (i.e., whether green or dry matter, among other factors). For instance, Napier grass has the shortest value chain, as it is mostly sold directly from producer to consumer, while other fodder types, for instance, hay, mostly has a comparatively longer value chain with other actors such as transporters and traders. Our analysis reveals positive returns from growing fodder, demonstrating the extent to which commercial fodder production and seed production, aggregation, transportation and trade, are viable business opportunities which have not been fully exploited. Further, the study found that established compound feed millers (small-scale) had market margins ranging from 20%-44%, while livestock feed-ingredient traders' margins ranged between 26%-71%.

This report discusses study findings from a field survey conducted in March --April 2018 and details some of the constraints faced by actors in the two value chains. Opportunities for interventions in the value chains are also discussed.

1.1 Global

Animal feed is food given to domestic animals including fodder, forage, and compound feeds. Fodder refers to any agricultural foodstuff used to feed domesticated livestock; it refers to food given to animals, rather than the food animals forage for themselves. On the other hand, forage is food that animals take mainly via browsing or grazing. Fodder and forage can be either planted (planted fodder and pasture) or naturally growing. Conversely, compound feed is fodder that is blended from various raw materials (the main ingredients being feed grains, which include corn, soybeans, sorghum, oats, and barley) and additives (which may include premixes) and are formulated according to the specific requirements of the target animal. Premixes are composed of micro ingredients such as vitamins, minerals, chemical preservatives, antibiotics, fermentation products, and other essential ingredients. In general, livestock feeds consist of roughages, concentrates, minerals, and vitamins. Likewise, the raw materials for feed manufacturing originate from cereals, legumes, and oilseed cakes, and animal by-products from fish, meat, and bone meal.

Global status of compound feeds value chain 1.1.1

Compound feeds (sometimes also referred to as industrial or formulated feeds) may be produced in industrial feed mills or using simple on-farm mixers. Commercial production and/or sale of manufactured feed products takes place in more than 120 countries and directly employs more than a guarter of a million people (FAO and IFIF, 2010)¹. Global production of compound feeds in the year 2016 was estimated at one billion tons (IFIF, 2017)², with ten countries producing more than 60% of this total (Rogers Gilbert, undated). The 2016 Global Feed Survey conducted by Alltech reported that global animal feeds were worth US\$450 billion and were 996 million tons in volume by 2015. Three countries - China, the United States, and Brazil combined -- produce 43% of the total global manufactured feed, with China leading (18.3%) followed by the United States of America (USA) (17.6%). The Alltech Survey further reported that nearly half of the 36.13 million tons of feed produced in Africa was manufactured in South Africa (32%) and Egypt (17%). Furthermore, the 10 largest feed manufacturers in the world produce less than 65 million tons per year — less than 11% of global feed output -- while approximately 3,800 feed mills manufacture more than 80% of the world's industrial feed (Roger Gilbert, undated).

The Alltech Survey showed an increasing trend toward feeds for white meat, especially poultry. Poultry feeds account for the largest share of manufactured feeds, followed by pigs and cattle; cattle feed is mainly concentrates for dairy cows. In the year 2015, 47% of manufactured feeds were for poultry, followed by pigs at 26% and ruminants at 20% (Rogers Gilbert, undated). In terms of ingredients, feed manufacturers across 131

countries preferred maize (76%) and soybean meal (96%) as the main sources of carbohydrate and protein (Alltech, 2016 in USAID-KAVES, 2017).

In terms of growth, there was a 2.57% jump in global feed production in 2017 from 2016, with dairy being one of the few sectors that saw growth across all regions; Africa's dairy feed production rose by 10% (Alltech Global Feed Survey, $2018)^3$.

According to Kilimo Trust (2017), in Eastern Africa, three East Africa Community (EAC) countries --Kenya, Uganda and Tanzania (countries with the largest livestock industry in the region) -- had a demand for animal feeds amounting to six million MT against production of 1.7 million MT in 2014. This demand is expected to increase by 60% by 2020. The biggest demand is in Kenya, the country with the largest and the most dynamic animal feed industry in the region (Kilimo Trust, 2017). Collectively, these countries had a deficit of animal feed standing at eight and 5.3 MT in 2013 and 2014, respectively, against a backdrop of increasing demand in the same period (Kilimo Trust, 2017). Increasing demand of animal feed is driven by increasing demand for livestock and livestock products because of a growing population and urbanization in the region (see Thornton, 2010)4. On average, the EAC imported 7,900 MT of maize bran and 766 MT of soya beans annually between 2011-2015, and Kenya took up 70% of the total (Kilimo Trust, 2017). While soya bean cake is imported from the Netherlands, USA, India, Malawi, and Zambia, maize bran is imported from the USA and India. Over the same period, the region exported 204,138MT of bran (70% wheat bran) and

USAID-KCDMS Feed and Fodder Value Chain Assessment Report- 2018

¹ FAO and IFIF. 2010. Good Practices for the Feed Industry – Implementing the Codex Alimentarius Code of Practice on Good Animal Feeding. FAO Animal Production and Health Manual No. 9. Rome, Italy. ² IFIF 2017. International Feed Industry Federation (IFIF) Annual Report. 2016/2017. http://annualreport.ifif.org/

a5b7e25c-9ffc-49fa-9155-172c7eb289f7%7C0bb51f65-30c4-40e0b48b-76a14eacf4d3

⁴ Thornton, P. K. (2010). Livestock Production: Recent Trends, Future Prospects. Philosophical Transactions of the Royal Society B, 365(1554), 2853-2867. https://doi.org/10.1098/rstb.2010.0134

https://go.alltech.com/hubfs/GFS2018%20Brochure.pdf?hsCtaTracking=

66,649 MT of oilseed cake (mainly sunflower seed cake) to the United Arab Emirates (UAE), Oman, India, Egypt, Italy and Pakistan (Kilimo Trust, 2017).

The findings by Kilimo Trust (2017), in inter-regional trade landscape, Uganda and Tanzania dominates export of bran (maize and rice) and sunflower seed cake respectively and Kenya is the biggest importer. In 2013, Kenya sourced 25, 848 MT of maize and rice bran and 29,543 of sunflower and cotton seed cake from Uganda and Tanzania respectively. In 2015, there was reduced trade in cereals brans with Uganda taking the

lead at 14, 210 MT while the opposite was for the case for oilseed cakes with Tanzania exporting 38, 114 to her regional partners. This shows the dynamics in availability and trade of raw materials in the region because of the weather variability (Kilimo Trust, 2017). It is important to note that poultry feeds constitute the highest proportion of animal feeds demanded in Kenya, Uganda and Tanzania at 64%, 96% and 60% respectively, the difference is mainly contributed by dairy feeds as demand for others such as pig, dog and fish feeds though increasing are still negligible (Kilimo Trust, 2017).

According to Kilimo Trust (2017), the animal feed processors in the EAC region are characterized by:

- High levels of informality and poor coordination in the animal feed industry which contributes to poor quality assurance of raw material and finished products. For example, in Uganda, animal feeds have been found to have high level of aflatoxins; likewise, in Kenya, farmers are challenged with unverifiable nutrient composition, as well as the presence or absence of substances that may be harmful to human and animal health.
- On average, the processors in the region utilize 44% and 45% of their production and storage capacity, respectively, because of raw materials quantity and quality supply constraints and low demand of feeds due to high cost.
- Animal feeds processors in Uganda and Tanzania use more of the locally produced sunflower oilseed cake than Kenya, which utilizes more of maize and rice brans to produce animal feeds. This is relatively consistent with the production capacities of raw materials by these countries.

Since 2015, the governments of Kenya, Tanzania, Uganda, and Rwanda gradually have removed taxation on both feed and raw materials used in their production to increase access to meat, milk, and eggs, as well as to boost the feed production industry in East Africa.

1.1.2 Global status of the fodder value chain

It is estimated that feed and fodder account for 60% - 70% of total cost in livestock production (see for example Wambugu, et al., 2011). Feed (referring to fodder and forage) scarcity – the inadequacy of feeds in terms of quantity

as well as quality- has been a longstanding technical constraint for productivity improvement of livestock in smallholder mixed farming, as well as pastoral and agropastoral production systems developing countries (Jabbar, 2008)⁵. The data on fodder production and utilization at the global level is scant, and varies widely by country, depending on the cropping pattern, climate, social-economic conditions, and type of livestock. Most available information is about manufactured feed rather than about fodder (Jabbar, 2008). Figure I shows the global share of land used for pastures in 2014.



⁵ Jabbar, M. A. Feed and Fodder Markets in South Asia and East Africa: A Synthesis of Four PRA Case Studies. ILRI. 2008.



Figure 2: Total land (hectares) used for grazing in Africa

I.2 National

Limited literature is available on the dairy feeds and fodder value chain in Kenya. A few studies (SNV, 2013; KMT, 2016; Gitonga, 2014; Githinji, et al., 2009; Omollo, 2017; USAID KAVES, 2017) analyzed various aspects of animal feed production, quality and quantity, and marketing without completely addressing the entire compound feeds and fodder value chain in the country. SNV conducted a few studies during the implementation of the Kenya Market-led Dairy Programme on compound feeds and fodder, particularly in traditional dairy areas of the country and pastoral arid and semi-arid lands (ASALs) of northern Kenya, but none in the pre-commercial dairy counties of western and lower eastern Kenya. Moreover, while these studies address the policy and regulation concerns of manufactured feeds, and the production and marketing of fodder, other aspects of the value chain are scantily addressed. Some of these studies lumped compound animal feeds (dairy, poultry and others) together, making it difficult to isolate and understand the trends in production of dairy supplements and marketing in the country (KMT, 2016; Gitonga, 2014; Githinji, et al., 2009; USAID-KAVES, 2017). Except for the USAID-funded Kenya Agricultural Value Chain Enterprises (USAID-KAVES) project (2017), which used a value chain approach to study the fodder value chain in Kenya, most available information is about compound feeds rather than fodder. However, using a value chain approach to analyze compound dairy feeds and various fodder types in one single study is rather complex because it involves several value chains.

I.2.1 Compound feeds value chain

In Kenya, white maize and its by-products constitute roughly 50-60% of the rations in manufactured animal feed. This has exerted tremendous pressure on domestic resources and supplies, resulting in price escalations in a period of significant deficits due to drought or crop damage (USAID-KAVES 2017). USAID-KAVES (2017) used information from Alltech Surveys and the Kenya National Bureau of Statistics (KNBS), to estimate Kenya's feed production between 2009 and 2016 (Table I). The country produced about 0.85 million metric tons (MMT) of manufactured animal feed in 2016 according Alltech Survey which is significantly different from that of KNBS official records approximating production at 0.555 MMT in the same period. The variance is associated with the large informal segment of the industry which could not be accurately accounted for by the official statistics (USAID KAVES, 2017). The country's annualized growth rate (CAGR) is estimated at 4.7% (projecting growth of up to 1.02 MMT) according to Alltech Surveys and 8% according to the KNBS (projecting growth of up to 0.76 MMT).

Table 1: Production of Manufactured Animal Feeds										
C			Prod	Growth		2020				
Konvo	2010	2011	2012	2013	2014	2015	2016*	(2010-2016)		projected
- Kenya		2011						Total	CAGR	(MMT)
Alltech	0.646	0.695	0.742	0.793	0.800	0.836	0.851	31.8%	4.7%	1.02
KNBS	0.349	0.433	0.471	0.528	0.540	0.545	0.555	59.0%	8.0%	0.76
Source: Adapted from USAID KAVES, 2017										

Data retrieved from KNBS abstracts, reported in Table 2 and Figure 3, on the value of animal feeds in Kenya, show significant decline between 2009 and 2011 before rising consistently to Kenyan Shillings (KES) 8.628 billion in 2016 from KES 5.544 billion in 2009 (KNBS, 2017). Although the value of manufactured cattle feeds increased in the two-time periods, the proportion to total value of animal feeds remain constant at 18.4% (Table 2).

	Table 2: Value of Manufactured Animal Feeds (Million KES)									
Feed types	2009	2010	2011	2012	2013	2014	2015	2016		
Pig feed	390	289	254	327	402	459	518	560		
Poultry feed	3596	2888	2537	3264	4016	4588	5178	5596		
Cattle faced	1022	021	721	020	1140	1204	1470	1501		
Cattle feed	1022	821	721	928	1142	1304	14/2	1591		
Other feeds	566	455	399	514	632	722	815	881		
Total	5544	4453	3911	5032	6192	7073	7984	8628		
% value of cattle	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4		
food										
leeu										

Source: Authors' estimations from KNBS, 2017



Figure 3: Value of various manufactured animal feeds (million KES)

Other studies (Gitonga, 2014; Githinji et al., 2009) report that the demand for compound feeds outstrips the supply, even though the installed capacity to produce the compound feed could adequately meet the demand. Registered feed manufacturers account for about 60% of the demand, while unregistered small-scale manufacturers, home/community-based formulators, and importers account for the balance (Gitonga, 2014).

In Kenya, the milling installed capacity utilized is at 69% (KMT, 2016), a significant increase from 45% in 2008, as reported by Githinji in2009. This implies that the potential monthly production is above 90,000 MT (or about 1,126,656 MT annually). As observed from primary data collected in this study (and observed by Gitonga in 2014, as well as Kenya Market Trust (KMT) in 2016), the actual capacity utilization is constrained by an inadequate and erratic supply of raw materials, irregular (seasonal) and unreliable demand, and marketing challenges, among other factors. For example, the average production of most small feed manufacturers is about 500MT per month (KMT, 2016; primary data from this study). Of the estimated manufactured products, poultry feeds formed the largest proportion (41%), with dairy feeds (39%) following closely (KMT, 2016), implying that dairy concentrates supply is slightly more than 0.3 million MT annually.

The high cost of some of the ingredients, such as oilseed cakes and meals, finer mineral elements, fish meal, and aminoacids, has also affected the quality and quantity of production. First, the country imports over 70% of the raw materials needed for manufacturing compound animal feeds, the bulk of which consists of grain and oilseed cake by-products (SNV, 2013). Furthermore, the inability to fully use the installed capacity means there is an underutilization or overinvestment, with unnecessary overhead costs, possibly contributing to final cost of feed (KMT, 2016). In addition, the large number of small-scale producers possibly suffers higher costs from poor "economies of scale." In Kenya's 2018/19 financial budget, the country removed the value-added tax (VAT) from animal feeds ingredients, with the objective being twofold - to make feeds affordable to farmers and to attract investment in the sector.⁶

1.2.2 Compound feed operators

In Kenya, commercial dairy feeds include dairy meal, dairy cubes, calf pellets, maize germ, maize bran, molasses, cotton seed cake, wheat pollard, and wheat bran, with the main sources of energy used being maize combined with other nutrient sources including high protein ingredients, such as sunflower and cotton seed cakes and premixes (USAID KAVES, 2017). The current number of compound dairy feed operators in the country is not known due to the

dynamic nature of the businesses and a policy environment which encourages small and medium feeds formulators. Some of these formulators are informal. including farmers who formulate, feed, and sell surplus. The growing demand due to an increasing dairy population, especially in non-traditional dairy production areas, is also another factor contributing to the increasing number of operators. The State Department of Livestock Production, together with the Food and Agriculture Organization of the United Nations (FAO), has initiated the process of taking inventory of animal feed manufacturers and other operators in the 23 ASAL counties in Kenya. This would be later extended to the rest of the country (State Department of Livestock, June 2018). Meanwhile the most recent literature on the population of animal feeds manufacturers and other operators in the country is estimated by Kenya Market Trust (KMT) (2016) and Gitonga (2014), which did not cover the whole country. According to Gitonga, there were about 100 registered livestock feed manufacturers in 2008, which had increased to about 150 by 2013. Of these, 20 were also large grain millers and eight



were oilseed manufacturers. There were also nearly 50 registered raw material importers and six suppliers of feed premixes (minerals, vitamins, and other mineral elements). In addition, there were hundreds of home/communitybased formulators whose growth was driven by farmers' desires to contain spiraling production costs. In 2016, KMT estimated the population of animal feed operators at 305, while the following year, Kilimo Trust estimated it at 307. Of those 305, 115 were manufacturers, 96 were raw materials suppliers (or ingredients), and 94 were both producing raw materials and manufacturing feeds. This resulted in a total of about 210 feed millers, more than twice the number established in a 2008 survey by the Ministry of Livestock Development (KMT, 2016).

