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Livestock Feed Production and Marketing in Central and North Rift Valley Regions of Kenya




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Abstract

Availability and access to feed resources are important constraints to livestock productivity in East Africa. This study examined the production and marketing of livestock feeds in Central and North Rift regions in Kenya. Looking at existing fodder value chains to assess constraints and opportunities using the value chain approach, a rapid reconnaissance survey was conducted in which 93 actors were interviewed along the value chain in November 2010. Fodder marketing takes place at two levels: location (a cluster of 2-3 villages) and district. Trading at location level involved input sellers, producers selling directly to rural retailers, rural consumers, or if they were near major district towns, to wholesalers. District level trading involved traders who sourced for fodder outside the district and retailed to wholesalers in major consumer markets within districts and to a lesser extend retailed in local areas. Service providers such as transporters and feed processors operated at all levels. Input providers comprised of agrovet and general retail shops. Traders comprised of individual traders and cooperative societies. Feed trading is seasonal commonly occurring during the dry season with seasonal price variations at all levels. Feed price have increased by about 15% within the past year. In all the sites, local feed markets are dominated by livestock keepers selling excess fodder. There are few "specialized" fodder sellers, i.e. non livestock keepers who grew fodder as a source of income. Commonly traded feeds in the dry season were Rhodes grass, maize stovers, oat straws and Lucerne hay that were preferred due to longer storage period. Others forages were Napier grass and roadside harvested grass. Most traded fodder had low gross margins (GM) although food-feed crops such as oats, sweet potato, etc tended to have higher GM. Actors reported an increasing demand for purchased fodder although they all operated in uncoordinated manner. Cooperative societies played a key role in linking buyers and sellers, stimulating demand and providing credit. Lack of input capital is perceived as a major constraint more than lack of market because demand for feed is strong during the dry season. This study concludes that there is need to promote feed marketing as a package alongside feed conservation, feed processing as well creating platform for that provide linkages for all actors to operate in coordinated way. Processing of feed is important to reducing bulkiness and handling costs hence easy storage and transportation. Provision of market information to producers and buyers is important to enhance and improve feed marketing systems.

Keywords: Marketing; Livestock feed; Value chains;

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Introduction

In sub Saharan Africa, the availability of sufficient high quality feed is a key constraint to improving milk yields and hence dairy income for smallholders through intensification of smallholder dairy systems (Ayantunde et al 2005; Mapiye et al 2006). Large numbers of dairy cattle continue to be fed at levels that barely maintain them, far less support production of marketable surpluses of milk. However, enhancing the quality and quantity of feed supplied to livestock under increasing resource constraints in smallholder systems is complex. Current feeding patterns are often opportunistic and based on a strategy of risk minimization such as livestock being viewed as provider of manure, prestige, storage of capital and traction (Ehui et al 1998).

Against this backdrop, a narrow focus on improving feed supply for productivity benefits is unlikely to succeed. There are three potential intervention options for improving feed supply in smallholder systems: (1) producing more and better feed on farm; (2) making better use of what is there; (3) sourcing feed from off-farm sites. There is evidence that farmers are giving more emphasis to off-farm feed than has been the case in many previous efforts because in intensifying livestock systems there tends to be a shift to greater use of off-farm feed resources (Nyanganga et al, 2009). As a result, feed and fodder markets have been emerging spontaneously in response to growing demand from smallholder livestock producers due to inadequate land size to produce adequate food for human consumption and feeds for livestock (SLP 2010).

Fodder production and use is driven by increases in population and income, which increase milk demand and thus the demand for fodder. It is also associated with seasonal experiences such as drought, improved incomes from fodder production and marketing encouraging more farmers who have access to land and water to go into fodder production (Nyanganga et al, 2009). With the present trend of rising feed prices and global inflation, livestock production is most hit in terms scarcity and high cost of feeds. As a result, the greatest constraint to livestock productivity in developing countries currently is the shortage of feeds and forages especially in the dry season (Ayantunde et al 2005).

The problem of feed shortage can be addressed through promotion and improvement of feed production, value addition where applicable and marketing by smallholder producers. This is the approach of the East Africa Dairy Development (EADD), a regional development program whose aim is to sustainably increase production and quality of milk through improved feeds and nutrition. The project started with an assumption that as the dairy industry grew, fodder demand

would outstrip supply on EADD farmers. Dairy farmers would thus want to buy fodder and that "fodder farmers", some with dairy cows and some without, would emerge to sell fodder to them. This has not been the case and the paper seeks to examine the reasons why.

The objectives of this study were to;

1. Describe existing fodder value chains, extending from farmers selling fodder to farmers buying fodder. Assess the demand for purchased fodder and the supply of fodder.
2. Determine the profitability of different types of fodder technologies that have a high market potential as well as smallholder fodder marketing enterprises.
3. Identify value chain actors' main constraints and opportunities and the steps that need to be taken to facilitate the emergence of fodder selling enterprises.

We use the value chain framework, described in the next section, to identify opportunities and constraints for increased fodder marketing and how to help link smallholder farmers to fodder markets. The study was intended to help EADD to expand the numbers of fodder selling farmers in accordance with project objectives, hence it addresses the hypotheses that:

1. Farmers who have access to cheap abundant feed resources such as grazing prefer not to buy feed
2. Feed demand is highest in high population density areas with small land sizes.
3. Feed demand is highest during the dry season when supply is low

Conceptual Framework

Value chain analysis examines the full range of activities required to bring a product or service from its conception to its end use, the firms that perform those activities in a vertically coordinated chain, and the final consumers of the product or service. The activities include design, production, marketing, and support to get the final product or service to the end consumer (Kaplinsky and Morris 2000). The chain actors who actually transact a particular product as it moves through the value chain include input (e.g. seed suppliers), farmers, traders, processors, transporters, wholesalers, retailers and final consumers (Hellin and Meijer 2006).

This paper employs a value chain analysis approach to analyze the livestock feed subsector in Kieni West, Nyandarua North (Olkalau), Nyandarua South (North and South Kinangop) and Kabiyet districts in Kenya. It examines both the supply and demand side factors that affect fodder production and marketing. Using the value chain framework the study looks at how

different actors in the chain interact and establish costs and benefits of fodder marketing along the chain.

Methodology

A rapid reconnaissance study was conducted in Kieni West, Olkalau, Kinangop and Kabiyet sites of EADD Project in Kenya. Focus group discussions were held with producers and buyers guided by a structured checklist while individual interviews were conducted with input suppliers, transporters and traders. The development of the checklist was based on indicators developed by the key informants such as dissemination facilitators with an intention of capturing information on costs, income, profit margins and constraints and opportunities for each actor. The checklist was modified as the survey went on, initial surveys experiences were used to fine tune the questions to ensure that relevant information was collected**.** The interviews involved a total of 93 respondents' including 41 producers, 3 input sellers, 10 traders, 9 transporters and 30 buyers.

Study Sites

Kabiyet is situated in the North Rift Valley while Olkalau, South & North Kinangop and Kieni West are situated in Central Province in Kenya. The EADD project has helped to establish a chilling plant in each of the study sites that acts as a cluster of business development services. The project design is based on the hub model approach and involves working with registered Dairy Farmers' Business Association (DFBAs) that brings together a number of farmer groups who supply milk to the DFBA for marketing and in return are provided with various services such as breeding services, animal health, livestock feeds and financial services (Lukuyu 2010). The sites were chosen based on diversity in production systems and agroecological characteristics. Kieni and some part of Olkalau receive less rainfall with prolonged drought while Kabiyet receives short rains and long rains and South & North Kinangop receive high rainfall from April to November.

Kieni West district is administratively located in Central province. It lies within the longitudes of 36˚40" East to 37˚20" East. The northernmost point of Kieni division just touches the Equator (0˚) and then extends to 0˚30" South. Annual rainfall ranges from 660 mm to 1148 mm (Gtz 2007). The district has dry areas which are characterized by low rains and the wetter highlands

characterized by frequent rainfall. The main farming enterprises are crop and dairy farming. Dairy is considered more advantageous due to predictable incomes than food crops in the region. Zero grazing is the main dairy farming system in the district.