This study's field survey, conducted in March-April 2018, observed several small-medium feed operators taking advantage of the government policy on duty free raw material imported into the country, especially from neighboring Uganda and Tanzania. The availability of comparatively cheaper raw materials and the high cost of finished animal feeds by formal feed millers motivated the importation, trade, and formulation of animal feeds by informal small-medium business, including farmers. Therefore, the current population of animal feed operators could be much higher than estimated previously. Given this scenario, the accurate estimation of current production (supply) and demand of compounded feeds becomes rather complex.

⁶ <u>https://www.businessdailyafrica.com/analysis/columnists/Removal-of-VAT-from-animal-feeds-timely/4259356-4654562-r0j9kbz/index.html</u>

2.I Fodder

The cost of dairy feeding constitutes between 60% - 80% of the overall cost of production in smallholder farms in Kenya, and efficient feeding could significantly increase farmers' profit margins (Auma et al., 2016; USAID KAVES, 2014; SNV, 2013). Most important, all-year-round access to quality feed and fodder determines the competitiveness of the dairy sector (SNV, 2013). Fodder is the backbone of the industry, largely because dairy cows are ruminants, making them highly dependent on forage for milk production (SNV, 2013). Development of a high-quality, innovative forage sub-sector will minimize farmers' production costs and seasonal fluctuations in milk supply, as well as improve operational profits (SNV 2013).

Experience from practicing farmers show that a significant proportion of nutrition is met while using appropriate quality and quantity forages, rather than the more expensive compound feeds: a dairy cow could produce up to 20 litres of milk a day on a balanced forage feed with no compound feeds (SNV, 2013). Studies show that smallholder farmers' exposure and awareness of different fodder crops in Kenya is high, but only 55% grow at least one fodder type on their farms (SNV, 2013). More recently, frequent droughts, resulting from climate change and variability as well as poor land use practices, have significantly contributed to degradations and loss of natural pastures, (Omollo, 2017) further complicating the situation. This was particularly noted in ASAL areas.

Challenges in animal feeding and the growing demand for fodder motivated government initiatives (e.g. KALRO) in collaboration with development agencies to support fodder establishment, production, and marketing (Omollo, 2017). One such initiative was the introduction of several natural fodder improvement technologies in the drylands to increase feed availability during the dry periods and diversify income through the sale of hay and grass seed among communities living in the ASALs (Mnene et al., 1999; Dolan et al., 2004; Munyeki et al., 2015; Lugusa et al., 2016 in Omollo, 2017). These initiatives, coupled with a demand for fodder and the inability of many farmers to establish and preserve enough fodder on-farm, created the emergence of a commercial fodder sector in Kenya (SNV 2013).

Three business models emerged: i) large-scale commercial fodder producers supplying farmers and dairy societies; ii) dairy societies' out-grower model, whereby dairy societies are producing fodder through their own members, supported technically under a buy-back arrangement; and iii) dairy societies establishing their own large-scale fodder production (SNV, 2013).

In addition, primary data collected for this study observed that individual smallholder dairy farmers are producing and selling surplus fodder to their neighbors and through markets and the trend is increasing. There are various fodder types grown in Kenya, but the most common and widespread are Napier grass, Boma Rhodes grass, and natural pastures. Hay (from Boma Rhodes grass) and Lucerne are the most commonly traded, while Napier grass dominates localized sales between farmers within proximity. Hay from five species of Brachiaria introduced by the International Livestock Research Institute (ILRI), the International Centre of Insect Physiology and Ecology (ICIPE), the International Center for Tropical Agriculture (CIAT) and partners is also picking up in western Kenya. Hay production from natural pastures has become an important source of income and livelihood for farmers and farmer groups in Makueni, Kitui, and Taita Taveta counties, to the extent the county government and other developmental partners subsidize production and harvesting through construction of hay bans and mowing. In Makueni, mowing tractors are in very high demand, especially in Kibwezi East and West during the end of the season (Field Survey, 2018). Moreover, commercial production of maize silage and trading is emerging in some parts of the country (SNV, 2013).

Estimating national pastures and fodder demand is difficult due to the dynamics of the various livestock production systems and inaccurate information on livestock populations and acreages under fodder production and conservation. A recent study suggests that Kenya suffers large deficits of livestock feeds particularly forage for dairy cattle. The deficit is over 3.6 billion bales of hay annually worth USD nine billion (USAID-KAVES, 2017). The demand is expected to increase in view of the emerging fodder demand by neighboring countries (MoALF, 2017). Production of these quantities of fodder would require an additional 15 million acres of land under fodder crops and pasture which could be realized by shifting to utilization of the arid and semi-arid areas (MoALF, 2017). Using primary data collected for this study, gross margin analysis shows pasture and fodder farming is profitable and there is effective demand. This observation is also evident in the Ministry of Agriculture, Livestock and Fisheries (MoALF 2017).

2.2 Counties

The KCDMS program's target counties include Kisii, Migori, Homa Bay, Kisumu, Siaya, Kakamega, Bungoma and Busia counties in Western Kenya, and Kitui, Makueni and Taita Taveta in the lower eastern part of the country. These are typically emerging dairy areas, as opposed to the traditional dairy areas of the Central, North and South Rift Provinces, where dairy production is relatively advanced.

2.2.1 Compound feeds in KCDMS program's target counties

In any dairy production system, whether in commercial or in emerging dairy areas, compound feeds are crucial in raising productivity and are largely composed of dairy meals and raw material used in formulating dairy meal (ingredients), mineral salts, and calf pellets. The field survey revealed that several farmers are formulating their on-farm rations using available raw material (ingredients) for making dairy meal. Some farmers feed these ingredients (e.g., sunflower and cotton seed cakes, maize/wheat/rice brans, and molasses) directly to dairy cows, especially in western Kenya. Formulation of on-farm rations is motivated by a number factors including:

- high cost of manufactured feeds;
- low cost of main ingredients used in formulating dairy meal because of the government's duty-free policy on imported raw materials compared to tax levied on finished products;
- the ease of accessibility of the main raw materials from neighboring countries (Uganda and Tanzania); and
- promotion of on-farm feed formulation by public livestock extension departments, particularly through IFADfunded Smallholder Dairy Commercialization Programme (SDCP), which supports farmers and farmer groups in western Kenya with feed milling equipment.

It would be important to note that the policy environment has motivated business around the main raw materials

used in feed formulation in the local markets where traders import maize/wheat germ/bran, cotton and sunflower seed cakes, and mix in the open-air markets according to the farmers' recommendations.

This scenario is gaining momentum in western Kenya, where in some places it is already challenging major feed miller's products. Taxation of finished products and not raw materials is pushing millers away from formulating animal feeds through milling by-products. In turn, these millers dispose the raw material in the market because of the high demand. A case in point is the Kisumu United Millers Company.



Animal feed milling group supported by SDCP (IFAD), Kisii sub-county (March 2018)



Animal feed milling equipment unit at Nyangusu Feeds, Kisii County (March 2018)

Information gathered from the primary data collected for this study revealed that, apart from major millers, a few small feed manufacturers with capacity of at least a half-ton feed mixer exists in the project counties, even though most of them operate below capacity due to marketing challenges. In lower eastern region, USAID-KAVES supported dairy cooperatives to establish an animal feeds manufacturing unit in Machakos town which is producing and supplying dairy meal (among other animal feeds) competitively to farmers through member cooperatives. Among the counties surveyed, it is only in Migori and Taita Taveta where active feed millers were not found to be present (see Annex for details). While it not clear when the miller in Migori stopped operating, one in Taita Taveta was operational until 2016. In addition to larger millers like Kisumu United Millers (raw material) and Kisumu Lake Feeds Company, Kisumu hosts several smaller feed millers. These include Sakina Feeds - located in Nyando sub-county with two distribution outlets (Kisumu and Ahero); Rusinga Feeds (Migosi); and Victoria Feeds (Riat Airport).

Kisii County hosts three feed millers - Nyangusu, Angaza, and Santana. In Bungoma, there is Eden Feeds and Sashishi Feeds in Kakamega. In Taita Taveta and Makueni, Mombasa millers established a depot at Voi and Kibwezi. Finally, Kitui Ginners, located in Kitui County, produces cotton seed cake. As mentioned earlier in this report, commercial dairy feeds include dairy meal, dairy cubes, calf pellets, maize germ, maize bran, molasses, cotton seed cake, wheat pollard, and wheat bran. However, the most commonly used compound feed is dairy meal and calf pellets. These are commonly fed to cattle alongside mineral salts. Through focus group discussions (FGDs), the study attempted to approximate the proportion of farmers that feed their animals on dairy meal, mineral salts, and calf pellets - the results of which are presented in Table 3. Based on the index computed from the information gathered during FGDs, on average, about 40% of farmers (32/80) in all the KCDMS counties use dairy meal as a feed supplement for their milking herds. The index is much higher (60%) in Kisii County and about 50% in Kakamega and Taita Taveta, irrespective of the sources (including on-farm formulated), quality and feeding regime (whether tailored to the recommended feeding regime). In Migori, Kisumu, and Bungoma counties, about 40% of the farmers use dairy meal to feed their milking herds. The percentage of farmers feeding their milking herds on dairy meal is much lower (about 20%) in Kitui and Makueni. These results roughly reflect the relative level of dairy concentration as Kisii, Kakamega, and Taita Taveta are the counties with the highest levels.

Table 3: Status of Feeding of Compound Dairy Feeds in Program Counties (Index 0-80)							
County/Dairy Concentrates Type	Dairy Meal	Mineral Salts	Calf Pellets				
Migori	4	7					
Kisii	6	7	3				
Kisumu	4	8	2				
Bungoma	4	6	I				
Kakamega	5	6					
Kitui	2	7	2				
Makueni	2	7	2				
Taita Taveta	5	6	2				
Ranking Index	32	54	13				

Source: Author's own estimation using data collected from FGDs with county livestock production

As evident from the results presented in Table 3, the proportion of farmers feeding mineral salts are much higher than dairy meal since several farmers with indigenous breeds supplement their cattle with mineral salts but not dairy meal. Despite the difference in percentages reported, these results are quite consistent with those of Auma et al., (2016; 2018). Auma et al., (2016; 2018) reported 14% and 31% of the farmers, respectively, feeding dairy meal in nine of the project counties. Variations were noted across counties and year.

2.2.2 Fodder in the KCDMS program's target counties

The field survey was meant to try and establish the status of fodder production and utilization by farmers through the County Livestock Production Extension Officers and other stakeholders during FGDs. This was the first point of entry to understand the types of fodder grown by cattle keepers and the extent of fodder use in the respective sub-counties. Bio vision's Infonet website (<u>https://www.infonet-biovision.org/AnimalHealth/Fodder-production</u>) gives a detailed synthesis of fodder crops grown in Kenya. These include fodder grasses (e.g., Napier, Brachiaria, Boma Rhodes, Guatemala, and cultivated or naturally growing common grasses); fodder legumes (e.g., Desmodium, Centroma, Lablab, and Mucuna); and crops grown purely as livestock feed or residues used as fodder (e.g., maize, sorghum, oats, and other emerging crop residues such as sweet potato vines and sugarcane tops).

The extent of fodder production and utilization together with crop residues, fodder trees, and shrubs were ranked for each sub-county and an average estimated for the entire county (Table 4). Further, the utilization index (which is the sum of the rank for all the counties visited) was computed for a general comparison of various fodder types. Napier grass was found to be the most widespread improved fodder grown and used by cattle keepers in the KCDMS project counties. The estimated overall utilization index is 52/80, though there are variations across the counties (Table 4).

From the FGDs, it was estimated that at least more than 60% of farmers grow and/or feed cattle on Napier grass in western Kenya, compared to about 40% in lower Eastern Province, where climatic conditions are not very favorable for growing Napier grass and other fodder species that are not drought tolerant. Cattle keepers in lower Eastern counties largely depend on natural pastures. With an overall ranking index of 51/80 in the eight counties surveyed,

natural pastures are a significant source of fodder/forage for many cattle keepers, not only in lower Eastern, but in all the KCDMS counties. Kisii and Bungoma are the only counties with the lowest percentage (50% or five out of 10, as reported in Table 4) of farmers relying on natural pastures, probably due to limited pasture land owing to small land sizes per household.

Table 4: Status of fodder production and utilization in KCDMS program counties (rank index 0-80)										
County	Napier grass	Natural pastures	Boma Rhodes	Brachiaria grasses	Maize Stover	Sweet potato vines	Sugar cane tops	Banana pseudo- stem/ leaves	Rice straws	Legum e crop residue
Migori	8	7	1	2	9	5	1			
Kisii	7	5	2		8	3	6	4		
Kisumu	8	8	2	3	4	3			5	
Bungoma	6	5	5		9	6	6	4		
Kakamega	9	7	4		8	6	4	3		3
Kitui	4	8		2	10	3				3
Makueni	5	8	2	4	8					4
Taita Taveta	5	7	1	2	8			4		
Rank Index	52	51	17	13	64	26	17	15	5	10

Source: Authors' own estimations using data collected from FGDs with county livestock production

Based on the ranking (Table 4), the study found that the production and utilization of Boma Rhodes was insignificant except in Bungoma and Kakamega counties, where four to five farmers out of 10 were indicated to be using, but not necessarily growing Boma Rhodes grass. It is worth noting that Boma Rhodes grass is the most traded fodder type.

The extent of growing and utilizing Brachiaria grass, introduced in nine of the twelve counties by the Accelerated Value Chain Development (AVCD) project, seemingly is negligible in the overall fodder production and utilization landscape (an estimated index of 13/80). These results. though qualitative, are consistent with the quantitative results from Auma et al. (2016) and (2018) that surveyed nine⁷ of the twelve KCDMS counties. Auma et al. (2016) and (2018) reported that 83 and



63% of the cattle keepers in the nine project counties were growing Napier grass in 2016 and 2017, respectively. The study also reported that about 5-6% of farmers grew Rhodes grass (Chloris gayana) (in 2016 and 2017), and 13% planted Brachiaria grass in 2017. The average area under Napier grass according to the studies ranged between 0.5-0.6 acres, Rhodes grass between 2-37 acres and Brachiaria grass at 0.22 acres reflecting the commercial nature of Rhodes grass.

Crop residues and other by-products contribute a significant proportion of dairy feeds, especially maize stovers, with a utilization index of 64/80 (Table 4), implying that approximately 80% of the farmers across the KCDMS program counties utilized maize stovers as fodder. Sweet potato vines are also common across the counties, though with a comparatively low utilization index (26/80). Farmers in all the counties (except in Makueni and Taita Taveta) were found to be using sweet potato vines as fodder. Feeding crop residues and crop by-products with low nutritional value, such as sugarcane tops, bananas stems, legumes and rice straw during dry season, were found to be an emerging trend as a dry season feeding strategy. Sugarcane tops and rice straws, which farmers previously collected freely and used as fodder during dry periods, are presently being traded and offer a business opportunity for the youth in Migori, Kisumu, Kakamega, and Bungoma, where farmers use them for feeding during dry seasons. This was observed during the field survey in March-April 2018 and reported by fodder traders at Luanda market (Vihiga), Ahero (Kisumu), and Khayega (Kakamega).

Moreover, it became apparent that the sale of green fodder is on the increase in the last three to five years with sugarcane tops among the traded products. Previously, farmers used to dispose of the sugarcane tops by burning. Having found their way into the fodder market, they are presently being sold along the major roads or at market centers. The survey team came across several youth selling the green fodder (Napier grass, sugarcane tops, ordinary/common grasses, and rice straws. This result is consistent with previous findings (Auma et al., 2017; 2018), which reported over 95% of farmers using crop residues for feeding in 2017 and 2018, with maize stovers being the most utilized among crop residues (94%).

⁷ These exclude Kisii, Bungoma, and Kakamega counties.

In a FGD in Migori County, participants were asked whether the county is self-sufficient in fodder production. Mrs. Jaqueline Magero, the County Director of Livestock Production, responded amazingly, saying... "that the question should be asked directly to the cows as they have a better answer in terms of productivity and body conditions..." which emphasized serious deficits of fodder and feeds in general in the county, since productivity of the cows is evidently low (see Auma et al., 2018).



Text Box 1: Focus Group Discussions in Session (Source: Field Survey, March/April 2018)





Shashishi dairy meal, Rhodes grass, and Brachiaria grass in western Kenya (March 2018)

3.1 Value chain mapping

Since there are different kinds of compound dairy feeds utilized as cattle feed and different types of fodder grown and traded in the project counties, the value chains in this study are divided between compound feeds and fodder value chains. Further, to simplify the two value chains for ease of analysis, the study lumped crop residues together with fodders in the fodder value chain and focused on dairy meal in the compound feeds value chain, since dairy meal is the predominant kind of compound feed.

3.1.1. Compound feeds (dairy meal) value chain actors

In general, there are five value chain actors from production to marketing nodes of the dairy meal value chain, i.e., before it reaches the consumer node -- the farmer. The dairy meal value chain actors include raw material (ingredients) suppliers, manufacturers (feed mixers/formulators), distributors/wholesalers, retailers, transporters at various nodes of the value chain and consumers (farmers). Table 5 presents a summary of the status of dairy meal actors in eight of the 12 counties.

Actor	Roles	Key characteristics activities and functions
Actor	Roles	Rey characteristics, activities, and functions
Animal feed raw material supplies/traders	Produce and sell milling by-products, which is the raw material in feed manufacturing. Supplying raw material to feed manufacturers/traders. Transport raw material to large buyers.	In Kenya, these are mainly maize and wheat millers, cotton ginners, and edible oil and fats producing companies located in major towns. Other sources include small scale rice millers in market centers within rice producing areas, that sell rice milling by-products to feed manufacturers. The cost of the raw materials from local millers is higher compared to millers in Uganda and Tanzania. Therefore, the non-miller, small-scale feed processors tend to import ingredients (Field Survey, 2018). Majority of these small-scale traders mix ingredients manually according to the farmers' needs, especially in Western Kenya.
Feed manufacturers	Milling human food and use by-products to formulated animal feeds. Small feed manufacturers import raw material from Uganda and Tanzania. Formulating feeds and pack in branded bags. Distribution of animal feeds through own depots or through agrovets. Transport feeds to distribution outlets and agrovets.	Most of the large feed manufacturers are also maize and wheat millers and hence use milling by-products to formulate animal feeds. The large milling companies are found in major towns and have established distribution depots in urban centers or use major agrovet stockists as the main distribution outlets/wholesale. The small-scale feed manufacturers import raw materials, mainly from Uganda and Tanzania, where maize and wheat bran, maize germ, wheat pollard, cotton and sunflower cake are comparatively cheaper. Some import on their own while others rely on traders. Small scale feed producers own small- scale feed mixers with a capacity of 0.5-2.5 tons per hour. Therefore, their feed production capacities and sale turnovers are less than 30 tons per month. Most small-scale feed producers own at least one vehicle which they use to transport feed ingredients and compounded feed to distribution outlets and customers. Some local farmers who are around and within market catchment of these producers buy feeds from the factory directly. There is a significant variation in prices between smaller and larger millers. However, prices among millers of the same scale (large or small millers) do not differ.
Feed distributors/ Feed wholesalers	Distribution outlets owned by manufacturers. Wholesale and retail transportation	Some large feed manufacturers, such as Mombasa Millers, own distribution outlets and deliver feeds to clients directly from the factory. Major agrovet stockists act as distribution outlets of large manufacturers. They sell to other smaller agro-vets at wholesale price and to farmers at retail price. Distributors are appointed to deal with a specific brand of feeds and cannot wholesale/retail another brand of feeds from a competing company. Distributors transport dairy meal to retail agrovet stockists and give feedback from the farmers on the performance of the feed to the manufacturers.

Table 5: Description of Dairy Meal Value Chain Actors and Their Roles

Table 5: Description of Dairy Meal Value Chain Actors and Their Roles						
Actor	Roles	Key characteristics, activities, and functions				
Retailors	Retail dairy meal and many other animal products Break the bulk repackage Advisory services to farmers	These are mainly sole proprietorship businesses run and managed by owners, family members, and - in most cases – by private individuals with a background in animal production and health. Unlike wholesalers, they sell multiple brands of feed ingredients and dairy meal, unpacked and re-packed in smaller quantities, and give advisory services to farmers. The businesses are in both major urban and rural centers. The price of the same brand of dairy meal varies by location, but the differences between one agrovet to another within the same locality is marginal.				
Farmers and farmers' groups supported with feed mixers and hammer mills	Formulate homemade dairy meal	Individual farmers or farmers' groups supported by donor-funded projects are formulating dairy meal locally for use on-farm and sale to members.				
Transporters	Transport of raw material to feed formulators and deliver dairy meal to agrovets	Most of transportation of raw materials to dairy meal formulators is through hired transport, but delivery of dairy meal to distribution outlets, wholesale, and retail markets is mainly through companies' own transport.				
End users/farmers	Mixing	About 14-31% of farmers use dairy meal (Auma, et al., 2016-18). This includes farmers feeding dairy cows only for a few weeks before and after calving, and not entirely throughout lactation period as recommended by research. Majority of farmers buy branded products from agrovet stockists. However, farmers are increasingly formulating their own feeds at home. Some farmers also instruct feed ingredient traders in open air markets to formulate feeds according to farmers' preference.				

3.1.2. Compound feed (dairy meal) value chain map

From this study's findings, the dairy meal value chain map was found to be rather similar across all the KCDMS program counties (Figure 4), with slight variations in cases where feed millers are located within the county, particularly small-scale millers who sell directly to consumers and are not using distributors or wholesalers. Animal feed millers are concentrated in Nairobi and Central Province (KMT, 2016). This study also found that most large millers serving western and lower eastern Kenya are in Nakuru, Nairobi, and Central Province, respectively.



Figure 4: Dairy concentrates

3.1.3. Fodder value chain actors and value chain maps

The fodder value chain generally varies by region, fodder type, and the kind of fodder, i.e., whether green or dry, among other factors. Napier grass has the shortest value chain, as it is generally sold directly from producer (fodder surplus from dairy farmer or commercial fodder farmer) to the consumer (fodder-deficit dairy farmers or dairy farmers who do not produce their own fodder). However, there are a few instances where trading in Napier grass was observed in Luanda and Khayega markets in Vihiga and Kakamega counties, respectively. The hay value chain in western Kenya is less developed than in lower eastern region. This could be due to longer dry periods in lower eastern region which encourages commercial fodder production. In addition, the harvesting of hay and seeds from natural pastures, produced by range reseeding and the fencing of natural pastures for regeneration, are common practices in lower eastern but not western Kenya (Omollo, 2017). Figures 5 to 7 illustrate the fodder value chain maps for selected fodder types and in different regions (lower eastern vs western Kenya counties) of the KCDMS program counties.



Figure 5: Green fodder Napier grass/ Brachiaria grass value chain- western Kenya



Figure 6: Hay value chain (Boma Rhodes) -Kisii County



Figure 7: Fodder value chain-Lower Eastern

Table 6 gives a general synthesis of the fodder value chain actors. This includes descriptions of their characteristics and roles.

		5
Actor	Roles	Key Characteristics, Activities, and Functions
Producers- farmers/ farmers' groups	 Collection of wild grass seeds. Production of fodder and crop residues. Harvesting fodder and crop residues and selling excess. Fodder conservation and storage (hay). Processing fodder and crop residue and selling excess. 	Production of fodder is largely subsistence by smallholder farmers keeping cattle, even though some sell what they consider excess. Though few, commercial fodder producers are increasing in number and the most common fodder type grown commercially is Rhodes and Brachiaria grasses, the area under production varies. Baling and selling of natural grass is common in lower Eastern but not in Western Kenya, where it's harvested and sold green in the urban and peri-urban area. Conservation and the sale of crop residues is increasingly becoming important due to increased frequency of long-dry-spells. Baling is mainly manual, using a box baler. Some farmers/farmers' groups have hay bans previously supported by donor-funded programs and projects. Most of these hay bans are empty due to a low volume of hay produced and/or a high demand, leaving nothing for storage. County governments, in lower eastern, supports farmers and farmers' groups with tractor balers and mowing and baling of hay is mechanized. A few individual farmers have mechanized baling equipment which are hired by other farmers when county government equipment is not operational or fully occupied.
Fodder traders	Harvesting, aggregation, and transportation	The most traded fodder is grass hay, mostly by agrovet stockists; informal traders; farmer's cooperatives societies (particularly those offering inputs, check-off systems to members); and hay producers-vertical integrations. Rhodes grass is the most traded type of hay, even though Brachiaria is also picking up in some parts of the counties where it has been promoted in the last two years. Green fodder (Napier grass and natural pastures) is also traded by youth in peri-urban areas. They buy from farmers' harvest, aggregate and transport to strategic locations along the road or market centers. They also sell crop residues including maize stovers, sugarcane tops, and rice straws when feed is scarce after prolonged dry periods.
Transporters	Aggregation, transportation, and selling	The modes of transportation for fodder and crop residues range from use of lorries and pick-ups to motorcycles and bicycles, depending on distance and the volume and type of fodder/crop residues being transported. Some fodder transporters combine transport function with trade in fodder; however, in most cases, transporters are hired by traders and farmers (consumers) for their services.
End users	Harvesting, storage, and processing of fodder/residue using pulverizes before feeding	End users of fodder are smallholder farmers keeping 1 - 4 dairy cattle of improved breeds (cross and pure) (Auma et al., 2018). Fodder conservation and storage is common in lower eastern and but not in western Kenya. Farmers depend on their own grown fodder, except those in peri-urban areas who rely on the market but supplement with purchased fodder during prolonged dry periods. A few dairy farmers use pulverizers to process fodder and crop residues before feeding.

Table 6: Description of Fodder Value Chain Actors in KCDMS Program Counties

3.1.4. Efficiencies, Performance, and Margins

To analyze the performance of the dairy feeds (compound and fodder) value chains in KCDMS counties, the results of this study are presented in this section, mostly in the form of case study scenarios. The results are presented, first focusing on compound feeds, then followed by fodder.

Analysis of performance in compound feeds (dairy concentrates) value chain

The major animal feed millers in Kenya rely on their own milling by-products for the main raw material used in animal feed production, while small-scale millers rely on import from Uganda and Tanzania. According to the information provided by the small-scale millers interviewed in the KCDMS project counties, the raw material from these countries are cheaper than locally available material, coupled with the government's duty-free policy on animal feeds on raw material implemented after the Association of Kenya Feeds Manufacturers (AKEFEMA) lobbied the government. Table 7 presents prices of various raw materials reported by millers, indicating, in most cases, the source of the raw materials. From the table, United Millers' prices are higher than reported by Eden Millers (Uganda and Tanzania), except for the price of wheat bran, which is apparently the same. Eden Millers reported a price of KES 18 per kilo for wheat bran from Mombasa Millers and United Millers while data collected from United Millers shows the highest prices of wheat bran produced by is KES 14 per kilo. Consequently, there is a possibility that either United Millers reduced their prices especially for wheat bran due to competition and/or Eden Millers may not have been aware of the prevailing local prices now that it relied on imports. The price of wheat pollard from United Millers is nearly double that imported from Uganda, and maize germ is slightly cheaper than whole maize from Uganda. Cotton seed cake from Makueni Ginnery is cheaper (KES 25,000/MT) than that sourced from Tanzania (KES 38,000/MT).

Table 7: Prices of Main Raw Material Use by Various Millers and Sources							
		Price					
Raw Material/ Source	Description	(KES/MT)	Remarks				
United Millers							
Maize germ	40Kg Bag @880	22,000.00					
Wheat pollard	40 Kg Bag @ 1100-1200	30,000.00					
Wheat bran	50 Kg Bag @600-700	14,000.00					
Eden Millers (wholesale prices)							
			KES 18/Kg United and				
Wheat bran UG	KES 14 per Kilo	14,000.00	Mombasa Maize Millers				
Whole maize UG	KES 2300 per bag of 90Kg	25,555.55					
Sunflower seed cake UG	KES 25 per Kg	25,000.00					
Cotton seed cake -TZ	KES 38 per Kg	38,000.00	KES 25/Kg Kitui Ginneries				
Soya beans -BIDCO KE	KES 60 per Kg	60,000.00	BIDCO				
Wheat pollard UG	KES 18 per Kg	18,000.00					
Sweetex Feeds - Bungoma (retai	ling prices)						
Maize germ (Source UG)	70 Kg @ 1750	25,000.00					
Wheat bran (source UG)	50Kg@1000	20,000.00					
Wheat pollard (sourced UG)	50 Kg Bag @1250	25,000.00					
Omena (Sourced UG)	IKg@100	100,000.00					
Sunflower seed cake (Sourced UG)	I Kg @40	40,000.00					
Cotton seed cake (sourced UG)	I Kg @55	55,000.00					
C E: 11 2010	·	·	·				

Source: Field survey, 2018

Further analysis of the retail prices (Sweetex Feed ingredient trader in Bungoma) of wheat bran, wheat pollard, and sunflower and cotton seed cake indicated a margin of 43%, 39%, 60%, and 34%, respectively when compared with prices of imports reported by Eden Millers (Table 7). These high margins (which included transport and other marketing costs incurred by the trader) could explain the surge in raw material importation and trade, especially in western Kenya which is competing against established millers' products.

The accessibility of ingredients in the open-air market also encourages on-farm formulation to manage the high cost associated with supplementary feeding and milk production. The availability of raw materials and the high cost of processed feeds creates a business opportunity for small-scale feed formulation, especially for youth and women, if quality and standardization challenges can be addressed.

The study listed all the feed millers/formulators operational in the eight counties surveyed, and profiled information on installed mixer capacity, estimated annual capacity, and actual production of dairy supplements, as well as the cost of production and consumer price per ton (Table 8). The study estimated the market margins by subtracting the cost of production from the price consumers pay per ton. Established millers (small-scale) had market margins ranging from 20%-44% compared to animal feed ingredient traders ranging between 26%-71%. Considering that established millers had the cost of distribution and marketing included in the margins, while traders sell directly to consumers without marketing costs, the market margins are a good approximations of profit margins because feed ingredient traders formulate dairy supplement without overhead costs such as licenses and tax fees.

Animal feed preparation ongoing

Тс	Table 8: Livestock Feed Millers and Traders' Capacity, Cost of Production of Dairy Compound Feeds and Market Margins									
County	List of Millers/Traders	Installed Mixer (MT)	Annual Capacity (MT)	Estimated Annual Production (MT)	Cost of Production (KES /MT)	Consumer Price (KES/MT)	Margins (KES/MT)	Margins (%)		
Migori	No active millers									
Kisii	Nyangusu Millers	2		96						
	Angaza(Aqua) Feed Millers	0.5		36	27,600.00	40,000.00	12,400.00	44.93		
	Santana	0.5		36						
	Genga Feed Solutions	0		168	27,142.85	34,285.71	7,142.86	26.32		
Total				336						
Nyamira	One End Feeds									
Kisumu										
	Kisumu Lake Feeds Limited		3120	1200	22,222.22	27,142.85	4,920.63	22.14		
	Sakina Feeds	1.5		360	30,000.00	36,000.00	6,000.00	20.00		
	Rusinga Feeds			0						
	Vitoria Feeds			0						
	United Millers - maize and wheat by-products		7620	7620						
Total				9180						
Bungoma	Sweetex Feeds	0	180	120	27,361.11	35,000.00	7,638.89	27.92		
	Eden Feeds	2.5	2940	840	21,428.57	28,571.42	7,142.85	33.33		
	Lunakwe Millers Bumula farmers' group									
	Professor Bwibo Kimilili									
	Mlisho Bora Kimilili									
	Muliro Umoja Tongaren									
Total				960						
Kakamega	Sashishi in Mumias West	1.5	360	198	24,000.00	31,000.00	7,000.00	29.17		
Kitui	Kitui Dairy Goats-Kitui West									
	Kitui KDC									
	Kitui Millers									
	Utoo Feeds Kitui Central-	0	104	96	21,000.00	36,000.00	15,000.00	71.43		
	Kitui Ginneries (cotton seed cakes			720						
Makueni	Miela Poultry and Animal Feeds -Sultan Mbs-Nrb Road									
Taita Taveta	No active millers									

Source: Author's estimates from primary data

26 USAID-KCDMS Feed and Fodder Value Chain Assessment Report- 2018

3.1.5. Analysis of performance in fodder value chain

In this section, case studies on Napier grass, Boma Rhodes grass, Brachiaria grass, natural pastures/common grasses and pulverized maize stovers are presented. We estimated the gross margins of various fodder types and crop residue -- Brachiaria, Boma Rhodes, Napier grass, natural pastures (range reseeding) and total mixed ration (TMR) of maize stover (Tables 9 to 15). Natural pastures had the highest gross margin per acre (KES 165,100), mainly because of the huge local and international market for seeds (Field Survey; Omollo, 2017). FAO Somali, FAO Kenya, German Agro Action, and World Vision are some of the non-governmental organizations (NGOs) buying large quantities of grass seeds under various projects supporting farmers in Somaliland, Southern Sudan and Rwanda (Field Survey, 2018). Local markets include Kitui, Makueni, Taita Taveta, Meru, Mandera, coastal region, as well as NGOs and community-based organizations (CBOs) working in pastoral and agro-pastoral parts of Kenya. The newly promoted Brachiaria grass has the best gross margins per acre per year when the sale of Boma Rhodes seeds is not considered due to high yields (300 bales) per cutting comparatively.