Ol Kalou is located in Nyandarua North district and lies between $0^0$50' South and $36^0$42'. The district is divided into 6 locations and covers an area of 592.2Km^2. The area is of high to medium potential in terms of agricultural production, with a mean annual rainfall of 1500 mm. The main food crops grown in the region include maize, wheat, beans, peas, cabbages, potatoes, carrots, onions and tomatoes. Livestock reared include cattle, goats, sheep and chicken. The district has some dry areas called the dry lowlands characterized by low rains and the wet highlands characterized by frequent rainfall. The main dairy farming system is zero grazing in the dry lowlands and grazing in the upper highlands.

South and North Kinangop is located in Nyandarua South district. The annual rainfall is about 1400 mm per annum and the main food crops grown are irish potatoes, maize, beans, vegetables such as cabbages, carrots and spinach and fruits. Livestock reared include cattle, sheep, goats and chicken. Zero grazing is the main dairy farming system in the sites.

Kabiyet is located in Nandi North district and lies between $34^0$44' South and $35^0$08' East. Kabiyet covers an area of 268.8 km^2 and has 6 locations. Average rainfall is about 1500mm per annum and the main crops grown include maize, beans, Irish potatoes, sorghum and millet. The major livestock kept include dairy cattle, sheep, goats and poultry. Dairy farming system is characterized by both zero grazing and grazing.

Seasonality

Some of the study sites have a single long rainy season in a year which fall between March and November (Table 1). Kabiyet in the north rift valley and Kieni West in central have short rainy seasons between September and December. However, study sites that have a long rainy season experience a long dry season between December and February. While those with a short rain season experience a short dry spell around September to October. Though in Kieni and Kabiyet, the short rains have little impact on feed availability as there is scarcity from September to March.

Table 1: Rainfall calendars for all study sites

Site	J	F	M	A	M	J	J	A	S	O	N	D
Kabiyet										S	S	
Kieni West										S	S	
Olkalou (Nyandarua N.)												
Nyandarua south												

(Source Lukuyu et al 2010)
Shaded box denotes wet season
Blank box denotes dry season
S = Short rainy season

Sample selection

EADD dissemination facilitators, interns and training of trainers assisted to select and locate respondents in their respective areas. Producers and buyers were selected from different locations based on agroecological zones, and they had to be from different villages. Membership in the cooperative societies was also considered before selection. Snowballing[1] approach was used to select traders and transporters. Snowballing is where a respondent led the team to the next actor whom they know was used to identify additional trader or transporter.

Table 2: Actors interviewed by focus group discussion and individual interviews

Market chain actor	Kieni W.	Kabiyet	Olkalau	S.Kinangop	N.Kinangop
Input sellers	-	3			
Producers who sell	14	5	10	8	4
Buyers who use	13	6			11

[1] Snowball sample; when interviewing members of a population, the interviewed persons are asked to name other individuals who could be asked to give information on the topic. These new individuals are interviewed and continue in the same way until the sample size is reached.

Fodder Traders	6	3		1	
Fodder transporters	6	3			
Total	**39**	**20**	**10**	**9**	**15**

Results and discussions

Farming systems

In all the sites, dairy production is the most important farm enterprise because it brings in daily cash income to most households compared to most food crops. Milk payments for morning milk are made on monthly basis while evening milk is sold at farm gate on daily basis. There are a variety of crops grown (Table 2). In Kieni, the large scale horticultural farms grow baby corn hence supplying crop residue from the corn to livestock farmers in the area. In Olkalau, the large scale farmers grow barley for supply to the East Africa Breweries Limited and sell barley straws to fellow farmers. In Kabiyet, Olkalau, Kinangop and Kieni, maize is grown by almost all farmers both as source of cash income and household food. Hence crop residues from maize form a large proportion of the livestock feed resource. The bulk of the land allocated to forage production is under grazing (natural pastures).

Farmers in all the sites also grow forages such as Boma Rhodes, Napier grass, fodder shrubs, purple vetch, oats, kikuyu grass, Columbus grass, lupin, siratro and sweet potato vines. The feeds commonly traded are Rhodes hay, oat, maize stovers and Napier grass. Baled Rhodes grass is regarded as the most important feed grown and traded in both regions (Table 4). Rhodes grass (baled, loose and ground) is also the most marketed feed followed by dry and green maize stovers and Napier grass. The feeds are sold to local farmers, retailers/traders and institutions such as dairy co-operative societies and schools.

Table 3: Production characteristics (total land area, land allocated to fodder and number of dairy cows), of the study sites

Parameter	Study Sites				
	Kieni	Kabiyet	Olkalua	S.Kinangop	N.Kinangop
Total land acreage per household (range, acres)	1-12 for smallholder farmers 160-2000 for large scale farmers	1 – 20	1.5 – 25	2 – 20	0.25 - 40
Land allocated to forage (acres)	0.5 – 6	1 – 13	0.75 – 3.6	1 – 3	0.25 - 20
Main crops grown	Horticulture (vegetables), Food crops such as maize and beans mainly grown by smallholders. Coffee as a cash crop mainly produced by large scale farmers	Main food crop are maize, beans and sorghum. Horticultural crops are also grown	Main food crop are maize, Irish potatoes, sorghum, vegetables and a variety of horticultural crops. Wheat as a cash crop is produced	Main food crop are maize, sweet potatoes, Irish potatoes, sorghum, vegetables and a variety of horticultural crops	Main food crop are maize, sweet potatoes, Irish potatoes, sorghum, vegetables and a variety of horticultural crops
Number of dairy cattle per farm (range)	1–12 animals for smallholders; 50-200 for large scale farmers.	1 – 30	1-3	1 - 4	

Table 4: Feeds grown and sold in the study sites and their levels of importance as feed for livestock

Feeds produced	Kieni W.	Olkalau	S. Kinangop	N. Kinangop	Kabiyet	Production and sales level
Maize Stover – green	√ (H)	√ (H)	√ (H)	√ (M)	√ (M)	Green maize stover is common in Kieni, Olkalau and South Kinangop, it is grown and sold by majority of farmers in the sites
Maize stover – Dry	√ (M)	√ (M)	√ (M)	√ (M)	√ (H)	Dry maize stover common in Kabiyet. It is collected after harvesting of maize and is sold per trailer load (tonnage)
Napier grass	√ (H)	√ (H)	√ (H)	√ (H)	√ (H)	Napier grass is grown in almost all fields, though fewer people sell, it was mentioned as the most popular feed used by livestock farmers.
Rhodes grass-loose	√ (M)				√ (M)	Rhodes grass is grown and sold in bundles (unbaled), this is common in Kieni and Kabiyet
Rhodes grass – baled	√ (H)	√ (M)	√ (M)	√ (H)	√ (H)	Rhodes grass grown and baled, also common in all sites
Oats (Straws baled)		√ (H)	√ (H)	√ (H)		Oat straws are baled, also common in Olkalau and Kinangop
Barley		√ (H)		√ (H)		Barley straws are baled, also common in Olkalau and Kinangop
Purple Vetch			√ (H)			Leguminous forage common in Kinangop
Lupin		√ (M)	√ (M)			Leguminous forage common in Kinangop
Columbus grass		√ (M)	√ (M)			Columbus is grown and is common in Olkalau and S. Kinangop
Improved kikuyu grass			√ (M)			Kikuyu grass is grown and is common in S. Kinangop
Sweet potato vines	√ (M)	√ (M)	√ (M)	√ (H)	√ (L)	Sweet potatoes are grown for food and the vines are used for fodder, there are no sales involved in the sites
Natural grass	√ (M)				√ (M)	Always available

Fodder tree & shrubs.(*calliandra, leucaena, desmodium, tree lucern*)	√ (L)	√ (M)	√ (M)	√ (L)	√ (L)	Grown by few farmers but not sold

H- Level of importance in production high; M- Level of importance in production is medium; L-level of importance in production is low

Fodder value chain actors

Seed/input sellers at the start of the chain; the group comprises of agrovet shops, co-operatives, government institutions such as Kenya Agricultural Research Institute (KARI), Kenya Farmers Association (KFA) & Kenya Seed Company and farmers, who supply seeds, planting materials and other inputs to producers.

Producers; are farmers who undertake production of livestock feeds with an intention to sell, some grow for their own livestock but sell when there is excess.

Traders; this group acts as a link between producers in the local[2] and regional market and consumers in the regional market.