Table 9: Brachiaria Gross Margins – Chamgiwadu Farmers' Cooperative, Migori County						
0.25 Acre of Brachiaria in Year I						
ltems	No.	Unit Cost (KES)	Total Cost (KES)	Remarks		
Land preparation	I	300	300.00	Use of animal draft power		
Harrowing	I	300	300.00			
Labor for nursery prep (MD)	I	150	150.00			
Cost of seeds (0.5 Kgs)	0.5	4300	2,150.00			
Labor for transplanting	I	400	400.00			
Fertilizer DAP	12	125	1,500.00			
Fertilizer CAN	12	95	1,140.00			
Labor for fertilizer application	2	150	300.00			
Labor for harvesting @1500 per cutting	3	1500	4,500.00	1500/ cutting		
Total variable cost		4	10,740.00	42,960.00 acre		
Yield (670kg/harvest X3 price 15/Kg	2010	15	30,150.00	120,600.00 I acre		
Gross margin/0.25 acres per year		4	19,410.00	77,640.00 acre		
Gross margin (%)			180			
Cost of production in subsequent year						
Alternative pricing (KES 250/bale; 45 bales	135	250	33,750.00	Labor for baling not considered		
Cost of leasing land KES 30 000 per year because of competition with sugarcane production						

Cost of leasing land KES 30,000 per year because of competition with suge Source: Author's own calculations

Our gross margin estimates for Rhodes grass-based hay (Table 10), derived on the primary data gathered for this study through FGDs, is compared with that of Egerton University's "Seed of Gold" column in the **Saturday Nation** newspaper, May 5th, 2018 (Table 11). The Egerton estimates include the value of seeds, which overestimates the margins. Moreover, the cost of production estimates in the Egerton study did not use current labor prices of harvesting, further overestimating profit margins.

Table 10: Boma Rhodes Hay Gross Margins – Primary Data					
I.0 Acres Boma Rhodes (Hay)					
Item	No.	Unit Cost	Total		
Land leasing cost (per year)	I	10000	10,000.00		
First ploughing	I	6000	6,000.00		
Second ploughing	I	4000	4,000.00		
Seeds (sourced from farmer in Nyamira)	5	700	3,500.00		
Planting (group members)	20	150	3,000.00		
DAP 50 kg bag (applied at planting)	I	2700	2,700.00		
CAN 50 Kg bag	I	2700	2,700.00		
CAN application labor (group)	20	150	3,000.00		
Uprooting weeds (group members)	20	150	3,000.00		
Harvesting using pangas	2	500	1,000.00		
Baling KES 20/bale by members (120 bale/cutting)	360	20	7,200.00		
Transport to hay ban (group members)	360	10	3,600.00		
Total variable cost			49,700.00		
Yield (120 bales per cutting X 3 cuttings/year	360	300	108,000.00		
Gross margins year of establishment			58,300.00		
Gross margin (%)			117		

Source: Author's estimations from primary data

Table 11: Gross Margins of Hay and Seeds-Boma Rhodes – Secondary Data						
Production cost per acre						
		Unit	Estimated			
ltem	Unit	Cost	Cost (KES)			
First ploughing	l	8000	8,000.00			
Second ploughing	I	8000	8,000.00			
Harrowing	I	5500	5,500.00			
2 Kg seeds @ KES 1000 per kilo	2	1000	2,000.00			
Fertilizer - I bag of DAP @2700 per bag	I	3000	3,000.00			
Farm yard manure 10 tons @1000 per ton	10	1000	10,000.00			
Labor for sowing	I	5000	5,000.00			
Top dressing CAN – 2 bags @2700 per bag	2	2700	5,400.00			
Top dressing manure-5 tons @1000/ton	5	1000	5,000.00			
Labor for uprooting weeds 10MD@300	10	300	3,000.00			
Miscellaneous cost (transport/communication)	I	5100	5,100.00			
Est. total cost of hay production			60,000.00			
Income hay/ seeds						
No. of harvested bales = 300 per cutting for three						
cutting/year at 200 each	900	200	180,000.00			
Profit from hay			50,000.00	120,000.00		
Sale of seeds-450Kg @1000 per Kilo	450	1000	450,000.00			
Profit from seeds (excl. labor 15,000)			435,000.00	15,000		
Profit (seeds and hay)/acre-first year			485,000.00			

Source: Saturday Nation, 5th May 2018 ("Seed of Gold" column)

Table 12: Gross Margin of Napier Grass							
0.25 Acres Napier Grass Gross Margins - Riamaher	Kisii						
Items	No.	Unit Cost	Total	Remarks			
Land leasing cost (1/4 acre)	I	5000	5,000.00				
Land preparation (MDs/ group)	4	150	600.00				
Planting material (contributed by farmers)	I	0	-				
Fertilizer (DAP, Kg)	35	52	1,820.00				
Labor for planting (farmers' group)	4	150	600.00				
Applying farmyard manure after cutting	20	100	2,000.00				
Harvesting labor (by buyers)			-				
Transport cost (by buyers)			-				
Total variable cost		4	10,020.00	40,080.00			
Yield (28 lines of Napier, three cuttings in a year)	84	300	25,200.00	100,800.00			
Gross margins			15,180.00	60,720.00			
Gross margins (%)			151				

Source: Author's estimations from primary data

Several coping strategies are used to feed dairy cattle during dry periods when acute feed shortages are experienced, and which are becoming more frequent. Similarly, the high cost of dairy concentrates encourages farmers to use locally available feeds efficiently. The study analyzed one such scenario in Rongo, Migori County, where a farmer with a pulverizer uses maize stovers, Boma Rhodes, Desmodium, and other legume residues to make a total mix ratio (TMR) for his own use and sells excess to his neighbor (Table 13). The gross margin approximated is at 40% of the cost of production.

Table 13: Gross Margin of TMR (Maize Stover) - Case Study of a Farmer in Rongo, Migori						
I.0 acre of Maize Stover TMR						
ltems	No.	Unit Cost	Total	Remarks		
Harvesting labor (supporting harvesting of another farmers' maize)	3	300	900.00	Equivalent to cost of raw material		
Labor for harvesting maize stovers	3	300	900.00			
Transportation using a lorry - two trips	2	1500	3,000.00			
Storage labor	4	300	1,200.00			
Fuel cost (KES 500 worth of fuel crush six bags-45 bags for HB)	7.5	500	3,750.00	Hybrid maize produces 42-50 bags, local 32 bags per acre		
Engine oil cost or crushing 45 bags (1200 for three months)	I	250	250.00			
Labor for crushing (45 bags crushed in 7.5 days@ 50/bag	45	50	2,250.00	I month of 26 days crush 156 Bags		
Cost of other ingredients in TMR (Desmodium, Boma Rhodes, etc.)	45	50	2,250.00			
Total variable cost			14,500.00			
Sales of TMR (45 bags; KES 400-500/bag)	45	450	20,250.00			
Gross margins			5,750.00			
Gross margin (%)			40			

Source: Author's own calculations

I. 0 Acres of Natural Pastures, Hay and Seeds (Cenchrus ciliaris sp.)							
		Unit					
Items	No.	Cost	Total				
Fencing labor cost using local materials	10	200	2,000				
Land preparation cost	Ι	2000	2,000				
Planting labor (broadcasting)	Ι	200	200				
Labor for uprooting of weeds (KES 200-1000 weed type)	Ι	500	500				
Labor for cutting, baling and transporting hay (150-180 bales/ acre)	180	70	12,600				
Labor for harvesting seeds (KES 100-200/Kg depending on sp.)	200	200	40,000				
Labor for transport of seeds from farm (10 Kgs bag @KES 10)	20	10	200				
Labor for drying and packaging (KES 20 per bag of 10 Kg)	20	20	400				
Packaging material cost	Ι	2000	2,000				
Total variable cost			59,900				
Value of hay (production: 150-180 bales/ acre)	180	250	45,000				
Value of seeds (KES 700-900/Kg)	200	900	180,000				
Gross production			225,000				
Gross margin			165,100				
Gross margin (%)			276				

Source: Author's own calculations

Table 15 is a case study of a group of women producing commercial hay in Tongaren, Bungoma County. The group could hardly break-even in the first year due to a low harvest resulting from poorly established Boma Rhodes and the effects of the long dry spell experienced in 2016. The group got discouraged and subsequent harvestings were done by a buyer who paid a flat rate of KES 25,000, irrespective of the number of bales. The buyer used a tractor to mow and bale the grass, and the group expects the fourth harvest in June/July after the long rains; they are negotiating for better terms this time around.

Table 15: A Case Study of Commercial Hay Producers - Tongaren ACK Women's Group- Bungoma									
I.0 Acres Boma Rhodes	I.0 Acres Boma Rhodes								
Itoms	No	Unit Cost	Total Cost						
	NU.	(KES)	(KES)						
Land fencing cost - barbed wire	I	4500	4,500.						
Fencing poles	I	3000	3,000						
Labor for fencing	I	1000	1,000						
Total cost of fencing			8,500	exclude in the GM					
Land-leasing cost (per year)	I	10000	10,000						
First ploughing	I	3000	3,000						
Second ploughing	I	3000	3,000						
Seeds 10 Kgs and transport	I	9500	9,500						
Planting and fert. application labor	I	3000	3,000						
DAP - two bags (50Kgs)	I	8000	8,000						
Spraying and weeding	I	1000	1,000						
Labor for spraying	I	800	800						
Harvesting 10 MD (first cutting)	10	300	3,000						
String for baling (cutting)	I	1000	1,000						
Transport and lunch for members	I	3000	3,000						
Total variable cost of production Year I			45,300						
				Cut once per yr.					
	150	200	45.000	due to poor					
First narvesting (150 bales) @KES 250-300	150	300	45,000	establishment and					
				drought					
Gross margin Year I (KES loss)			- 300						
GM (%)			-0.7						
Year 2 cost of production									
Land-leasing cost	I	10000	10,000						
Spraying and labor cost	I	1800	1,800						
CAN (two bags)	2	2500	5,000						
Total variable cost			16,800						
Gross sales Year 2 (buyer harvested using	· .								
tractor)		25000	25,000						
Gross margin Year 2			8,200						
GM (%)			49						
Year 3 cost of production									
Land-leasing cost	I	10000	10,000						
Spraying and labor cost	1	1800	I,800						
CAN (two bags)	2	2500	5,000						
Total variable cost			I 6,800						
Gross sales Year 3 (buyer harvested using	l .	25000	25.000						
tractor)		25000	25,000						
Gross margin Year 3			8,200						
GM (%)			49						
Expecting fourth cutting in June/July									
Total cost of investment over three Years (ind	:l.		07.400						
fencing)			87,400						
Gross sales for the three cuttings			95,000						
Net return on investment (three	1								
cuttings/harvesting)			7,600						
				1					



These case studies demonstrate the extent to which commercial fodder production offers viable business opportunities which have not been fully exploited, particularly in western Kenya where land could be limiting. In lower eastern Kenya, large tracts of land are not under crop cultivation because of low precipitation, even though they are adequate for natural pasture production.

Farmers and groups interviewed in Kitui, Makueni, and Taita Taveta confirmed that a huge market exists for natural pasture seeds and hay, but producers need to be better organized to exploit the market (Omollo, 2017). The KCDMS counties are net importers of hay from the Rift Valley, especially Nakuru, Uasin Gishu, Kitale, and Eldoret (Field Survey, 2018). This creates business opportunities in commercial fodder and seed production, aggregation, transportation and trade, especially for the youth and women. The biggest challenges to seed production and trade opportunities are the stringent regulations on seed certification by the Kenya Plant Health Inspectorate Service (KEPHIS), which have denied farmers lucrative markets outside the county.

4.0 **PRODUCTION AND SUPPLY**

4.1 **Productivity by counties**

4.1.1 Compound dairy feeds

Production and Supply: Since farmers in KCDMS counties depend largely on dairy meal manufactured and supplied from outside the counties, analysis of the local supply situation might be misleading unless the study restricts itself to the milling capacity in these counties (see Table 8). Overall, the size of the animal feed industry in Kenya has been steadily increasing in the last ten years, mainly due to the growth of the livestock sub-sector (Gitonga, 2014). In 2008, there were about 100 registered livestock feed manufacturers. By 2013, that number had increased to about 150 (Gitonga, 2014). Of these, twenty were also large grain millers and eight were oilseed manufacturers. There were also nearly fifty registered raw material importers and six suppliers of feed premixes (mineral, vitamin, and other mineral elements) (Gitonga, 2014). By 2016, the number of millers and operators reached 305 (307 from other sources), of which 115 were manufacturers, 96 were raw material suppliers (or ingredients), and 94 were both producing raw materials and manufacturing feeds (KMT, 2016). This excludes hundreds of home/community-based formulators and open market traders of feed ingredients whose growth is driven by farmers' desires to contain spiraling production costs (Gitonga, 2014; KCDMS Feeds Survey, 2018).



Feed ingredient trader, Kisii town (March 2018)



4.1.2 Fodder

The study estimated fodder production and productivity, assuming several factors due to the technicalities involved. These are further complicated by the fact that most farmers growing fodder feed directly from the farm, and commercial fodder production is still limited, since only 18% of what is produced is traded or sold to other farmers in the project counties (KCDMS Draft Baseline Survey Report, 2018). Several farmers (29%-35%) growing fodder have not set aside land for fodder, and instead use hedges, farm boundaries, road sides, and soil conservation structures to grow fodder. Unfortunately, these areas could not be estimated (Auma et al., 2016; 2018). All the same, the study estimated fodder production using bales of hay equivalent based on average yield per acre. This is because hay bales are measurable and the most traded fodder. According to the KCDMS Draft Baseline Survey Report (2018), the yield of Napier in the KCDMS counties is near optimum (38 tons/ha), but all other fodders grown attained yields below the potential and or national averages: Boma Rhodes (6.7 tons/ha), Brachiaria sp (8.6 tons/ha), Desmodium (5.4 tons/ha) and sweet potato vine (20.2 tons/ha). Nguku, (2015) reported dry matter yields of Napier at 5430 kg /ha and Brachiaria Piata sp. at 8,867kg/ha which were the highest among Brachiaria species established for trial. Sita, (2017) reported biomass potential of up to 30 tons/ha for Brachiaria species. Table 16 presents snapshots of types of fodder grown in nine of the 12 KCDMS counties and the average area for each fodder (Auma et al., 2016; 2018).

Table 16: Average Area (acres) under Improved Fodder by Fodder Types in Nine KCDMS Counties					
Type of Fodder	2016	2017			
Napier grass	0.56	1.14			
Planted grasses, e.g., Boma Rhodes grass	1.71	I.46			
Fodder maize	0.25	1.05			
Fodder shrubs (Calliandra, Sesbania, Lucaenia)	0.12	0.21			
Other fodder legumes (Desmodium, Lucerne, Vetch)	I.80	0.18			
Other (specify)	0.52	2.23			
Brachiaria/Mulato	0.00	0.39			
Overall	0.60	0.54			

Source: Auma et al., 2016; 2018

Supply: To estimate fodder supply, the study used the AVCD Baseline and Annual Monitoring Survey data. This data captured the area under improved fodder by fodder type (or the proportion of household landholding under improved fodder) and the area set aside for grazing (proportion of household landholding under natural pastures) (Auma et al., 2016; 2018). Data for non-AVCD counties were obtained from other sources (RoK, 2014). Using household averages for area under improved fodder and natural pastures, the study estimated the total area separately under improved fodder and under natural pastures for each county by extrapolating sample averages to county population (households), weighted by the proportion of farmers keeping cattle, growing improved fodder, and/or setting aside land for grazing (natural pastures) – Table 17. It is important to note that this approach could significantly underestimate the quantity of fodder produced because farmers growing improved fodder on farm boundaries, hedges, roadsides. and soil conservation structures (strips) are not included. Similarly, farmers grazing cattle on communal land, by the roadside, and other farmers' parcels of land are not included, as it's difficult to determine the area available for grazing.