- Traders who buy and sells fodder in localized markets. These include agro vets, general shops, cooperatives, roadside fodder markets etc
- Traders who source for fodder from outside the districts and supply local traders at a profit

Traders consist of individual traders and cooperative societies who buy and sell feeds. Cooperative societies offer service to their members; they sell feeds on credit and payment done through check off system against milk supplied.

Transporters; these are service providers who offer transportation services to all actors along the supply chain; they transport inputs, feeds to buyers and also from sellers to the market. The group comprises of cooperative societies and individuals who own trucks, tractors, pickups, motorcycles and donkey carts.

Buyers; they are the final consumers of feed from the regional and local markets, they are found within the cooling plants catchment zones. The group comprises of farmers who own livestock but do not grow feeds or farmers who grow own feeds and buy in times of scarcity.

Other *services providers*; these are individuals who offer services to the actors along the chain they are;

[2] Local market implies the cooling plant catchment zones and the neighbouring regions while regional market implies areas far from the cooling plants catchment zones

- feed processors who pulverize, chop or mill feed,
- individuals who offer hay making services, grass cutters and balers,
- tree nursery operators
- individuals who make silage for a fee.

Actor Profiles

The profiles of the input sellers, producers, transporters, traders and buyers are shown in Table 5. Forty-three percent of those who responded to the question about age were aged between 20-39 years while 25% were aged above 60 years. Input sellers transporters and traders were relatively young and none was aged above 60 years. Most of the actors in all categories had an above secondary education. Most producers own 1-9 cows and lives less than 4 km distance from the road.

Table 5: Profiles of market actors interviewed, showing gender, age, education, land size and number of dairy cows

Profile Parameter		Input sellers	Producers who sell	Traders	Transporters	Buyers who use
Gender distribution	Male Female	2 1	35 5	7 3	8 1	26 6
Age distribution	20-39years 40-59 years >60 years	2 1	10 2 7	5 1	5 4	2 9 6
Education level	Primary Secondary Tertiary	 2 1	2 16 10	 2 5	3 5 1	4 8 5
No. of cows	1 – 9 10 – 20 >20		24 2 1			15 1 1
Dist to road	0 – 4 km	3	28	6	9	17

Note: Some questions such as age, education and no of cows were not asked in the initial study sites (olkalau and Kinangop)

Operations of the feed value chain actors

Two types of fodder markets exist in study sites. These include localized feed production and marketing and external market. The localized markets are found within the district where producers reside and dominated by individual farms that produce feeds for own livestock but sell whenever there is excess often in the wet season. The external markets are found outside the districts where producers and consumers reside and are dominated by traders who buy and sell feeds to producers during times of scarcity (Figure 1). In each of these markets the feed value chain is composed of different actors who undertake different roles. They include input suppliers, producers, transporters, traders, and consumers (Figure2).

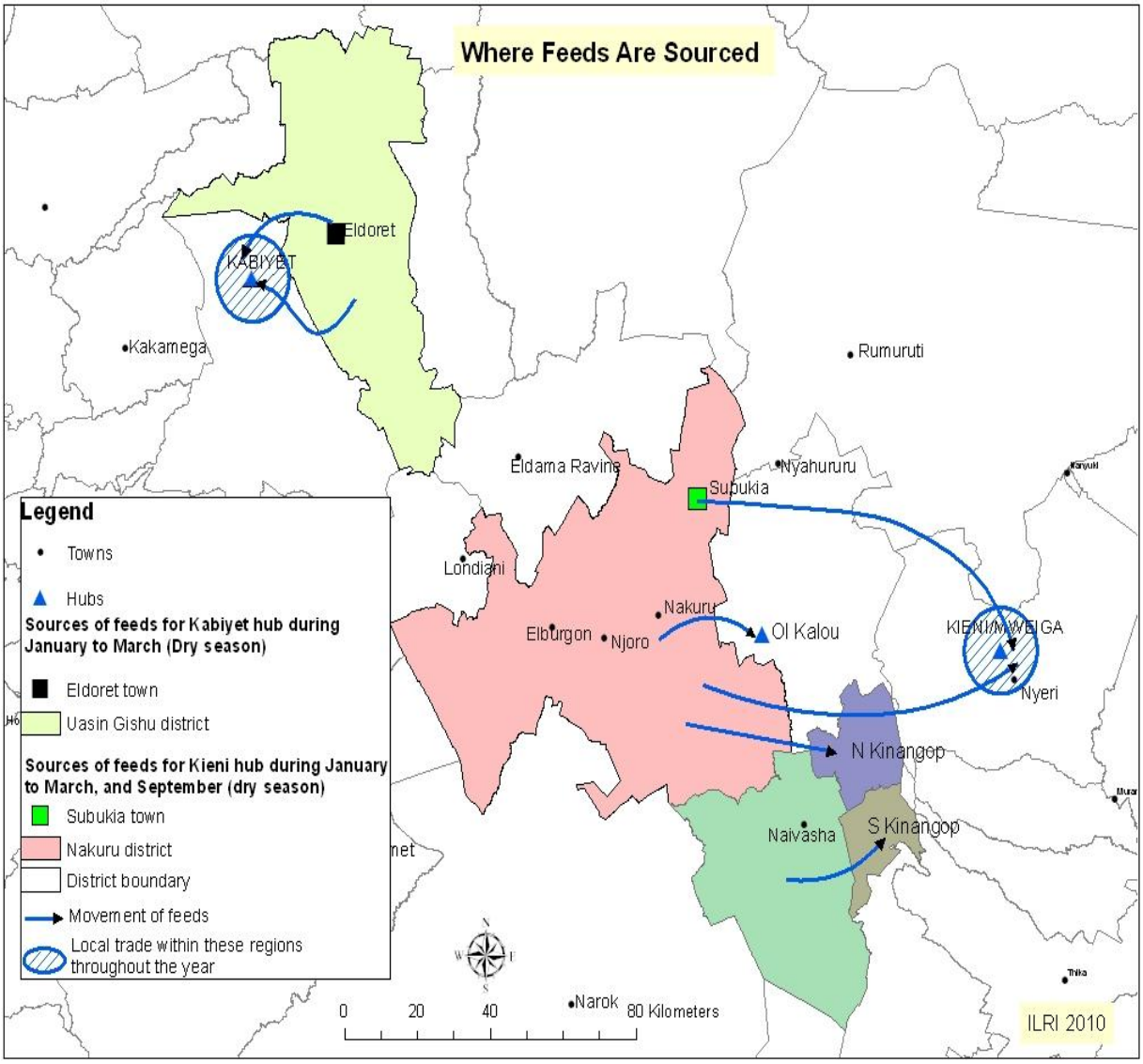

Figure 1: Map showing Geographical flow of feeds.

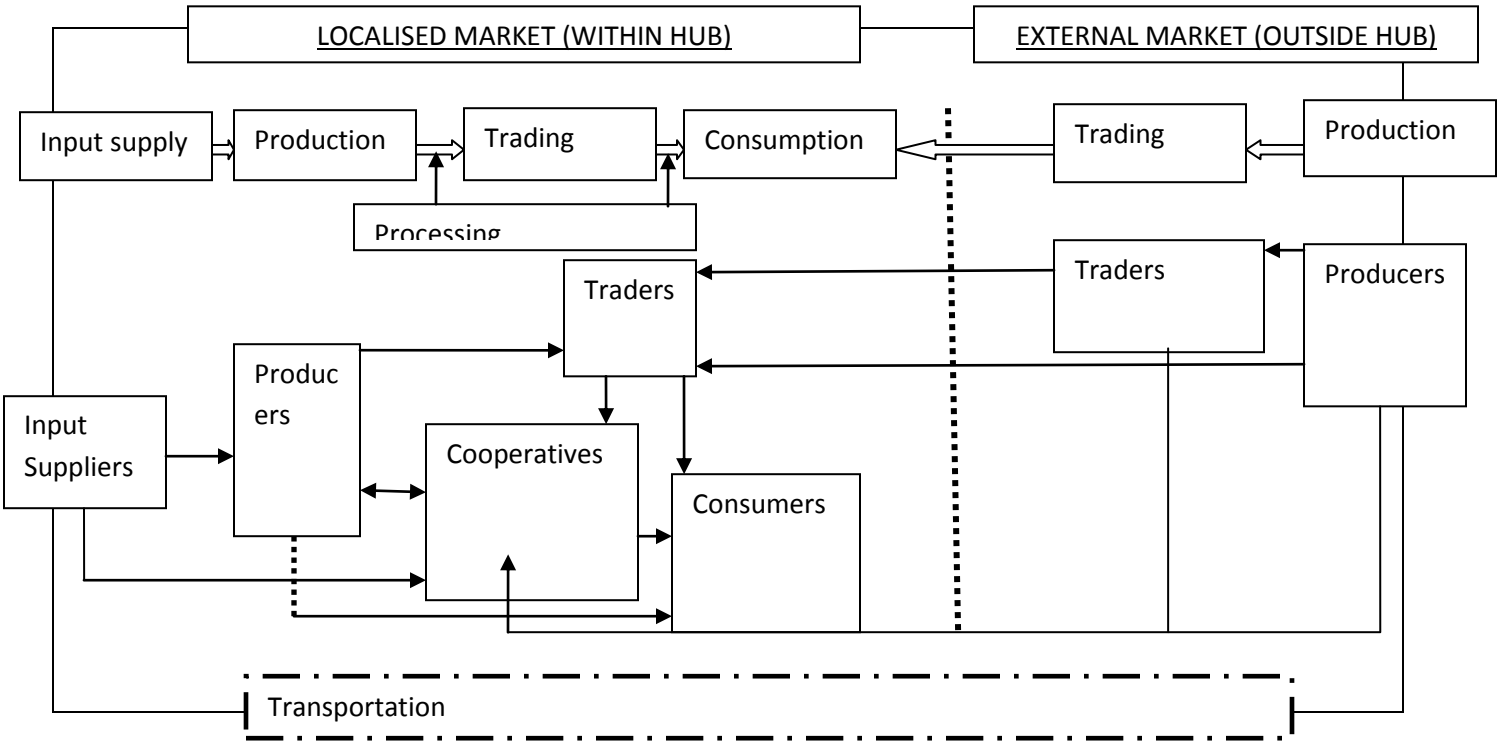

Fig. 2: Feed value chain[3]

Feed input sellers

They operate at the start of the chain and comprises agro vet shops, dairy co-operative societies, government institutions such as Kenya Agricultural Research Institute (KARI), Kenya Farmers Association (KFA) & Kenya Seed Company and individual farmers who supply seeds & planting materials (tree nursery producers) to producers. Agro vet shops specialize in trading in agriculture, livestock and veterinary input products. The inputs sold include forage seeds such as

[3] Localized market implies the cooling plant catchment zones and the neighbouring regions while regional market implies areas far from the cooling plants catchment zones

maize, Rhodes grass, Columbus grass, Nandi setaria, forage sorghum etc, fertilizers such as di ammonium phosphate (DAP), calcium ammonium nitrate (CAN), Urea, foliar feeds etc, herbicides and pesticides.

Livestock Feed Producers

Producers operate on small or large scale. Producers are mainly farmers who grow fodder with an intention to feed their own livestock but also sell when there is excess. Majority of the producers only sell feeds when they have unplanned surplus. However, there are also producers who don't have livestock and grow fodder as a source of income. We did not find any farmers who produce fodder with the sole intention of selling.

Feed selling mainly takes place during the dry season although some trading takes place during the wet season. The dry season falls between September and March although this may be altered by the changing weather patterns. There is variation in prices across seasons with dry season experiencing an increase in the price of feed and wet season experiencing reduced feed prices. For example in Kieni producers sell a bale of Rhodes grass at Ksh. 180 during the wet season and Ksh. 250 during the dry season and in South Kinangop, a bale of oat straws is sold at Ksh. 225 during the wet season and Ksh. 300 during the dry season.

All of the fodder exchange transactions in local and external markets are on-the-spot trading; there are no contractual arrangements. Few farmers exchange feeds for other services/goods e.g. a bag of maize is exchanged with a bag of ground hay and manure in exchange with maize stover.

Feeds Trading

Traders acts as a link between producers and consumers in the localized and external markets. Feed trading has started to intensify due to increasing demand in the study sites. Traders who buy and sell feeds in localized markets include individuals, agro vet shops, general shops, dairy

cooperative societies, roadside feed markets etc. Traders in external markets source for feeds from outside the districts and supply to local traders at a profit. These include individual traders and dairy cooperative societies. Dairy cooperative societies offer this as a service to their members. They sell feeds on credit and payment done by farmers through check off system against milk supplied. The cooperative societies do not consider feed trading as an important business since it contributes only 3-10% of total income of the societies. In Kieni, feed selling is important business for individual traders since it formed a significant (46%) source of their total income. In Kabiyet, selling feed contributed 5- 25% of the total income of individual traders interviewed. In South Kinangop, selling feeds contributed 8% of total income of the cooperative society.

Livestock farmers source for feeds from traders, the feeds are delivered at a cost depending on distance in the case of Napier grass and maize stover and number of bales in case of hay. Most traders store feeds on their premises before selling to farmers. Rhodes hay (loose, baled or ground) is stored for a period ranging 2-6 months. Lucern hay and oat straws are stored for a period of 1 – 4 months by the traders. Maize stovers are stored for a maximum of 1 month to avoid spoilage while Napier grass is stored for not more than 2 days.

The traders (both dairy cooperative and individual) buy maize stovers, Napier grass, wheat straws, oat straws, lucern hay and Rhodes hay, from both local and external markets, for storage and sale to consumers (Table 6). Purchases are common during the dry season when there is high demand for feed.

Table 6: Feeds sold and their levels of importance to traders

Feeds	Kieni W.	Kabiyet	Olkalau	S. Kinangop	N. Kinangop	Source	Level of Importance
Rhodes hay – baled	√	√	√	√	√	Local& other regions	High for all sites due to longer storage period
Wheat straws	√					Other regions	Low: due to low supply
Napier	√	√	√	√	√	Local	Low: due to storage
Maize stover		√				Local	Low: traders do not stock stovers
Oat straws - baled			√	√	√	Local	High: due to longer storage period

Barley straws – baled	√		√	Local	High: due to longer storage period
Lucern hay		√	√	Other regions	High due to longer storage period

Feeds Buying

Buyers are the final consumers of feed and traders in both local and external market, they are found within the milk cooling plant catchment zones of the EADD. The group comprises of farmers who own livestock but do not grow feeds, farmers who grow own feeds and buy in times of scarcity and traders who buy when there is plenty and sell in times of scarcity. The consumers either purchase feeds from other farmers or traders during times of feed shortage especially during the dry season. The feeds bought from external markets are shown in (Table 7). Rhodes grass, Napier grass, maize stovers, oat straws, lucerne hay and natural grass were cited as the most preferred feeds due to their availability during the dry periods. In addition they are preferred because they have high dry matter and sustain milk production. For example Napier grass was cited as having a high biomass production per unit area while Lucerne for its high protein and Rhodes grass & oat straws can be stored for a longer time.

Table 7: Feeds coming from outside and their levels of importance to buyers

Feeds from outside	Kieni W.	Kabiyet	Olkalau	S.Kinangop	N. Kinangop
Rhodes grass- loose	√ (M)	-			
Rhodes grass – baled	√ (H)	√ (H)			
Natural grass (mixed)	√ (M)	-			
Wheat straws	√ (M)	√ (M)	√ (M)		√ (M)
Maize stover (green)	√ (H)	√ (M)	√ (H)	√ (H)	
Maize stover (dry)	√ (M)	√ (H)			
Oat straws –baled			√ (H)	√ (H)	
Barley straws – baled			√ (H)		√ (H)
Lucern hay				√ (H)	√ (H)

Level of Importance to buyers: H- is high; M- is medium; L- is low

Service Provision

There are a number of service providers along the feed market value chain. These include transporters, feed processors and hay makers. Transporters are service providers who offer transportation services for inputs and feeds to all actors along the supply chain. The group comprises of dairy cooperative societies and individuals who own trucks, tractors, pickups, motorcycles and donkey carts. The dairy cooperative societies provide transport services to members and buyers of feeds, while independent transporters provide transport services to any feed sellers and buyers. Dairy cooperative societies do not charge lower transport charges than private transporters but members still use this means due to the availability of payment through check off system. Constraints encountered by transporters include high and fluctuating fuel prices, poor road network, labour scarcity, high wear and tear as a result of poor road network, corruption on the roads and stiff competition from other service providers.