Based on several assumptions (see Annex 4), about 1.14 million hectares (468,000 and 676,000 under improved fodder and natural pastures respectively) is estimated to be under fodder and forages in the 12 KCDMS counties in 2017/18. This has the potential to produce close to 1.1billion bales of hay equivalent a year assuming an average productivity of 450 and 300 bales for grass and legume per acre (0.4ha) per year respectively. It is important to note that fodder production estimates in this case include those for local and improved cattle. With intensification of improved dairy in these counties, the demand for high quality fodder and forages will increase, attracting higher benefits than leaving the land for open grazing or fallow. There is an opportunity to convert some grazing land for high quality fodder production in some of the counties. Brachiaria, which is a high yielding, high quality fodder with a high protein content, is suitable for farmers and commercial fodder production since it could be fed directly, baled into hay, and used for making silage. Table 17: Estimated Area under Improved Fodder and Natural Pastures (Ha) by Counties

Counties	Estimated No. of	Estimated Area	Estimated Area	Total Area	Estimated Bales
	Households 2017	under Improved	under Natural	Available for	of Hay Equivalent
		Fodder (Ha)	Pastures (Ha)	Fodder and	Produced
				Pastures (Ha)	
Busia	161,583	11,485	26,590	38,075	35,695,476
Bungoma	366,562	8,431	11,466	19,897	18,653,439
Homa Bay	210,211	21,411	64,536	85,948	80,575,843
Kakamega	434,331	27,363	23,106	50,469	47,314,915
Kisumu	216,179	107,034	20,006	127,040	119,099,890
Kisii	290,861	12,286	9,121	21,407	20,069,443
Kitui	221,755	77,250	60,534	137,783	129,171,957
Makueni	162,139	111,693	381,828	493,521	462,676,005
Migori	203,815	2,647	1,182	23,829	22,339,993
Siaya	169,191	40,714	44,355	85,069	79,752,579
Taita Taveta	76,844	I 4,888	21,762	36,650	34,359,515
Vihiga	106,466	12,473	11,522	23,996	22,495,868
Total	2,619,937	467,675	676,010	1,143,685	1,072,204,922

Source: Authors' estimations

4.2 Summary of key productivity opportunities

Among other opportunities detailed in the table which follows is the opportunity to adopt varieties of high yielding improved fodder species availed by research and suitable for humid, midland, and semi-arid lands by smallholder farmers. One such example would be Brachiaria. The grass has high biomass and can be used for hay and silage. Bringing some land under natural pastures to growing improved fodder will increase land productivity and increase biomass for dairy feeding. The low yield of fodder per unit area is because of planting of unsuitable species and poor fodder management due to low commercialization. Reseeding rangeland with suitable natural pastures species will rehabilitate degraded rangeland, as well as double benefits to the smallholder farmers-feeds and environmental protection.

Table 18: Summary of key opportunities for intervention in feed and fodder production								
Activities	Challenges	Opportunities for Intervention						
Fodder production and utilization	 High demand of fodder amidst reducing land sizes in some counties and competing farm enterprises Knowledge gap – information on fodder production and good feeding practices Certification process for grass seeds as outlined by KEPHIS regulations is a challenge to smallholder seed producers 	 Adopt varieties of high yielding improved fodder species availed by research in suitable areas Testing and implementing viable commercial seed/splits production models Testing and implementing viable commercial fodder production models Extension and training on production and feeding Support farmers' groups to develop effective feeds plan and put it into use - planning to ensure adequate supply of fodder at the time of scarcity 						
Compound feed production	 High prices of finished products (compound feeds) Quality in terms of nutrient values and food safety 	 Training farmers and small-scale feed formulators on on-farm compound feed formulation Certification and standardization of small-scale compound feed formulators Supporting production of local milling and mixing machinery through transfer of knowledge and skills Supporting research, development, and policy for local production of raw materials for feed manufacturing Capacity building on feed quality, use of available feeds and ingredients, proper storage, stock management transporting and handling of feed like pest management and affects animal production and productivity (KMT ,2017). 						

5.0 MARKET DEMAND

5.1 Demand for Compound Feeds in KCDMS Counties

The study estimated potential demand for dairy concentrates (meal) based on the proportion of lactating dairy cows producing eight litres and above assuming one kg of dairy supplement for every two litres produced over and above eight litres per cow per day (Table 19). Currently, potential demand for dairy meal is at 46,000MT in the KCDMS counties and projected to increase by more than 3000 MT to 48,000 MT in 2022 due to an increasing dairy cattle population (1.3% annually). These figures are a close estimate of the actual demand for dairy meal according to previous studies which reported 14%-34% of farmers feeding dairy meal in the nine of the 12 KCDMS counties (Auma et al., 2016; 2018). Farmers producing high volumes of milk per cow are likely to reap higher benefits from high milk prices (KES 60 per litre) and recover the cost of production plus gain a wide profit margin. This creates business opportunities in milling and distribution of dairy concentrates with market value of between KES 1.2-18 billion in 2018 to 1.3-2.0 billion in 2022, depending on current consumer price per kg ranging between KES 27 and 40. Intensification of dairy production could further expand the demand and market for dairy concentrates.

Table 19: Projected (Potential) Demand for Dairy Meal by Counties (MTs)						
Counties	Estimated Number of Lactating Cows 2018	Proportion of Dairy Cows Producing < 8 Litres (80%)	Proportion of Dairy Cows Producing ≥8 Litres (20%)	Potential Demand Dairy Meal (MT) Annually 2018	Potential Demand Dairy Meal (MT) Annually 2022	
Busia	5,307	4,246	1,061	1,117	1,176	
Bungoma	37,660	30,128	7,532	7,925	8,345	
Homa Bay	3,164	2,532	633	666	701	
Kakamega	49,284	39,427	9,857	10,370	10,920	
Kisumu	7,431	5,945	I,486	1,564	1,647	
Kisii	64,670	51,736	12,934	13,608	14,330	
Kitui	23,763	19,011	4,753	5,000	5,265	
Makueni	9,590	7,672	1,918	2,018	2,125	
Migori	4,373	3,498	875	920	969	
Siaya	1,757	1,405	351	370	389	
Taita Taveta	12,146	9,717	2,429	2,556	2,691	
Vihiga	15,610	12,488	3,122	3,285	3,459	
Total	218,199	174,560	43,640	45,914	48,349	

Source: Authors' own estimations

5.2 Demand for Fodder and Forages in KCDMS Counties

Based on the projected population of improved dairy cattle (ILRI Database, 2018), the study estimated daily and annual dry matter intake (DMI) for the KCDMS counties (Table 20) based on several assumptions (see Annexes). The total fodder consumption for improved dairy cattle (potential demand) is approximately 182 million bales per year (average weight per bale estimated at 15 kg) for the dairy cattle population approximated at 628,000 in the 12 counties. This requires about 485,000 hectares of land to produce. These figures seem realistic in comparison to the most recent study by USAID-KAVES, (2017) which estimated the potential demand of hay at 1.96 billion bales per year for 7.2 million improved dairy cattle which require approximately two million hectares of land to produce. These estimations were based on a daily DMI of between nine-14 kg or 3% of the animal's body weight, assuming average body weight of 300 Kg, to factor different reproductive cycles of the cattle, breeds, etc.

Assuming four months of a dry period in a year in which fodder is scarce and farmers rely on the market or buy from neighbors, potential demand for hay is approximately 60 million bales per a year for improved dairy cattle only (Table 19). This is projected to increase due to an increasing improved cattle population (1.3% annually), the frequency of severe dry spell, and effects of climate change overall. This creates a business opportunity for commercial fodder production.

Previous studies estimated between 30%-37% of farmers purchase various fodder types from other farmers (neighbors) and markets to supplement their own production during fodder-scarce dry periods of the year (Auma, et. al., 2016; 2018). Assuming a producer price of KES 200 per bale for a 15 kg bale of hay, the study estimates the market value of hay at KES 12 billion during the four months dry period in the 12 KCDMS counties. This creates commercial fodder production as a business opportunity within and between the counties.

Table 20: Estimated (Potential) Demand for Hay (15 kg Bales) based on improved dairy cattle population by County							
Counties	Estimated No. of Dairy Cattle 2018	Daily DMI in MTs	Annual DMI (MT)	Annual Bales of Hay Equivalent Required	Estimated Area (Acres) for Production	No. of Hay Bales in Four Months of Dry Period	
Busia	16,738	167	61,093	4,848,648	12,930	1,616,216	
Bungoma	107,601	1,076	392,744	31,170,140	83,120	10,390,047	
Homa Bay	11,076	111	40,426	3,208,435	8,556	1,069,478	
Kakamega	125,105	1,251	456,635	36,240,858	96,642	12,080,286	
Kisumu	18,240	182	66,578	5,283,943	14,091	1,761,314	
Kisii	165,821	1,658	605,245	48,035,320	128,094	16,011,773	
Kitui	70,201	702	256,233	20,335,952	54,229	6,778,651	
Makueni	23,538	235	85,914	6,818,611	18,183	2,272,870	
Migori	12,034	120	43,924	3,486,024	9,296	1,162,008	
Siaya	6,000	60	21,900	1,738,131	4,635	579,377	
Taita Taveta	28,929	289	105,590	8,380,123	22,347	2,793,374	
Vihiga	42,341	423	154,545	12,265,447	32,708	4,088,482	
Total	627,624	6,276	2,290,827	181,811,631	484,831	60,603,877	

Source: Authors' estimations

The projected demand (potential) for hay (equivalent) will increase from 182 to 192 million bales based on a dairy cattle population increase alone (Table 21). This will expand the potential hay market by about KES 800 million in the 12 KCDMS counties at current prices of KES 200 per bale. Similarly, without intensification, additional projected acreage of production will be required and will increase to 510,000 hectares, assuming an average production of 450 bales of grass and 300 bales of legumes per acre per year (see USAID-KAVES, 2017 and Annex 4).

Т	Table 21: Projected DMI, Bales of Hay and Acreage Based on Dairy Cattle Population in 2022					
Counties	Projected Population of Improved Dairy Cattle 2022	Projected Annual DMI (MTs) 2022	Projected Annual Bales of Hay (Grass and Legumes) 2022	Projected Ha under Fodder without Intensification (2022)	Projected (Potential) Demand for Hay in Four Months of Dry Period (2022)	
Busia	17,625	64,332	5,105,737	13,615	1,701,912	
Bungoma	113,306	413,568	32,822,868	87,528	10,940,956	
Homa Bay	11,663	42,570	3,378,555	9,009	1,126,185	
Kakamega	131,739	480,847	38,162,451	101,767	12,720,817	
Kisumu	19,208	70,108	5,564,113	14,838	1,854,704	
Kisii	174,613	637,337	50,582,288	134,886	l 6,860,763	
Kitui	73,923	269,819	21,414,221	57,105	7,138,074	
Makueni	24,786	90,470	7,180,153	19,147	2,393,384	
Migori	12,672	46,253	3,670,862	9,789	1,223,621	
Siaya	6,318	23,062	1,830,292	4,881	610,097	
Taita Taveta	30,463	111,188	8,824,460	23,532	2,941,487	
Vihiga	44,586	162,739	12,915,795	34,442	4,305,265	
Total	660,902	2,412,293	191,451,796	510,538	63,817,265	

Source: Authors' own estimations

5.3 Market Channels

Compounded feeds' market channels

There are five marketing channels of compounded feeds including dairy meal (KMT, 2016):

- Manufacturers (source) + Distributor + Wholesaler + Retailer + Consumer (37.1%);
- Manufacturers (source) + Distributor + Retailer + Consumer (37.1%);
- Manufacturers (source) + Distributor + Others + Wholesaler + Retailer + Consumer (11.4%);
- Manufacturers (source)+ Distributor + Consumer (8.6%); and
- Manufacturer (source)+ Consumer (5.6%).

The predominance of any channels varies depending on the size of the feed manufacturer (source), other market functions undertaken by the producer (such as transportation), distribution, and the quantity demanded by the farmer. Most farmers buy dairy meal from the local agrovet stockist, while others buy from major distributors (agrovets) directly. Some farmers buy dairy meal from feed manufacturers directly, especially where manufacturers operate at a small scale and/or buy in large quantities. Mombasa Millers established distribution outlets in Voi and Kibwezi and on market days, retail the inputs directly to farmers. This is a case of vertical integration which is not common with large-scale feed manufacturers.



Mombasa Maize Millers Company Ltd Depot, Voi (March 2018)

5.4 Market channels for fodder

The most predominant fodder marketing channel is the Producer + Consumer. Except for hay, most farmers buy fodder from producers directly using their own means of transport. The second most important channel, particularly for hay, is the Producer + Retailer + Consumer, where retailers includes agrovets stockists and traders selling animal feed ingredients (Field Survey, 2018).

5.5 Local/Regional/International Demand

In 1995, FAO reported concentrates utilization in developed countries comprised 40% of total feeds, but only 12% in developing countries. Cereals constituted half to three-quarters of this concentrate, with most of the remainder provided by cereal milling residues and oil meals (FAO, 1995). As has been mentioned earlier, among the East Africa Community (EAC) states, Kenya, Uganda, and Tanzania have the largest livestock industry with demand for animal feeds amounting to six million MT, against production of 1.7 million MT by 2014 (Kilimo Trust, 2017). This demand is expected to increase by 60% by 2020 (Kilimo Trust, 2017). Kenya contributes the biggest share of the demand because it has the largest and most dynamic animal feed industry in the region (Kilimo Trust, 2017). According to Gitonga (2014), the demand for animal feeds increased from about 400,000 MT in 2004 to about 650,000MT 2013 (Figure 8). Githinji, et al., (2009) estimated production and millers installed capacity by region between 2003 and 2008 (Table 21). These estimates exclude feeds formulated at the farm and, therefore, underestimate production and utilization. Dairy concentrates account for about 39% of the animal feeds produced/utilized according to KMT, (2016), Gitonga, (2014) and Githinji et al., (2009), even though USAID-KAVES (2017) reported 60% accounted for poultry and only 20% account for cattle. Based on these estimates (and as has been discussed elsewhere in this report), the average installed milling capacity utilized was at 69% in 2016, up from 44% in 2008 (KMT, 2016; Githinji et al., 2009) and supporting increasing production trends as reported by other studies.



Figure 8: Source: State Department of Livestock and AKEFEMA (in Gitonga, 2014)

Table 21: Compounded Feed Production Trend, Installed Capacity by Regions and Year (Dairy Concentrates Account						
for 39%)						

		Ac	tual Product	ion (Tons)			
Region	Installed Capacity	2008	2007	2006	2005	2004	2003
Nairobi	405,068	181,366	194,095	168,032	146,062	133,180	125,230
Thika	160,940	71,634	70,919	60,648	47,657	46,415	44,777
Kiambu	50,160	21,008	15,677	11,934	8,220	I,760	
North Rift	37,030	21,882	23,142	16,658	15,621	12,536	4,249
Nyanza	19,537	12,108	12,691	12,962	11,200	10,000	12,000
Nakuru	69,362	39,409	33,693	34,394	33,243	31,593	23,967
Mt. Kenya	25,320	4,656	3,733	4,240	4,056	1,990	1,840
Coast	76,150	22,904	19,410	9,723	6,950	6,900	7,400
Total	843,567	377,948	373,259	318,591	273,009	244,374	219,463

Source: Githinji et. al., 2009

5.6 Summary Key Market Opportunities

Among other opportunities detailed in Table 22, is the recognition that fodder production, aggregation, transportation and trade is a new business opportunity in some project counties, as demand for hay increases due to an increasing population of dairy animals in the pre-commercial dairy areas and increased frequency of prolonged dry periods, as well as the effects of climate change. Production, aggregation, packing, transportation and trade in pastures seeds is a big business opportunity in semi-arid counties. The major constraint is accreditation and certification of seeds by KEPHIS. Production of animal feeds using installed capacity of small-medium millers located within the counties will reduce the cost of dairy supplements.