Processors are individuals who offer feed processing services such as pulverizing, chopping or milling feed to the actors across the chain. Individual farmers also own feed processing machines. Other service providers include; baling services for a fee although many farmers considered these as inadequate or unavailable in all the study sites; silage making for a fee or establishment of tree nurseries. The EADD project is providing extension services to these service providers, these services were however limited in all survey areas.

Feed shortage and coping strategies

In all the study sites, feed shortage is experienced in the months of October through to the beginning of March. Feeds are abundant in the months of March to August (Table 8).

Table 8: Annual Feed Calendar for Several Feed Resources

Month	*Importance*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Natural grass	*H*	*Scarce*			*Increasing*		*Abundant*				*Start decreasing*		
Oat	*H*	*Scarce*			*Increasing*		*Abundant*				*Start decreasing*		

Green maize stovers	***M***	***Unavailable***					***Available in small quantities***			***Unavailable***	
Dry maize stovers	***M***	***Available***	***Unavailable***					***Available***		***Unavailable***	
Napier grass	***H***	***Scarce***		***Increasing***			***Abundant***			***Decreasing***	
Rhodes Hay(Dry)	***H***	***Abundant***			***Decreasing***		***Scarce***		***Increasing***		***Abundant***
Ground maize	***L***	***Abundant***		***Decreasing***			***Scarce/Unavailable***			***Abundant***	

H-High; M-Medium; L-Low

Coping strategies used by farmers in the sites to overcome feed shortages during dry seasons included utilization of conserved feeds, purchase of off farm feeds, use of public land for grazing and use of commercial feeds (Table 9). Most strategies require farmers to commit cash to feeding cattle with accompanying increased costs of milk production. It was clear that not all farmers can afford such strategies and therefore opt for cheaper strategies such as use of public land for feeding cattle. This latter strategy increases disease risks and reduces production due to under-feeding and long distances that livestock have to walk.

Table 9: Coping strategies during the dry season for feed buyers in the study sites

Coping strategy	Kieni W.	Kabiyet	Olkalau	S. Kinangop	N. Kinangop	Strength	Weakness
Use of conserved feeds (hay, silage)	1	1	1	1	1	Ensures feed is available	Expensive to make.
Feeding crop residue (e.g. Maize stover)	1	1	1	1	1	Cheaper	Sometimes not available
Off farm purchase of feeds (hay, maize stover)	2	2	2	2	2	Ensures feed is always available	It is costly
Purchase concentrates	2	2	2	2	2	Maintain milk production during the dry season	It is costly
Harvesting of grass from public land (forests, river banks)	3	2	3	3	3	Cheap	Tick borne disease risk and low production, not sustainable
Grazing on public land	3	2	2	2	2	Cheap	Tick borne disease risk and not sustainable

1-mostly used; 3-least used

Feed price variation

The price of feed has increased over the past one year (from year to year) by about 15%. In all the sites, the prices of feeds fluctuate between seasons. Prices go up during the dry season and and drop drastically during the wet season in some cases for example in Kabiyet, ground maize prices rise from Ksh. 700 in March to Ksh. 2500 in June when majority of the farmers have exhausted their stock. In Kieni, the cost of purchasing hay increases from Ksh.150 per bale during the wet season to Ksh. 250 during the dry season. In North Kinangop, lucern hay costs Ksh. 200 during the wet season and Ksh. 250 during the dry season. In Kabiyet, milled hay (hay milled and packed in 90 kg bags) cost Ksh.350 in the wet season and Ksh.500 in the dry season (Table 10).

Table 10: Feed Price Trends during 2010 in Kabiyet

Feed	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Boma Rhodes Hay (KSh/	250	250	250	230	230	230	230	250	250	250	250	250
Ground maize (Ksh)	700	700	1800	2000	2300	2500	2500	2500	2500	1500	700	700
Ground Maize stover (Ksh)	200	-	-	-	-	-	-	-	-	200	200	200

Costs and Margins

Boma Rhodes is harvested twice a year often during the dry season to ensure that the fodder is baled while dry. In the surveyed sites, the average yields per acre is 300 bales per harvest. The bales weigh 12 to 15 kgs.

Boma Rhodes hay has high profit margins and net income as compared to Napier grass and dry maize stover. The high margins for boma rhodes are attributed to the high demand for hay by dairy farmers because it can be stored for longer periods of time i.e. 2 to 3 years (Table 11).

Table 11: Costs and returns for producing and marketing of Boma Rhodes hay in the wet and dry seasons per acre.

Item	Wet Season	Dry Season	Annual
Yield per acre (bales)	300	300	600
Price per bale (Ksh)	200	250	225
Gross output (Ksh)	**60000**	**75000**	**135000**
Variable costs			
Planting materials/acre (Ksh)	7000	-	7000
Fertilizer	5000	5000	10000
Harvesting and baling cost/acre	11000	11000	22000
Hired labour (Land prep)	4000	-	4000
Family labour	1500	1500	3000
Total	*28,500*	*17,500*	*46,000*
Gross Margin	***31,500***	***57,500***	***89,000***
Other costs			
Other charges; Depreciation	1210	1210	2420
Storage	2600	2600	5200
Total	3810	3810	7,620
Net income	**23,880**	**49,880**	**73,760**

Source: Survey; data gathered from Focus group discussions

In the dry lowlands (Olkalau), oat is harvested 3 times in a year while in the wet highlands (S. Kinangop) oat has 2 scenarios for harvesting; once in a year if oat was planted solely for seed production, twice per year if oat was planted for both seed and hay. The farmers use a harvester and baler for harvesting and baling seeds and hay. During the dry season 400 bales and 15 bags of seeds are realized from one acre while 400 bales are realized during the wet season which is the first harvest. During the first harvest, oat is not left to produce seeds. The oat straw can be stored for longer periods of time of up to a year.

The groups interviewed attributed high margins in oat production to use of a manual box baling method which is cheaper compared to use of a baler machine. Another reason farmers gave for high margins is that they plant re cycled seeds which gives it high demand and therefore more value attained from oat (Table 12).

Table 12: Costs and returns for producing and marketing of oat in the wet and dry seasons per acre.

Item	Wet Season	Dry Season	Annual
Yield per acre (bales)	400	400	800
Price per bale (Ksh)	225	300	262.5
Seeds (90 Kg bags)	-	15	40
Price per bag	-	3,000	3,000
Gross output (Ksh)	**90,000**	**165,000**	**255,000**
Variable costs			
Planting materials/acre (Ksh)	13500	-	13500
Fertilizer	3000	-	3000
Transport costs (seeds, fertilizer)	450	-	450
Land preparation	4500	-	4500
Hired labour	2250	2250	4500
Family labour	150	150	300
Harvesting and baling cost/acre	3000	3000	6000
Harvesting and baling materials	2950	2950	5900
Total	29,800	8,350	38,150
Gross Margin	***60,200***	***156,650***	***216,850***
Other costs			
Other charges; Depreciation	1210	1210	2420
Storage	620	620	1240
Rent (1 acre @ 5000 per year)	2500	2500`	5000
Total	4330	4,330	8660
Net income	**55,870**	**152,320**	**208,190**

Source: Survey; data gathered from Focus group discussion

Napier grass being a perennial crop is harvested three times in a year often in April, August, and October. Nevertheless, some farmers harvest more frequently especially during the wet season when rainfall and therefore growth rate is high. The yield per acre varied between ten and twelve tons while price per ton was reported to be Ksh.1300 -1500 (Table 13).

Table 13: Costs and returns for producing and marketing of napier grass per acre.

Item	Napier Grass
Yield per acre per harvest (tonnes)	11
Frequency of harvest	3 times
Yield per acre per year (tones)	33
Price per ton (Ksh)	1400
Gross output (Ksh)	**46200**
Variable costs	
Planting materials/acre (Ksh)	2000

Fertilizer	2500
Harvesting and baling cost/acre	
Hired labour	4000
Family labour	3800
Total	**12,300**
Gross Margin	***33,900***
Other charges; Depreciation	195
Net income	**33,705**

Source: Survey; data gathered from individual interview.