Table 22: Summary	Cable 22: Summary of Key Opportunities for Intervention in Feed and Fodder Production			
Activities	Challenges	Opportunities for Intervention		
Compound feeds	High prices of finished products	 Promoting small-scale feed formulators, e.g., supporting the formulators to map and utilize shorter supply chains that deliver products either directly to retail points or farmers (KMT, 2017) Building farmers' capacity to formulate quality feeds on-farm 		
Fodder	Increase in demand for quality fodder	Promoting the production, aggregation, packing, transportation and trade in pastures seeds as an emerging business opportunity		

6.0 SUPPORT SERVICES

6.1 Extension and Information Services

The National State Department of Livestock and County Livestock Production Department are responsible for public livestock extension support and information services. This is because donor-funded livestock projects and programs and other non-state actors working in the livestock sub-sector are implemented through public extension. Extension and information services are provided by County Livestock Production and Veterinary Officers; the former on general animal husbandry and the latter on disease control, specifically. They train and advise farmers during farm visits, demonstrations, and other training sessions. Agrovet dealers are also important private extension agents providing information to farmers through services offered at the farm and at the shop. This has been made possible by government regulations which require agrovet dealers to employ technical personnel with a background in animal health. Likewise, it's also since the majority of agrovet stockists are owned and managed by people with backgrounds in animal production and health (Auma et. al., 2017). Past and present donor-funded projects and programs supported public extension by training farmers. The Smallholder Dairy Commercialization Programme (IFAD), Community Driven Development and Flood Mitigation Programme (World Bank), Programme for Agriculture and Livelihoods in Western Communities (PALWECO, funded by Finland) are just some of the projects and programs supporting public extension and information in western Kenya. Furthermore, ICIPE, GIZ, and ILRI are some of the international organizations working through partners and local nonstate actors providing extension and information. K-USAID-KAVES, Sales. East Africa Agricultural Productivity Project (EAAP-World Bank), the Kenya Agricultural and Livestock Research Organization (KALRO), and the Tana and Athi Rivers Development Authority (TARDA) also provide extension and information on compound feeds and fodder. Private companies dealing in dairy concentrates provide information when promoting and launching new products. KALRO, ICIPE, and ILRI, together with partners, provide information on fodder species and collection of pasture seeds. According to FGDs during the field survey, public extension staff reported that they emphasized on-farm feed formulation to smallholder dairy farmers to reduce the cost of production and fodder conservation as a feeding strategy in dry periods.

6.2 Input Systems

As observed from the primary data collected for the study, and indicated by KMT (2016), the most common ingredients of compound dairy feeds are maize, wheat, and their by-products, and cotton and sunflower seed cake. The bulk of cotton and sunflower seed cake is sourced from East African countries, particularly Tanzania and Uganda. Finer mineral elements and additives are mainly obtained from South Africa and China (KMT, 2016). The importation of essential feed ingredients means that the eventual cost of procuring feed is high, and these costs are passed down to the farmers. The government removed taxes on raw materials to lower the cost of production but introduced the VAT (16%) on finished products, which is also passed down to the farmers.

The Kenya Seed Company produces and sells grass seeds through agrovet dealers and a few farmers in the project counties collect and sells grass seeds, particularly Boma Rhodes and natural pastures. ILRI, ICIPE, KALRO, and national and county governments support smallholder farmers with planting materials, training, and introducing new or improved species of grasses in KCDMS target counties. In western Kenya, ICIPE introduced Mulato (one of the Brachiaria grass varieties) and Desmodium. Likewise, KALRO developed Napier grass and the most recent species, Ouma II, and South Africa. Finally, ILRI introduced Brachiaria just to give a few examples. Government and donor-funded projects purchase and distribute planting materials to smallholder farmers to take up commercial fodder production and or on-farm cattle feeding after trainings and demonstrations.

6.3 Financial Services

Apart from several loan products available with commercial banks for many other businesses, one specific microfinance institution targets agrovet businesses in Kenya. The Kenya Livestock Finance Trust (K-LIFT) is a microfinance institution giving short and long-term secured loans to agrovet businesses on the condition that such agrovets are owned by veterinary professionals and must be stocking livestock protection and crop products only (http://www.klift.org/index.php/sales-distribution-ofagrovet-products). Long-term loans can be used for financing working capital required or the purchase of assets. It can also be used for off season re-stocking with agrovet products. It attracts an interest rate of 18% per annum with a repayment period of 12-18 months. Short-term seasonal loans are for re-stocking agrovets with products during the high-season periods

(during long and short rains and planting season). It attracts an interest rate of 2.5% per month with a repayment period of three months. The first-time borrowers using agrovet stock for security, the maximum loan available would be KES 100,000 and if securing through a title deed, the maximum would be KES 200,000. After successful repayment of the first loan, the ceiling for a second loan would be KES 200,000 to 1.2 million, depending on the applicant's risk profile. Any amount above KES 200,000 must be fully secured.

6.4 **Transport Services**

Transport services are critical in compounded feeds and fodder value chain due to bulk and distance between the point of production (milled) to distributors and consumers. Trailers and semi-trailers, lorries of varying capacities, pickups, public passenger vehicles and motorcycles are the main mode of transport services depending on the node of the value chain and the quantity involved. The field survey found various transport arrangements between the suppliers and consumers, and dependent on the value chain node, the size or volume involved, the distance to point of delivery, among others. Since most raw materials used in formulating compounded feeds are imported, transport arrangement and cost are met by the feed miller in most cases. Raw material sourced within the country (United Millers of Kisumu, for example) is delivered to feed millers but this kind of arrangement is not widespread since majority of millers of human products are also milling animal feeds. Finished feed products are transported to the distributors, wholesalers and in some cases to retailers by the feed manufacturers themselves factoring in transport costs. Among the small-scale millers, consumers collect feeds directly from the mill but when quantity purchased is substantial, the miller delivers without charging additional cost within 25Kms radius. In these kinds of scenarios, determining cost of transportation per unit weight is difficult but it is reflected in the price of the feeds purchased by the consumer since prices varied by distance to the point of wholesale of same feed brand. A miller (SAKINA Feeds, Kisumu) reported spending KES 3000 per ton of raw material sourced from Uganda (KES 90,000/ trip of 30,000 tons). SWEETEX animal feeds (Bungoma) hires a trailer at between KES 20,000-30,000 per trip of 15 tons of raw material sourced from Uganda monthly.

Apart from hay, the most traded fodder, there are no elaborate transport services in fodder except during fodder-scarce periods, when farmers and traders hire transport from source to consumer or to market destination. A hay trader in Bungoma (SWEETEX Animal Feeds) hires a lorry on a return journey from Kitale at KES 1500 for 200 bales implying part of transport cost is charged to other users. A transporter at Kabati Market (Kitui) has been in business of fodder transport for the last 19 years and vertically integrated into fodder trade sourcing for hay and maize stovers from farmers in Embu and selling at Kabati market and to local farmers in Kitui. On transport services, his profit margin is KES 4000 per trip when transporting fodder locally. This increased to KES 13000 per trip when transporting from farmers in Embu, a return distance close to 300 Km.

6.5 Marketing Services

Some farmers and traders with pulverizers crush hay and crop residues, especially maize stovers, for other farmers at a fee. This costs KES 50 for a bale of hay crushed. Storage, handling and de-bulking are some of the market services in the feed value chain.

6.6 Other VC Services

The quality control service is under the management of the Kenya Bureau of Standards (KEBS) which is responsible for feed testing. Since the KEBS lab is only in Nairobi, feed processors that are closest to the institution (about 3% of feed processors) take samples to KEBS for analysis (KMT, 2016). Small-scale manufacturers find it expensive to take samples for analysis as one sample test on average costs KES 4,000 (KMT, 2016; Field Survey, 2018). Internal quality control is done by resident feed formulation and a quality assurance specialist (KMT, 2016).

About 28% of manufacturers carry out their own feed analyses and the rest source from commercial service providers, KEBS, and private consultants, including universities. Regrettably, there is a certain unreliability of results. For example, there can be inconsistency in reports from service providers or samples from the same feed batches give different results. Some providers also reported using "outdated machines ... which sometimes break down or can only do certain tests." All these examples are illustrative of some of the challenges faced by millers that are dependent on external quality testing (KMT, 2016).

Table 23: Summa	Table 23: Summary of Key Support System Opportunities					
Activities	Challenges	Interventions/Opportunities				
Compound feeds	 High transport cost for raw materials VAT passed on to farmers raises the cost of finished products High costs and barrier to accessing credit 	 Support alternative models of farmers accessing feeds at reduced prices through bulk sourcing by farmer groups Support alternative models of encouraging liquidity-constrained farmers to access feeds through alternative financial inclusion systems, for instance, check-off system 				
Fodder	Cess fees charged at the border of every county increasing cost of marketing and which traders pass to the farmers.	Sensitive the county government on the negative impacts of these levies on smallholder farmers				
	Standardization of the weight of the bales	Sensitive the county assembles to pass enforceable legislations on standard weight of bales.				

7.0 INSTITUTIONAL RULES, NORMS AND TRENDS

7.1 Formal and Informal

Key legislation regulating animal feeds includes some old acts of Parliament: The Fertilizers and Animal Food Stuff Act Cap 345 (1967); The Standards Act Cap 496; The Animal Disease Act Cap 364; and The Animal Feedstuff Bill, 2016, which has been under review and aims to repeal the Fertilizers and Animal Foodstuffs Act, Cap 345, by bridging several gaps (KMT, 2016). The Animal Feedstuff Bill, 2016 has no legal framework that facilitates engagement between the Ministry and the industry players and does not provide a framework for governing and controlling the substandard or counterfeited manufacture of animal feedstuff (KMT, 2017). Enforcing agencies include the State Department of Livestock (particularly the Directorates of Veterinary Services and Livestock Resources); the Kenya Bureau of Standards (KEBS) for laboratory testing of feeds; and the Kenya Plant Health Inspectorate Services (KEPHIS) which is responsible for fodder planting materials, including production and trade on seeds. The certification process for grass seeds as outlined by KEPHIS regulations is a challenge to smallholder seed producers, particularly natural pasture seeds with huge demand within and outside the country (Field Survey, 2018).

The Livestock Production Department has raised concern on the Animal Feedstuff Bill 2016 leading to a delay in approval of this bill. In the Bill, the Director of Veterinary Services is responsible for animal feed inspection and testing, but the Livestock Production Department believes that this is not the mandate of Veterinary Services, as they have no capacity or training to undertake this kind of assignment. During the FGDs with staff from the directorates of livestock production, it became apparent that they were not adequately informed of the rules and regulations regarding fodder production and trade but were somehow aware of the role of KEBS on manufactured feeds and the contested Animal Feedstuff Bill 2016.

In most of the counties visited, the County Executive Committee Member (CECM) and Chief Officers responsible for Agriculture and Livestock are considered the most influential leaders in the dairy sub-sector as they are acting on behalf of the Governor, the custodian of resources necessary to develop the sector. Therefore, they are the champions of change at the county level, as is the Cabinet Secretary at the national level.

8.0 COLLABORATION AND LEARNING OPPORTUNITIES ALONG THE VALUE CHAIN

What follows is a summary table providing an overview of key government, donors, research institutes, and other stakeholders active along the value chain (Table 24).

Table 24: summary of key stakeholders, collaborators and donors in working in the value chain				
Activity/ program	Stakeholder	Details and potential areas of collaboration		
Extension and subsidy	County Livestock Production and State Department of Livestock Production	The county governments support the fodder value chains through the Department of Livestock Production providing extension services to the farmers. Some counties support farmers with inputs such as seeds of improved fodder either through donor funded programmes or counties own programmes. National government provides relief fodder to farmers during adverse weather conditions in lower eastern Kenya. Migori County plans to establish a compounded feed manufacturing factory, Kisii County government supported private, small-scale feed manufacturers with feed mixing equipment, and a World Bank-funded development project in western Kenya (Community Driven Development and Flood Mitigation Program) supported the establishment of animal feed manufacturing, most of which are not operational.		
Improved fodder technologies and inputs	Research organizations; ICIPE ILRI and partners, KALRO	ICIPE has been promoting Napier and Desmodium under its push-pull technology and Mulato (Brachiaria) to smallholder farmers in western Kenya. ILRI has promoted animal feeding technologies including training of farmers, as well as providing fodder planting materials such as Brachiaria, Napier species tolerant to diseases, and Boma Rhodes. KALRO promoted improved fodder and natural pasture management, including collection, treatment, storage and marketing of natural pastures seeds.		
On-farm feed formulation and production	Smallholder Dairy Commercialization Programme (SDCP)- IFAD-funded	The SDCP has been promoting dairy in western Kenya since 2006. Apart from trainings and extension through county livestock production departments, they use a grant approach to support farmers' groups with on-farm feed formulation and production equipment. These include hammer mills, small feed mixers (0.5 ton), and digital weighing scales. Operational capital and marketing are some of the challenges limiting the use of this equipment.		
Farmers capacity building and market facilitation	USAID-KAVES K-Sales	Supported commercial fodder production- (both natural pastures and improved by provision of seeds), construction of hay ban, and facilitated market linkages in markets for pastures seeds and hay.		
Capacity building with training of trainers (TOT) in Kambale	Taita Livestock Services Providers Association in Wundanyi	An association of private and public service providers working with smallholder farmers on animal health and breeding service in Taita Taveta.		
Sale of grass seeds	Kenya Seed Company Limited	Kenya Seed Company, a government parastatal, for bulk and sale of grass seeds to farmers.		
Mechanize harvesting of natural pasture into hay	Tana and Athi Rivers Development Authority (TARDA)	A government parastatal supporting development in the lower eastern. promoting natural pasture production, and conservation by mechanization of hay making. Gives subsidies on tractor services to farmers in mowing and baling natural and planted grass.		

9.0 REFERENCES

- ABS-TCM (African Breeders Services Total Cattle Management), (2013). Study on the Kenyan Animal Feed and Fodder Sub-Sectors Dairy Sector Structure: Kenya Feed Industry Policy and Regulatory Issues (Sub-report II). Retrieved from: <u>https://www.dialogkenya.info/docs/RES-KenyaFeedIndustryPolicyRegulatoryIssues--2013.pdf</u> (accessed Sep 2016).
- Auma, J., Rao, J and Kariuki, E. (2018). A draft report of the Annual Monitoring Survey of Beneficiaries in Western and Eastern Kenya, forth coming. Feed the Future Kenya Accelerated Livestock Value Chain Development- Dairy Component (AVCD-Dairy), Kenya. ILRI Project Report. Nairobi, Kenya: ILRI.
- Auma, J., Kidoido, M. and Rao, J. (2017). Feed the Future Accelerated Value Chain Development (AVCD) Program: Dairy Component Value Chain Analysis. Nairobi, Kenya: International Livestock Research Institute (ILRI).
- Auma, J., Kidoido, M., Rao, J and Kariuki, E. (2016). Report of the Baseline Survey in Western and Eastern Kenya, August 2016. Feed the Future Kenya Accelerated Livestock Value Chain Development- Dairy Component (AVCD-Dairy), Kenya. ILRI Project Report. Nairobi, Kenya: ILRI.

Auma, J., Omondi, I., Rao, J and Baltenweck, I., (2018). Dairy Value Chain Assessment Report. Kenya Crops and Dairy Market System Development Activity. USAID

- BLGG. (2013a). Study on the Kenyan Animal Feed and Fodder Sub-sectors, Sub-report VI: Trends in the Kenyan Fodder Sub-Sector.
- BLGG. 2013b. Study on the Kenyan Animal Feed and Fodder Sub-sectors, Sub-report V: Feed Quality Analysis. FAO http://www.fao.org/wairdocs/lead/x6123e/x6123e04.htm#TopOfPage
- Githinji, V. Olala, M. Maritim, W. (2009). Feed Milling Industry Survey Report; February 2009. Ministry of Livestock development and Agriculture sector development Unit.
- Kilimo Trust, (2017). Characteristics of Markets for Animal Feeds Raw Materials in the East Africa Communities: Focus on Maize Bran and Sunflower Oilseed Cake.
- Kennedy Gitonga. 2014. Animal Feed Situational in Kenya. Global Agricultural Information Network: USDA Foreign Agriculture Services.

https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Animal%20Feed%20Situation%202014_Nairobi_Ke nya_10-14-2014.pdf

KMT (Kenya Market Trust). (2016). Can Kenya Turn Around Its Informal Milk Markets.

http://www.kenyamarkets.org/press/can-kenya-turn-around-informal-milk-markets/ Retrieved March 6, 2018.