In Kieni, Olkalau, South & North Kinangop, maize stover is harvested twice a year while in Kabiyet maize stover is harvested only once a year. In Kieni the green stover yield per acre was reported to be 2.5 tons per season fetching a price of Ksh.2000 – 3000 per ton while in Kabiyet the yield of dry stovers was reported to be 4 tons per acre fetching a price of Ksh.250 per 90 kg bag, this is variable depending on the season with higher prices during the dry season (Table 14).

Table 14: Costs and returns for producing and marketing dry maize stalk per year in Kabiyet

Item	Dry maize stalks
Yield per acre maize grain (bags/cobs)	40
Price per bag/cob (Ksh)	800
Gross output (Ksh)	32000
Yield per acre maize stalks (tons)	4
Price per ton (Ksh)	250
Gross output (Ksh)	1000
Total Gross Output (Ksh)	***33,000***
Variable costs	
Planting materials/acre (Ksh)	1150
Fertilizer	5750
Manure (5 tons @ 2220)	
Hired labour (planting, weeding, topdressing, manure)	6400
Harvesting cost (labour)	3400
Family labour	750
Packaging materials	1280
Transport	2500
Total	*21,230*
Gross margin	***11770***
Other charges; Depreciation	1266

Storage	1200
Net Income	***9304***

Source: Survey; data gathered from individual interview (NB; data for green stover was not collected)

In Olkalau, barley is harvested once in a year. The farmer interviewed grows barley on large scale (i.e 50 acres). Barley yields 15 bags of grain and 80 bales of straw (Table 15). The price of barley differs with season, during the wet season a bale of barley straws goes at Ksh. 150 and Ksh. 200 during the dry season.

Table 15: Costs and returns for producing and marketing of barley per acre (using dry season prices).

Item	Barley
Yield per acre (bales)	80
Price per bale (Ksh)	200
Grains (70 Kg bags)	15
Price per bag	2250
Gross output (Ksh)	**49,750**
Variable costs	
Planting materials/acre (Ksh)	1500
Fertilizer	2000
Herbicide and pesticide	1400
Fungicide	300
Land preparation	4500
Planting	1500
Harvesting	2000
Baling	3200
Hired Labour	1200
Total	17,600
Gross Margin	***32,150***
Other costs	
Storage	3000
Total	3000
Net income	**29,150**

Source: Survey; data gathered from individual interview

Sweet potato vines are harvested continuously throughout the year in North Kinangop. On average 46,150 vines per acre per year (Table 16). Farmers get highest harvests during the dry season.

Table 16: Costs and returns for producing and marketing of sweet potato per acre

Item	Sweet potato
Yield per acre (vines)	46,154
Price per vine (Ksh)	1
Roots (bags)	38.46
Price per bag	3500
Gross output (Ksh)	**180,764**
Variable costs	
Land preparation	6924
Ridging	2308
Planting	5769
Hired Labour (weeding)	17,307
Harvesting	16,154
Total	*48,462*
Gross Margin	***132,302***

Source: Survey; data gathered from individual interview

Ground boma rhodes hay is also profitable as it gives relatively high margins. However information was only for one harvest which is accompanied by harvest of seeds (Table 17)

Table 17: Costs and returns of Ground Hay Production In Kabiyet - one season

Item	**One season**
Yield of hay	86
Price per bag	450
Yield of seeds	1
Price	3571
Gross Output	**42,271**
Variable costs	
Land preparation	3627
Planting material (seeds)	2100
Labour for planting	200
Herbicide	770
Top dressing	2460
Harvesting	2000
Labour for transportation	1000

Cost of processing (pulverising)	11180
Packaging	3870
Storage cost (pest control)	160
Repair and maintenance	200
Total	*27,567*
Gross Margins	**14,704**

Among all the feed enterprises oat is the most profitable venture followed by sweet potato vines then Boma Rhodes, the least profitable is dry maize stover (Table 18). Oat is more profitable since producers sell both seeds and straws. It is also high yielding as it produces more bales as compared to rhodes hay. Sweet potato vines have high margins due to the low production cost and also continuous harvests throughout the year. Producers for sweet potatoes also sell tubers and vines which earns more income.

Table 18: A summary of Costs and Returns for Several Feed Enterprises per Year

Feed Enterprise	Costs	Returns	Gross margins
Oat (baled)	38,150	255,000	**216,850**
Sweet Potato vines	48,462	180,764	**132,302**
Boma Rhodes (baled)	57,000	135,000	**78,000**
Napier grass	12,300	46,200	**33,900**
Barley (baled)	17,600	49,750	**32,150**
BomaRhodes (ground)	27,576	42,271	**14,704**
Dry Maize stover	21,230	33,000	**11,770**

Incomes in the value chain

Amongst producers, feed selling is the lowest contributor (2%) to their total income. The low contribution of fodder to the incomes of producers in the region is an indication that they do not give much priority to fodder selling as a business. Feed transportation business does not form a major component of cooperative society's income as it contributes about 5% of their total income.

Table 19: Percentage contribution of fodder to the income of actors

Actor	Percentage
Input sellers	8.5
Producers	2
Traders - cooperatives	6
- Individual	30
Transporters – cooperatives	5
- individuals	10

Value addition along the chain

On examining the value of a bale of Boma Rhodes hay along the chain, producers add most value compared to other chain actors (Fig 3), the value is the price for which a bale of Boma Rhodes is sold to the next actor in the chain.

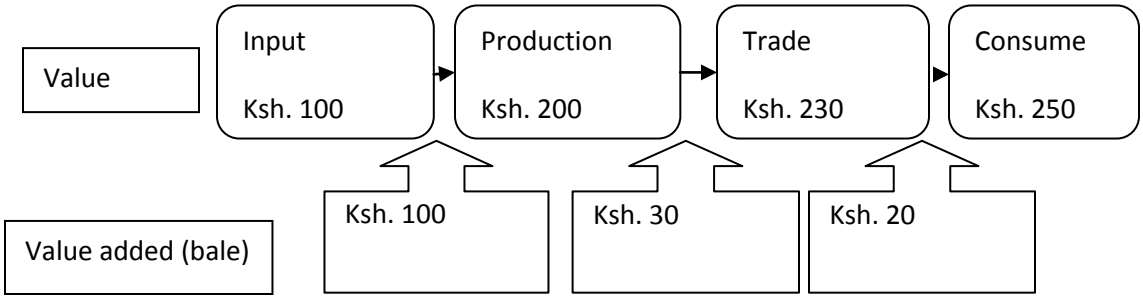

Fig 3: Value added for boma rhodes hay per bale along the chain

Constraints along the value chain

Input suppliers and producers reported the issues of seed quality being a major problem. The input sellers noted that some seeds especially of new varieties take a long time to mature and some are low yielding. Many farmers mentioned high costs of inputs as a major problem, inputs such as seeds (maize, Rhodes grass, Columbus grass, Nandi setaria and forage sorghum), fertilizers (DAP, CAN, Urea, foliar feeds), herbicides and pesticides are costly for producers.

Lack of working capital is a constraint for all actors in the chain. Producers argued that lack of capital was a more important problem than lack of markets. This suggests that there are opportunities to grow fodder for sale if investment constraints such as capital are tackled.

Seasonality availability of feeds was a major problem among all actors. Actors noted that feeds prices reduced significantly during the wet season when there is feed surplus. Lack of markets especially during the wet season was mentioned as a problem by the producers and a disincentive to fodder production and marketing.

Feed scarcity is exuberated by lack of storage facilities for most actors across the value chain. Storage facilities are essential in fodder trading since most feeds will require to be kept in moisture free environments to avoid spoilage and reduction in quality. Indeed, all actors complained that fodder such as maize stover and Rhodes grass hay are bulky and require a lot of storage space.

Producers growing feeds reported disease and pest problems for some feeds such as Napier which is affected by Napier smut disease.

Storage space was a problem among all actors, they all complained that fodder for example maize stover and rhodes grass are bulky and require a lot of storage space. Pests and diseases; producers growing feeds experienced disease and pest problems for some feeds such as napier which got affected by smut disease.

A trader in North Kinangop noted that lack of consistent market was a major problem, because farmers only purchase feeds during the dry season.

Future Demand

Demand for feed in the future is likely to increase due to farmers shifting from grazing to embracing zero grazing due to reducing land sizes. Further, farmers have started taking dairy farming as a business and the growing number of dairy farmers will make demand for feed to increase. Improved extension education on dairy production and knowledge is likely to make farmers adopt better farming techniques and increase demand for feeds. Feed conservation is also being adopted and farmers are likely to demand more for conservation in order to cushion themselves against any fodder fluctuations in the future.

Conclusions

Dairy cooperatives play a major role in feed marketing and transport businesses. They link buyers and sellers thereby stimulating demand. They provide producers and buyers the much needed credit against milk supplied.

Feed trade is a low priority enterprise amongst many of those selling. It is mostly traded when there is unplanned surplus. Amongst producers, fodder selling is the lowest contributor (2%) to their total income.

Oats, Boma Rhodes hay and sweet potato vines have high gross margins, compared to other feed enterprises; these can be used as a basis for selecting which feed enterprise to recommend to farmers. However, availability, farmers' preference and nutritive value need to be considered when selecting the technology to promote.

Capital to invest in fodder was a bigger constraint to fodder sellers than lack of market. The sellers also lacked capital for expanding. Since feed trade is a low priority enterprise feed sellers preferred spending available capital on other enterprises.

Feed trading is seasonal, i.e the buying and selling is more pronounced during the dry season. The study shows that there are prospects for increased demand and therefore there is need to promote feed production and marketing.

Recommendations

Production and marketing of feed through all actors, i.e producers, traders, transporters, processors and buyers in the various sites constitute a value chain. It is a source of livelihood in terms of cash earning and livestock off-take. Therefore, this system requires interventions targeting various issues along the chain.

Increasing productivity and profitability of livestock feed

- To facilitate the emergence of feed selling enterprises, there is need to promote feeds that can be easily marketed during the dry season, such as baled Rhodes grass. This can be

enhanced by introducing high yielding seeds to ensure high quantity and quality. Promotion of feeds that have high returns among producers could also facilitate emergence of fodder selling.

- Farmers need also to be assisted in assessing profitability of different feed enterprises. This could be through availing information on production costs and returns as well as other economic measures of different feed enterprises that thrive in the regions.
- There is need to promote production of pastures and fodders based on the agroecological zone and the farming system
- Equip farmers with appropriate technologies and skill of pasture and fodder production to increase efficiency from land preparation to harvesting
- Develop and strengthen linkages seed supply system to ensure seeds are available with the appropriate packaging and price. Where possible promote onfarm seed production through groups or individual farmers

Reducing marketing costs

- Processing of feeds (baling, grinding, etc) needs to be promoted to reduce bulkiness and therefore storage and transportation costs. This could help improve the profitability of fodder marketing.
- Promote onfarm feed processing to reduce bulkiness such as hay baling, processing of maize stover or drying of fodder shrubs leaves/stems and the use of local available equipment e.g hay box
- Collective action, such as farmer groups may help to minimize production and operational costs a better bargaining power and also to attract buyers who prefer buying in bulk. This enhances an increase in margins. Group sales will also reduce marketing and transaction costs and take advantage of economies to scale.
- Encourage Groups to use DFBA as a marketing platform

Improving market information and linkages between buyers and sellers

- There is need for feed marketing to be promoted as a package alongside, feed conservation, feed processing and linkages to buyers, service providers and input sellers.

This will create awareness on the roles of other actors and how best they can work together to strengthen the chain and increase individual gains. This can be done through use of the "SCALE" approach where all actors are brought together in a forum to provide an opportunity for networking and information sharing.

- There is need to develop and strengthen the feed marketing information system where buyers and sellers have a common avenue to get information one such avenue is where the DFBA can be used as an information centre, use of ICT e.g the cellphone on the agricultural commodity where we have buying and selling
- There is need for better linkage and coordination of private service providers as they will play a major role in provision of services such as input supply, extension services, transport and other services needed by farmers in the study sites. This will enhance fodder trading in the sites.

Increasing dry season availability of fodder

- Pasture and fodder production and feed selling should be linked to seasonality demand where producer understand the feed seasonal calendar and therefore maximize on the times of scarcity
- Producers (individual or groups) can initiate contract with their DFBA or for regional market with other uses and therefore base their production on demands. Feed storage will therefore be very important to avoid post harvest losses
- Feed conservation strategies should target months when there is scarcity, starting October to March. Further market linkage should be enhanced to ensure that areas with surplus feed are linked with deficit areas.
- Farmer training on the simple feed processing strategies such as box baling and silage making will help to enhance utilization of surplus feed during wet season and alleviate dry season feed shortages.

Institutional innovations

- The role of cooperative societies as a provider of feeds on credit needs to be formalized as this will stimulate feed production amongst producers who produce feeds and sell to cooperatives.

- Cooperative societies should be encouraged to provide feeds on credit to their members to facilitate utilization of produced fodder. They should also act as a link between producers and users for both local and regional market.
- Farmers should be assisted in production of quality seeds through linkage with institutions that supply seeds where coordinated production can guarantee availability of affordable and better yielding seeds.
- There is need to link farmer groups to financial institutions to get credit for producing fodder for the market.

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ANNEX

Napier grass Depreciation computation

Item	% utilization	cost	Useful life (years)	Depreciation
Hoes	100	350	5	70
Panga	100	200	5	50
Spade	60	250	2	75

Boma Rhodes depreciation computation

Item	% utilization	cost	Useful life (years)	Depreciation
Tractor	20	1800000	30	1200
Panga	20	200	5	10

Maize stalks depreciation computation

Item	% utilization	cost	Useful life (years)	Depreciation
Tractor	20	1800000	30	1200
Panga	20	200	5	10
Hoes	80	350	5	56

Costs and Returns for Oat Production during the Dry Season

Income	**Rate**	**Amount**
Sale of Oat grass	400 bales @ 300	120,000
Sale of oat seed	15 bags @ 3000 per bag	45,000
Total Income		**165,000**
Expenses		
Ploughing	Charge	3000
Harrowing	Charge	1500

Planting material (seeds)	90 kg @150 per kg	13500
Fertilizer	2 bags @ 1500/bag	3000
Transport costs seeds	150 ksh per bag	150
Transport costs fertilizer	150 ksh per bag	300
Labour to plant & harrowing	broadcastig 2 pple @150, harrowing 1500	1800
Labour for Weeding	3 days @ 150/day	450
Gunny bags for seeds and string	25 bags @ ksh30, string ksh 200 each	950
Labour for sealing bags	1 person per day @ 150	150
Harvesting & Baling	charge	3,000
Labour for harvesting	supervision 5 hrs	150
Cost of storage	Cost of setting up store 6200 for 5 years (divided by 5 year and 0.5 year since 2 harvests in a year)	620
Baling string	5 @ 200	1,000
Hire of baling box	4 days @ 200/day	1,000
Total Expenses		**30,570**
GROSS MARGINS		**134,430**

Costs and Returns for Oat Production during the Wet Season

Income	**Rate**	**Amount**
Sale of Oat grass	400 bales @ 225	90,000
Sale of oat seed	25 bags @ 3000 per bag	75,000
Total Income		**165,000**
Expenses		
Ploughing	Charge	3000
Harrowing	Charge	1500
Planting material (seeds)	90 kg @150 per kg	13500
Fertilizer	2 bags @ 1500/bag	3000
Transport costs seeds	150 ksh per bag	150
Transport costs fertilizer	150 ksh per bag	300
Labour to plant & harrowing	broadcastig 2 pple @150, harrowing 1500	1800

Labour for Weeding	3 days @ 150/day	450
Gunny bags for seeds and string	25 bags @ ksh30, string ksh 200 each	950
Labour for sealing bags	1 person per day @ 150	150
Harvesting & Baling	charge	3,000
Labour for harvesting	supervision 5 hrs	150
Cost of storage	Cost of setting up store 6200 for 5 years (divided by 5 year and 0.5 year since 2 harvests in a year)	620
Baling string	5 @ 200	1,000
Hire of baling box	4 days @ 200/day	1,000
Total Expenses		**30,570**
GROSS MARGINS		**134,430**

Gross Margins for Nappier Grass Production - one harvest

Income	**Rate**	Land Size (acre)	**Amount**
Sale of nappier	11 tons @ 1400	1	15400
Total Income			15400
Expenses			
Manual tillage	4 people for five @ 200 per person	1	4000
Labour land preparation	supervision for 5 days @ 200	1	1000
Planting materials(cuttings)	Ksh 500	1	500
manure	1 truck @ 2500	1	2500
Labour for weeding	2 people per day @ ksh 200 for 4 days	1	1600
Labour for harvesting	2 people per day @ ksh 200 for 3 day	1	1200
Labour for transport	2 people per day @ ksh 200 for 5 day	1	2000
Total Expense			**12800**
Gross Margins			**2600**