KMT (Kenya Market Trust) (2016). Mapping of Animal Feed Manufacturers and Suppliers of the Feeds' Raw Materials in Kenya".

http://www.kenyamarkets.org/wp-content/uploads/2017/10/Summary-Report-on-Animal-Feed-Millers-and-Ingredient-Suppliers-in-Kenya-2017.pdf

- KNBS (Kenya National Bureau of Statistics). (2017). Statistical Abstract, 2017.
 - https://www.knbs.or.ke/download/statistical-abstract-2017/
- Luseba D. and Rwamb, P. (2015). Review of the Policy, Regulatory and Administrative Framework for Delivery of Livestock Health Products and Services in Eastern and Southern Africa. Galvmed. http://www.galvmed.org/wp-content/uploads/2015/09/East-Africa-Review-of-Policy-Regulatory-and-

Administrative-Framework-for-Delivery-of-Livestock-Health-Products-and-Services-March-2015.pdf

- Ministry of Agriculture, Livestock and Fisheries. 2017. Re-positioning the Fodder Value Chain in Kenya. The First National Fodder Commercialization Conference; | 14th- 15th December 2017.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Bungoma County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Kakamega County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Kisii County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Kisumu County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Kitui County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Taita Taveta County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. Homa Bay County Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.
- Ministry of Agriculture, Livestock and Fisheries. 2014. National Household Baseline Survey Report Vol.i. Agriculture Sector Development Support Programme (ASDSP), Kenya.

- Ouma, E. O. (2017). Analysis of Fodder Production and Marketing in the Range Land of Southern Kenya. Unpublished, MSc Thesis; University of Nairobi. <u>http://erepository.uonbi.ac.ke/bitstream/handle/11295/101466/Omollo%2CErick%20O_Analysis%20of%20Fo</u> <u>dder%20Production%20and%20Marketing%20in%20the%20Rangelands%20of%20Southern%20Kenya.pdf?sequ</u> <u>ence=1&isAllowed=y</u>
- Ondiko, C. N., Njunie, M. N. and Ngode, L. (2016). Climate Smart Brachiaria Grasses for Improving Livestock Production in East Africa – Kenya Experience. In: Proceedings of the Workshop Held in Naivasha, Kenya, 14 - 15 September 2016
- Roger Gilbert (Undated). The World Animal Feed Industry: International Feed Industry Federation. https://www.usitc.gov/publications/332/pub3275.pdf
- USAID-KAVES. 2017. Fodder Value Chain Analysis. Repositioning the Fodder Value Chain for Sustainable Livestock Production.
- Wambugu, S., Kirimi, L., & Opiyo, J. (2011). Productivity Trends and Performance of Dairy Farming in Kenya. Tegemeo Working Paper 43. Tegemeo Institute of Agricultural Policy and Development, Nairobi

Annex I: Methodology

The study used both a qualitative and quantitative approach to data gathering, and both primary and secondary data collection techniques. Various sources of secondary information were retrieved, reviewed and analyzed. Amongst them were secondary data from the ILRI database, the AVCD baseline and annual survey data, the KNBS statistical abstract, and many other previous publications on animal feeds. To bridge the gap in the secondary information available, primary data was collected using qualitative data collection tools designed to gather information from various value chain actors and support. Primary data collection was conducted between mid-March and April 2018 in eight of the I2 KCDMS counties: Migori, Kisii, Kisumu, Bungoma, Kakamega, Kitui, Makueni, and Taita Taveta.

Focus group discussions (FGDs) and key informant interviews (KII) were conducted for various value chain actors identified by each County's Livestock Production extension staff and other stakeholders in compound dairy feeds and fodder sub-sectors. These actors include: compound animal feed raw material suppliers and traders; animal feed millers/operators or feed formulators; large (wholesalers) and small agrovet dealers (retailers); fodder producers; transporters; and traders (see Annexes or details). A total of eight FGDs of public livestock production extension service providers were conducted, one in each county, as the entry point of identification of the value actors and value chain map. Seventeen animal feed operators including millers, raw material suppliers, and traders were interviewed, with an emphasis on source of raw materials, cost of production, distribution channels and the trend in business expansion among other factors. Three out 17 animal feed operators were informal traders in raw materials, formulating feeds without any mixer directly to farmers based on farmers' demands and preferences.

Two operators-Kisumu United Millers and Kitui Cotton Ginners - were the only formal institutions producing raw materials for feed formulation. A total of eighteen agrovet dealers were interviewed using a checklist of questions to elicit information on the type of dairy feeds stocked, where sourced, and trends in volume sold to farmers in the past five years, among other information related to support systems. Out of the 18 agrovet dealers interviewed, half were doing both wholesale and retail business at the same time, distributing products of selected companies to other agrovets, while the other half were only retail agrovet shops dealing primarily with farmers. On fodder and pasture production and trade, 21 groups/cooperatives and individuals were interviewed using a checklist of questions guiding the discussions. Information on the cost of production, harvesting, storage and marketing was collected for purposes of estimation of the gross margins.

Summary of FGDs Participants by Counties					
County	Name/Type of FGD	No. of Male	No. of Female	Total	Remarks
Migori	Livestock production	10	3	10	Technical county staff
Migori	Chamgiwadu cooperatives	6	0	6	Commercial fodder producers
Kisii	Livestock production	11	0	11	Technical staff
Kisii	Riameri women's group	5	8	13	Commercial fodder producers
Kisii	Kenuri women's group	I	I	2	Commercial fodder producers, on-farm feed formulators supported by SDCP
Kisii	Ekerore youth group	5	6	11	Commercial fodder producers
Kisii	Enkurongo factory women's group	0	10	10	Animal feeds operators supported by SDCP
Kisumu	Livestock production	6	2	8	Technical staff
Kisumu	West Seme Marketing Enterprise-CBO	10	5	15	Commercial fodder producers
Bungoma	Livestock production	8	2	10	Technical staff
Kakamega	Livestock production	10	13	13	Technical staff
Kitui	Livestock production	7	I	8	Technical staff
Kitui	Kitalwa Poverty Eradication Group	7	5	12	Commercial fodder producers
Makueni	Livestock production	5	0	5	Technical staff
Taita Taveta	Livestock production	2	2	4	Technical staff

Agrovet Dealers Surveyed by Counties						
Date	County	Wholesale/ Retail Agrovet	Retails Agrovet	Description		
16/03/18	Migori	0	2	Ndati Agrovet, Moata		
21/03/18	Kisii	2	0	Enochem Agrovet, Josemo distributors		
	Kisumu	2	0	Mwangaza Agrovet, Kisumu Farmers' Centres (distributors of Unga products)		
04/04/18	Kakamega	I	1	Imani Agrovet, Kakamega Farmers Agency		
28/03/18 29/03/18	Bungoma	1	4	Bungoma chemist Agrovet, Munyambu Farmers Pride Agrovet, Lishe Bora and Poultry Feeds Agrovet- Kimilili, Bunyala Agrovet Kimilii, Nema Agrovet, Kimilili		
11/04/18	Kitui	2	0	Kitundu Agrovet, Snow Agrovet		
17/04/18	Makueni	0	1	Kamithi Agrovet		
19/04/18; 20/04/18	Taita Taveta	1	1	Mvoi Agrovet, Voi, Pam Tech, Wundanyi		
	Total	9	9			

Animal Feed Millers and Raw Material Producers/Traders Survey by Counties					
Date	County	Millers/ Formulators/ Operator	Raw Material Farmers/Traders (Formulator)	Remarks	
16/03/18	Migori	0	0	No animal feed operators found and visited	
21/03/18; 20/03/18	Kisii	2	2	Nyangusu animal feed factory, Angaza Animal Feed Millers, Gega Feeds Solutions (trader), Enkurongo factory women's group	
26/03/18	Kisumu	6	0	United Millers, Kisumu, Kisumu Lake Feeds Company, Limited; Sakina Feed Millers; Victoria Feed Millers; Sigma Feed Millers; Rusinga Feed Millers	
04/04/18	Kakamega	1	0	Sashishi Animal Feed Millers	
28/03/18 29/03/18	Bungoma	1	I	Eden Animal Feed Millers and Sweetex Animal Feed Trader	
11/04/18	Kitui	1	1	Kitui Ginnery producing cotton seed cake and Utoo Feeds Trader	
17/04/18	Makueni	1	0	Miela Poultry and Animal Feeds-Emali	
19/04/18; 20/04/18	Taita Taveta	2	0	Mombasa Miller's depot, New Generations Animal Feeds, Voi	
	Total	14	3		

Dete	Countra			Domoulus
Date	County	Farmer Cooperatives /Groups	Farmers	Remarks
16/03/18	Migori	1	1	Chamgiwadu Dairy Multipurpose Cooperative, homemade TMR using crop residues
21/03/18; 20/03/18	Kisii	3	0	Riameri women's group, Kenuri women's group (also supported with feed mixer, hammer mill and digital weighing scale), Ekerore youth group
23/03/18 26/03/18	Kisumu	1	2	Seme CBO, rice straw traders-youth group, rice straw trader- Gem Rae/ Ahero
04/04/18	Kakamega	1	1	Ikolomani Dairy Farmers' Cooperative (buying and stocking hay for members to buy), Khayega welfare group (fodder traders at the market)
28/03/18 29/03/18	Bungoma	2	0	Tongaren ACK women's group (growing hay for sale), Sufurias women's group (growing various fodders and making TMR and silage)
10/04/18 11/04/18	Kitui	2	2	Kitalwa poverty eradication group (hay and pasture seeds producers with a hay ban supported by project), Acacia pod traders (collecting and storing for sale to goat keepers). Kabati Crop residues traders and transporters
16- 17/04/18	Makueni	2	1	Kathonzweni Dairy Cooperative Society (supplied by hay from Kabarak, Nakuru, and sell to members). KAPALIC CBO producing hay and pasture seeds for sale. PETER MANGENGE KEFAS Kathonzweni- producing and trading on hay and pasture seeds. Rea Vipingo Dwa Estate- producing baby corn for export and selling crop residues to dairy farmers.
19/04/18; 20/04/18	Taita Taveta	2	0	Mngama Cooperative Society-buy pasture from farmers, cut, bale and store a hay ban before selling. Kishushe Hay Group hire county government mower to cut and bale hay for sale. Earned over KES 800,000 in 2015 from sale of hay.
Total		14	7	

Annex 2: List of key informant interviews and stakeholders consulted

Name	Contact detail	Relevant notes (vs., location, etc.)
Otieno Wambogo	0722552238	Ndati Agrovet Migori town, Migori County
Danish Otieno	0704180648	Animal health assistant attached to Ndati Agrovet, Migori
Moata Agrovet Sales	0723855719	Moata Agrovet, Migori town, Migori County
Joseph Liech		Chairman Chamgiwadu farmers Cooperatives, fodder producers
Joshua Kiche Maingi	0711286925	Coordinator Kobuya women's group using Pulvarizer to make TMR for use own use and sale
Florence Momanyi	0712541107	Key expert on-farm feed formulation for Enkurongo Factory women's group Kisii
Peter	0707759405	Genga feed solutions, Kisii town-formulating animal feed for sale to farmers preference
ELIJAH MEJA	0791700048	Manager Angaza Feeds Miller Kisii town, Kisii County
Mr. James Nyamoko	0723 557762	Nyanguso animal feed miller in Bobasi sub-county Kisii
Alice	0718223360	Enochem Agrovet-Wholesaler and retailer, Kisii town
Regina	0722954762	Josemo Distributors of Animal Feeds and Agrovet Wholesaler and Retailer
Peter Onyango Omolo	0173059848	Director Sakina Feed Miller, Nyando Kisumu County
Owesi	0734754817	Chairman West Seme Marketing Enterprise, Kisumu
Seline	0722862237	Salesperson at Mwanga agrove Kisumu Town
Paul	0722432292	Sales outlet at Pembe Feeds Outlets in Kisumu, two Brunches Kanu Street
Nancy Claris	0728978130	Salesperson at Unga Feeds Outlet. Kisumu, Kanu street
Moses Odhiambo	0799746993	Salesperson at Rusinga Animal Feed Miller's Outlet, Kisumu, Kanu Street
JOSEPH OLUOCH	0722671737	Framer and trader of rice straw (crop residue) at Gem Rae, Nyakach Kisumu
Joshua Okolo	0725907293	Manager Lake Feed Millers in Kisumu town
Mulei		United Millers, Kisumu, producing and selling maize bran, and germs, wheat bran and pollard
Pauline Juma	0790431799	Sweetex Animal Feeds Sales, Bungoma-formulating feed using imported raw material UG
Catherine Okirinyi	0713878499	ACK Mother Union Commercial Hay Producers at Tongaren, Bungoma
Mark Kizito Macharia	0723795637	Munyambu Farmers Pride Agrovet, Kimilili, Bungoma County
Irene Kiboyi	0720381432	Lishe Bora and Poultry Feed Agrovet, Kimlili, Bungoma County
ogonda	0711296160	Nema Agrovet, Kimilili, Bungoma
Okutu Paul	0720936329	Eden Millers, Manufacturer of Animal Feeds in Bungoma town

Name	Contact detail	Relevant notes (vs., location, etc.)
Hillary Mayaka	0722717581	Imani Agrovet Lurambi, Kakamega town.
Godrainh	072 813719	Kakamega Farmers Agent
Dr WASUNA M.O.	0723 285774	General Manager Sashishi Animal Feeds-Miller in Mumias town, Kakamega Sashishi. Sashishi @gmail.com
Evans Simiyu	0723493131	Khayega Welfare Group Khayega Market, Kakamega County Green Fodder Trader
Geoffrey Oyondi	0724660800	Ikolomani Dairy Farmers' Coop. Society, Kakamega County
Geoffrey Mutemi	0799711837	Collecting Wild Acacia Pods for Sale to Goat Keepers, Mwingi, Kitui
Lawrence Ndunga	0733501725	Kitalwa Poverty Eradication Group Commercial fodder producer, Mwingi, Kitui
Mutisia Mzee	0711101069	Crop (maize) residue trader and transporter at Kabati market, Kitui
Mutemi Ndavuta	0726607854	Proprietor Utoo feeds, a small-scale feed formulator, Kitui town
Mtinda Wambua	0720357105	Kitundu Agrovet, Wholesale and Retail, Kitui town
Dr. Kisinga	0720898966	Snow Agrovet Wholesale and Retail, Kitui town
Mary James	0722694261	Kitui Cotton Ginneries producing and selling cotton seed cake
Steven Kyonda	0728859213	Chairman Kathonzweni Dairy Cooperative Society buying and dairy feeds including hay to farmers
Boniface	0720041692	Kamithi Agrovet /Distributor, Emali own, Makueni
Jeremiah Angaya	0725896914 0737325078	KAPALIC CBO Kibwezi West-producers of Pasture Seeds and Hay, Makueni
Peter Mangenge	0705117686	Producer and Trader of Hay and Pasture Seeds at Kathonzweni, Makueni
Timothy Atieno	0715461870	Horticulture Section Manager. Rea Vipingo DWA estate; selling crop residue from baby corns to dairy farmers
Boniface Okeyo	0707247055	Mombasa Miller's Distribution Depot, Voi town, Taita Taveta
Julius Mwandairo Nyali	0729150545	New Generation Animal Feeds Stockist and Wholesale, Voi town
Stanley Rigah	0729767628	Salesperson Mvoi Agrovet, Voi town, Taita Taveta
Godmas Mbeya	0743862889	Mngama Cooperative Society, Mwatate, Taita Taveta
· ·	0727742436 0774040753	Producing, buying storing and selling hay
Loice Mbela	0704621647	Chairperson of Kishushe Hay Group, commercial producer of hay from natural pasture in Kishushe ranch
Jimson	0714730034	PAM TECH Agrovet Wundanyi, wholesale and retail of animal feeds
		Lomaster Agrovet Wundanyi, Distributor of Unga Feeds

Annex 3: Description of Animal Feed Manufacturers Surveyed (March/April 2018)

County	Name and type of active animal feeds formulators	Status of the business during field visits	Comments
	/ manufacturing/ ingredient processors/traders		
Migori	No animal feed manufacturer	Animal feeds is not operational and it not clear for how long it's been in that state.	
Kisii	Nyaguso feeds manufacturer - Bobasi (almost Transmara)	Receive most raw materials from Uganda and Tanzania and locally through some agents in Kisumu. Molasses from Transmara and lime from Koru. The factory has installed capacity of two tons mixer and produced classified feeds; all types of poultry feeds, dog meal, dairy meal, fish meal, which are certified by KEBS. County government supported with fish meal mixer in 2017. Dairy meal production and turnover is about four tons in less than a month. Distribute directly to agrovet shops in Locals, Kilgoris, Nyamira and Rongo and Homa Bay using own canter. Farmers buying in bulk pick directly from the factory or charged transport cost of delivery. Demand for dairy meal is increasing in the last 2.5 years since installation of the factory and marketing is not a problem. Prices are competitive as producer monitors prices of other competitors. The factory is established within the homestead in the rural area with lower cost of production because its neighbouring commercial maize is the growing belt of Transmara County. Challenges: irregular supply of raw material due to political tension in Kisumu limited operational capital, high cost of raw material, unstable electricity.	
	Angaza (Aqua) feeds manufacturer - Nyamataro Kisii town	Receive raw material from Nairobi and Kisumu; three to five tons twice per month of which 30% is for processing dairy meal. Transport expenses KES 5000-15000 per trip; Production capacity (feed mixer) 0.5 tons, producing 1.8-3.0 tons of dairy meal per month. 8 Distribution (agrovets) outlets in Kisii and Nyamira using the company's van. The demand for dairy meal is increasing, and the company increased its sales to 20% since 2015 when it was started. Cost of production: 5kg@ KES149, 50Kg @ KES1380 compared to whole sale price @KES 1880 and Retail price @ 2000 50 Kg bag. This is competitive compared to Santata in Kisii town and other products in the market. Challenges: Low operational capital, unavailability of raw material and high cost in certain period of the year.	
	Santana feed manufacturer Kisii town,		Not visited
	One-end feed manufacturer, Nyamira County		Not visited
	Gega feeds solutions-feed formulators/ ingredients trader- Kisii town	 Importing and selling dairy meal ingredient to farmers in Kisii town and Suneka market with the main brunch is in Nakuru town. Formulating feeds according to farmers specification without a mixer at estimated cost of formulation of KES 1800-1900 for 70 Kg since raw materials are sourced from producers directly in Uganda and not from brokers. Current (since 2017) turnover is about seven tons within three to four days and KES 50 per kilo for high yielding for farmers buying small quantities. High yield retail at KES 2400 and low yield at KES 2200 for 70kg bag. The demand is increasing compared to five years ago when the business failed to pick up in Suneka in 2011 having established the Nakuru branch in 2009. 	