Costs and Returns for Barley Production

Income	**Rate**	Land Size (acre)	**Amount**
Sale of barley	15 bags @ 2250 per bag	1	33750

Sale of straws	80 bales @ 200 per bale	1	16000
Total Income			**49750**
Expenses			
1st Ploughing	3000 per acre	1	3000
Harrowing	1500 per acre	1	1500
Seeds	30kg per acre @ 50 per kg		1500
Machine for planting	1500 per acre	1	1500
Fertilizer	50 kg bag per acre @ 2000	1	2000
Herbicide and pesticide	1400 per acre	1	1400
Fungicide	300 per acre	1	300
Harvesting barley straws	2000 per acre	1	2000
Baling	80 bales @ 40 per bale	1	3200
Cost f gathering	10 people for 4 days @ 300	1	1200
Total Expense			**17600**
Gross Margins			32150
Other costs			
Storage			3000
Net Income			29150

The cost and benefits of sweet potato production in Kinangop District

Item	Land Size	Man days	Unit cost	Total cost (0.13 acres)	Total cost/acre
COSTS					
Land Preparation					
1st Ploughing	0.13	4	150	600	4616
2nd Ploughing	0.13	2	150	300	2308
Planting	0.13	5	150	750	5769
1st Weeding	0.13	10	150	1500	11538
2nd Weeding	0.13	5	150	750	5769
Ridging	0.13	2	150	300	2308
Harvesting (tubers)	0.13	2	150	300	2308
Harvesting (vines)	0.13	12	150	1800	13,846
Total cost					*48,462*
BENEFITS		Yield			

Sweet potato vines (number)	0.13	6000	1	6000	46,154
Sweet potato roots (bags)	0.13	5	3500	17500	134,610
Gross Output					***180,764***
Gross Margins					**132,302**

Costs and returns of Ground Hay Production In Kabiyet - one season

Income	**Rate**	Land Size (acre)	**Amount**
Sale of hay	86 bags @450 per bag	1	38700
Sale of seeds		1	3571
Total Income			**42271**
Expenses			
1st Ploughing	2142 per acre	1	2142
2nd Ploughing	1285 per acre	1	1285
Supervision	1 man day	1	200
Planting material (seeds)	3.7 kg	1	2100
Labour for planting	1 person for @ 200	1	200
Herbicide	1 Liter @ 150	1	570
Labour for spraying	1 person @ 200	1	200
Top dressing	50kg bag @ 2260	1	2260
Labour for application	1 person @ 200	1	200
Labour for harvesting	4 people @ 200 per point	1	2000
Labour for transportation	10 people @ 100 per point	1	1000
Cost of processing (pulverising)	86 bags @ 130	1	11180
Labour for packing	86 bags @ 10 per bag	1	860
Cost of packaging materials	86 bags @ 35 per bag	1	3010
Storage cost (pest control)	Rodent kill @ 160	1	160
Repair and maintenance	Repairs @ 200	1	200
Total Expense			**27567**
Gross Margins			14704

COSTS AND RETURNS FOR BABY CORN IN MWEIGA (ROZZIKA)

Income	**Rate**	Land Size (acre)	**Amount**
Sale of baby corn	3.5 tons @ 310 per kg	1	1085000
Sale of green stovers	4.5 tons @ 4500	1	4500
Total Income			**1089500**
Expenses			
1st Ploughing	1660 per acre	1	1660
Planting materials	35 kg @ 280 per kg	1	9800
Labour for planting	4 people for 1 day @ 180 per person	1	720
manure	7 tons @ 2220 per ton	1	15540
Fertilizer	100 kg @ 34 per kg	1	3400
Herbicide	400gm @ 400	1	400
Labour for herbicide application	1 person @ 180	1	180
weeding	6people for 2 days @ 180 per person	1	2160
Manure application	2 people @ Ksh 155	1	310
Harvesting corn	3.5 tons @ Ksh 2 per kg	1	7000
Harvesting fodder	1 person @ Ksh.180	1	180
Total Expense			**41350**
Gross Margins			

Notes:

Ploughing and harrowing rates are considered as market rates

Assumption sale is done at farm level as it is always the case.

Gross Margin for ground hay- Tankinya cooling plant

Revenue	**Rate**	**Amount**
Sale of ground hay	100 bags per month @400 per bag	40000
Total revenue		**40000**
Variable costs		
Purchases	100 bags per month @ 350 per bag	35000
Handling charges	1person @200	200
Total Total variable costs		**35200**
Gross Margins		4800

Monthly Gross margins for fodder seeds seller-Kabiyet

Revenue	**Rate**	**Amount**
Sale of boma rhodes	20(1kg) bags per month @640 per bag	12800
Nandi sateria	10 kg @ 250 per kg	2500
Total revenue		**15300**
Variable costs		
Purchases of boma rhodes	20 (1kg) bags per month @ 580 per bag	11600
Purchases of nandi sateria	10 kg @ 200 per kg	2000
Handling charges	1 person @ 200	200
Total Total variable costs		**13800**
Gross Margins		1500

Monthly gross margins for fertilizer sales-Kabiyet

Revenue	**Rate**	**Amount**
Sale of D.A.P	40 bags per month @3050 per 50kg bag	122000
Sale of C.A.N	10 bags per month @ 2050 per 50kg bag	20500
Total revenue		**142500**
Variable costs		
Purchases of D.A.P	40 bags per month @2950 per 50kg bag	118000
Purchases of C.A.N	10 bags per month @ 1920 per 50kg bag	19200
Handling charges	2 people @ 200 each	400
Total Total variable costs		**137600**
Gross Margins		4900

Note

Not all fertilizer is used in fodder production.

Monthly gross margins for herbicide sales-Kabiyet

Revenue	**Rate**	**Amount**
Sale of roundup	16 liters per month @900 per liter	14400
Sale of wound out	10 liters per month @ 980	9800
Total revenue		**24200**

Variable costs		
Purchases of roundup	16 liters per month @800 per liter	12800
Purchases of wound out	10 liters @ 850 per liter	8500
Handling charges	1 person @ 200	200
Total Total variable costs		**21300**
Gross Margins		2900

Note

Not all herbicide is used in fodder production

Inputs required in production of fodder and their cost-Boma rhodes

Input	**Rate**	Land Size (acre)	**cost**
Boma rhode seeds	3 kgs	1	1920
D.A.P	100 kg	1	7100
C.A.N	75 kg		3075
Round up	1 liter	1	900
Total cost of inputs			**12995**

Inputs required in production of fodder and their cost-Nandi Sateria

Input	**Rate**	Land Size (acre)	**cost**
Nandi Sateria	3 kgs	1	750
D.A.P	100 kg	1	7100
C.A.N	75 kg	1	3075
Round up	1 liter	1	900
Total cost of inputs			**11825**

Gross margins for Hay sales-Trader

Revenue	**Rate**	**Amount**
Sale of baled hay	150 bales per month @ 225 per bale	33750
Total revenue		**33750**
Variable costs		
Purchases of hay	150 bales per month @ 180 per bale	27000
Off-loading	4 people @ 200 each	800
Storage cost	1500 per month	1500

Pest control	200 per month	200
Loading for customers	Ksh 5 per bale	750
Total Total variable costs		**30250**
Gross Margins		3500

Scenario 2

Individual Trader gross Margin-ground hay(Kabisaga)

Revenue	**Rate**	**Amount**
Sale of ground hay	60 bags per month @300 per bag	18000
Total revenue		**18000**
Variable costs		
Purchase of hay	100 bales per month @ 100 per bale	10000
Transport charges	1 trip @ 2000	6000
Total Total variable costs		**35200**
Gross Margins		4800

Scenario 2

Individual Trader gross Margin-ground ground sunflower (Kabisaga)

Revenue	**Rate**	**Amount**
Sale of ground hay	60 bags per month @300 per bag	18000
Total revenue		**18000**
Variable costs		
Purchase of hay	100 bales per month @ 100 per bale	10000
Transport charges	1 trip @ 2000	6000
Total Total variable costs		**35200**
Gross Margins		4800