County	Name and type of active animal feeds formulators / manufacturing/ ingredient processors/traders	Status of the business during field visits	Comments
	Enkurongo factory women group- feed mixers Bombasi	This is atypical village-based self-help group supported by Smallholder Dairy Commercialization Programme (SDCP) with hammer mill and half-ton feed mixer producing poultry and dairy meal for members at subsidized price and sell to other farmers in the village. Group officials were trained on feed formulation and operation of the equipment. They source raw material from Kisii town and source maize within the village. The scale of operation is very small without business growth.	These types of groups are common in Kisii County and Western Kenya where SDCP has been promoting dairy since 2006
Kisumu	United Millers (raw materials)	United Millers stopped production of animal feeds in 2011 and are concentrating on selling raw materials which are by-products of milling. Raw materials produced are maize bran and germ, Wheat bran and pollard. Monthly turnover of wheat pollard and bran are 400 tons and maize germ 235 tons per month. The main market includes Nyanza, Western and Nairobi. The individuals buying retail cater for their own transport cost, but they deliver to customers who purchase in bulk, e.g., customers in Nairobi. As raw material producer, they have no competitor in the region. Pricing; maize bran 40kgs bag @KES 880 (KES22, 000 per ton); Wheat bran 40kgs bag sold @KES1100-1200. Wheat pollard 50kgs bag @KES 600- 700 Volume of production has increased compared to when they use to manufacturer dairy meal now they sell raw materials which are used for formulating arrange of animal feeds including pig feeds.	Producers of raw materials in the region
	Kisumu Lake Feeds Company Feed Manufacturer - Kisumu town	Produce three categories of dairy meal; Super, Standard and Budget. Source raw material from Uganda, Tanzania, and Kenya in three to four trips a month and each trip's order are 30 tons. Dairy meal production/sales turnover is 30 tons per week or 90-100 tons per month. The production cost on average three million per month depending on the demand and during low seasons, ranges between 1.8- 2.0 million. Distribution outlets are mainly agrovets in Vihiga, Kakamega, Bungoma, Eldoret and none in Nyanza. Demand is not expanding as current production is at half -installed capacity of the machine and doing nine-10 tons per day. The company products are more competitive as their prices are lower than competitors; super 70Kgs KES 1900, standard 70Kgs KES 1600 and budget 70Kgs KES 1360. The prospects of dairy meal production are not bright due to high taxes by KRA and KEBS standard levies and requirements. High tax rates on finished product (16% VAT) just filed tax returns of KES 200,000 in the month of the visit. Tax on finished products and none on raw materials motivated millers to sell raw materials and avoid processing the feeds. High cost of production in terms of electricity and local raw material produced in Kenya.	
	Sakina Feeds-Nyando Sub-County	Source: 40% of raw material locally; Wheat and maize bran from United Millers, Wheat pollard from Usenge Lake Front Millers, premixes from Nairobi. Cotton and sunflower seed cakes from Tanzania. Transport raw material using own van, or the supplier delivers after confirming quality. Cost of transportation of raw material is three KES per Kg or approximately KES 90,000 per trip. Production capacity is 1.5 tons, while mixer and sales turnover are between 25-30 tons per month. Production Cost : best quality at KES 37/Kg and lower quality KES 30/Kg. Products are competitive despite high quality; high quality 10Kg KES 380; 20Kg KES 750, 50kg KES 1800, 70 Kg KES 2300, low quality 10 Kg KES 330	

County	Name and type of active animal feeds formulators / manufacturing/ ingredient processors/traders	Status of the business during field visits	Comments
		Owned: Two distribution outlets-Kisumu (KANU street) and Ahero market-vertical integration. Deliver 15 bags and above cost free within a radius of 25Km otherwise buyer collects or deliver at a cost included in the price. Individual farmers collect from the factory; market catchment; Kisii, Nyamira, Homa Bay, Migori, Siaya, Kakamega, Vihiga, Busia, Kisumu. Demand of dairy meal is increasing from one to three tons in a month since started manufacturing in 2014 to 2015 in July. In 2017 sales increased to 30-50 tons and cannot get lower that 25% at low periods. Income from sales improved and could put up more structures like the store, vehicle, more employees and administration block. Challenges: High demand of feeds but lack of enough funds for operational capital and expansion of storage. Transportation: Only one track that cannot serve the outlet shops and the customers. Test on aflatoxin they need a laboratory to help in testing there samples instead of taking to Egerton and Nairobi. Unreliable source of raw material as in 2016 there was a shortage of some raw materials. Competitors within the region are Vitoria Feeds, Runga Feeds, Kisumu Lake Feed.	
	Rusinga Feeds- Located in Migosi, Kisumu Town	Supplying farmers in Rusinga, Siaya and Kisumu Competitive pricing and packaging; High quality 10Kg, 20Kg, 50Kg, 70 Kg @ KES 400, 900, 1750, 2150 respectively. Ordinary quality @ 350, 650, 1600 and 1950. Distribution outlet at Kisumu, Kanu Street	Smaller than Sakina
	Victoria Feeds- located at Riat opposite Airport Kisumu	Not visited	
Bungoma	Sweetex Animal Feeds formulator/ trader in raw material-Bungoma Town	Trade in raw material for animal feeds and formulating according to farmers specifications; Wheat bran, wheat pollard, maize germ, cotton seed cake, sunflower, soya beans- fish meal, rice bran, powder yeast, dairy premixes and DCP/Lime imported from Uganda. Source 15 tons per month from Uganda costing KES 25000-30000 on transport (Trailer). 10 out of 15 tons imported used in formulating dairy meal. Turnover between 700-800Kg (about 11 bags) Daily at good time and three days. Cost of production without labor for 72 Kg is 1970 Sale outlets at Matunda Road Block and Kitale/Eldoret Road; The trader acts as wholesaler and retailer at the same time. The locally formulated dairy meal is competitive as 70 Kg bag is priced at KES 1750 (Cheaper than 50Kg from Unga feeds) and demand has doubled in the last 2 years. There are two traders who are in the same business, but they sell raw material and not formulation feeds. Challenges: Mixing large quantities of ingredients manually is labor intensive.	The trader was trained on feed formulation County Livestock Production Officer who was sponsored by an ILRI project from training in Bukura for one month
	EDAN Feeds Manufacturer- Bungoma town	Started 2012. Formulate three types of dairy meal; economy/standard, high yielding, and super. Source of raw material; Uganda, Tanzania and BIDCO Kitale. (Protein sources; Cotton seed cake, sunflower, soya beans, silver cyprinid). Cereal by-products; whole maize, maize bran and germ, wheat pollard. Raw materials are relatively cheaper in Uganda and Tanzania for example wheat bran from UG is KES 14 and from United Millers in Kisumu KES18. In 2014/15 the company used to import 30 tons of raw material monthly. Currently the business model adopted is production on order to avoid over stocking due to liquidity constraints because of a loan o KES 24 million. Raw materials are delivered by the suppliers and transport cost factored in the price. Production capacity is 2.5 tons per hour (two mixers) and use to produce 300 bags (70 Kg) in 20 days or 3500 bags (70Kg) in a month before introduction of tax in 2013.	

County	Name and type of active animal feeds formulators / manufacturing/ ingredient processors/traders	Status of the business during field visits	Comments
		The demand for dairy meal is declining compared to pig feeds. Monthly turnover is 900-1000 bags (70Kg) at cost of production of KES 1400-1500 (ingredients only) before factoring labor, rent, electricity and other overhead costs. Price varies by region, but the best quality ranged between 1800-2200 for 70 Kg bag. The company bought track through cooperative loan delivers finished products to clients and factor cost of transport. Market catchment includes Kakamega, Butere, Kitale (Mosop), Limuru, Konza City, Siaya, Kisumu. Main distribution outlets are agro- dealers in Kakamega, Kitale (Mosop) and Butere. The farmers collect directly from the factory and over 20 bags are delivered by the company track. The prices vary by regions but are competitive compared to the biggest competitors- Unga Feeds and Faida Feeds (Kitale). Faida Feeds has quality challenges and but cheaper in some regions. Challenges: Demand for dairy meal in western Kenya is low. Policy environment is not favourable-combination of tax regime and KBS requirements. The Animal Feed Manufacturers Association of Kenya (AKEFEMA) lobbied the MP against the raw material tax which was affecting the producers directly. It has very few members and membership fee are between 60,000-70,000. Since most of the feed manufacturers are not professional once registered, The Government and KEBS gets to know their existence. Donor Projects support farmers with feed mixers and hammer mills and extension emphasis on- farm feed formulation. Unfair competition from none professional millers who bribery KEBS. University lecturers are selling feed formulation formulas at KES 30,000.	Traders and
		Mlisho Bora Kimilili, Muliro Umoja Tongaren	farmers formulating feeds
	Feed manufacturer and formulators	Lurambi next to hospital, Shinyalu, Minami self-help group in Matuga. Formulation of homemade rations: There is a trader who crushes maize stovers and mixer, his not mobile, has half turner mixer. In Matete Lugari the smallholder dairy commercialization program gave feed mixers, the same to Nyangacheo	
	Sashishi in Mumias West	Import raw material from Lira Kampala in Uganda and premixes from Nairobi. Seasonality of raw material sometimes sourced from Mombasa Millers, United Millers, a miller in Busia. Rice bran from Uganda and Kibos has no capacity. Production capacity: Two mixers old and new of half and 1 ton, respectively; Procure raw material 30 tons monthly of which 50-55% used for dairy meal production - turnover of 15 tons per month. Cost of production (50Kg); High yield KES 1200, Ordinary KES 900. Catchment Area: Local market Bukura, Chavakali, Majengo, Khaenge, Kakamega, Siaya, Busia, Nambale. No distribution outlets yet and deliver to stockist directly using one-ton van without charging transport costs. Individual farmers buy directly from the factory. Competition: The only manufacturer in Kakamega but compete Eden Millers (Bungoma) and other products in the market. prices are competitive; high yield @1550 (50 kg), Ordinary KES 1350 and quality feedback from farmers is good. The production volume is increasing and demand for dairy meal is expanding due to increasing improved breeds. Challenges: The rules and regulation are not stringent enough making the industry exploited by non-professional. Seasonality of raw material affects pricing of feeds. Stored raw material affected by pest and aflatoxin.	

County	Name and type of active animal feeds formulators / manufacturing/ ingredient processors/traders	Status of the business during field visits	Comments
	Kitui dairy goats- Kitui West	Supported by World Vision and formulating animal feeds.	Not visited
	Kitui KDC	Is an NGO working in Kitui, formulating animal feeds	Not visited
	Kitui Millers	Producing maize bran.	Not visited
	Utoo Feeds Kitui Central-	A small business started in 2011 mixing feeds for bull energy. Sourcing maize bran from local millers, sorghum from local farmers and most of other raw material from a wholesaler in Thika stocking from BIDCO- Thika where most of the raw materials are cheaper. Cotton seed cake is sourced from Kitui Ginnery. Sale under Utoo branded dairy meal mixed manually. Capacity: Collect two tons per week from Thika using public transport or hire pick-up at KES 6000-7000. Total cost of raw material is KES 35,000 and half used for mixing dairy meal (17500). Sales turnover 20 bags (50Kg) at KES 1800. Local Market Catchment: Mtindia, Kwandindu, Lwanga, Kunguni and operating without an outlet. Competition; no similar business in Kitui County and feeds quality is better compared to commercial producers sold through the agrovets. The demand increasing as the business expanded from half to - two tons. Challenges: Operation capital to buy the raw material and transport in bulk is limited. KEBS certification requirement; Already taken sample provided with guidelines and certificate but not registration. Lack of mixer, hammers mill and digital weighing scale.	
	Kitui Ginnery	Producing up to 60 tons of cotton seed cake at KES 25/ Kg. The ginnery	
Makueni	Miela Poultry and Animal Feeds -Sultan Mbs-Nrb road	Anufacturing feeds and has sales outlet along Mombasa Road-Sultan Town.	Visited but not interviewed
	Mombasa Maize Millers	Mombasa Maize Millers' depot located in Kibwezi town serving parts of Makueni County.	Not Visited
Taita Taveta		No active feed manufacturer in the county as existing one stopped operation in 2016.	
	Mombasa Maize Millers	Mombasa Maize Millers' depot located in Voi town and distribute to Taveta on Thursdays.	Visited

Annex 4: Assumptions in the Estimation of Feeds Production (Supply) Demand (Potential)

USAID-KAVES, 2017 (assumptions)	
National livestock population, both pure and cross breed	7.2 million
Daily consumption, Kg DM cross and pure	9-14 Kg DM/daily
National fodder requirement based above	27.5 million metric Tons (1.96 billion bales of hay)
Annual growth rate of cattle population (indigenous)	0.9%
Annual growth rate of cattle population (improved)	1.3%
Average growth rate	1.10%
Per capita DM intake per day (Basal/ grasses)	6-8 Kg DM/daily
Per capita DM intake per day (Legumes)	3-6Kg DM/daily
Per capita DM intake per day (overall)	9-14Kg DM/daily
Average dairy cattle weight	300 KG
Tropical Livestock Unit of Kenya (250 Kg)	1
An average animal requires daily DM intake equivalent	2.0-3.5% of bodyweight
Small breed requires higher of above	
An average animal requires daily DM intake equivalent	3% of the bodyweight
Lactating cows, the DMI requirement for daily yields of 20-100 liters of 4% FCM milk per cow	2.1-5.8% of body weight
One acre produces of grass	450 bales
One acre produces of legume	300 bales
One bale is the equivalent to	14Kg (12.6 kg DM)
Natural pastures yield	10 tons of DM/ha/year
Improved fodder yield	20 tons of DM/ha/year



USAID-Kenya Crops and Dairy Market Systems Activity 8th Floor, The Westwood IVale Close, off Ring Road Parklands

Floor, The Westwood I Vale Close, off Ring Road Parkland P.O. Box 1181 Village Market Telephone: +254204241000 I Fax +254203749921 Email: info@kcdmsd.rti.org I Website: www.rti.org













