Study on the Kenyan Animal Feed and Fodder Sub-sectors

Trends in the Kenyan Fodder Sub-Sector

(Sub-report VI)

Perfometer Solutions

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Part of the “Kenya Market-led Dairy Programme” (KMDP) of

SNV/Kenya Netherlands Development Organisation

ACRONYMS

ADC	Agriculture Development Centre
ADF	Acid Detergent Fibre
CBE	(Milk) Collection and Bulking Enterprise
CFP	Commercial Fodder Producer
DFID	Department for International Development
EADD	East African Dairy Development program
FFS	Farmers Field School
HIPK	Heifer International Project in Kenya
ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development
KENFAP	Kenya National Federation of Agricultural Producers
MAP	Market Access Project
MASL	Metres Above Sea Level
MESPT	Micro Enterprise Support Development Support
NALEP	National Agriculture and Livestock Development Program
NDF	Neutral Detergent Fibre
OM	Organic Matter
SDCP	Smallholder Dairy Commercialization Program
SNV	SNV Netherlands Development Organisation
SPE	Service Provider Enterprise
SPEN	Service Provider Enterprise Network

TABLE OF CONTENTS

EXECUTIVE SUMMARY

More than anything else, year round access to quality feed and fodder determines the competitiveness of the dairy sector. Fodder is the backbone of the industry, largely because dairy cows are ruminants, making them highly dependent on forage for milk production.
Dairy producers need to be as proficient in the management of forages as in the management of their cows. Development of a high quality innovating forage sub-sector will reduce farmers' production costs and seasonal fluctuations in milk supply, thereby improving operational profits[(1)].

This sub-study, which is a component of the larger KMDP feed and fodder study, looked at the place of fodder in the smallholder dairy context and the factors that expose many smallholders in areas with a prolonged dry season to a vicious cycle of seasonal fluctuations in milk production, as well as diminishing profits. While there has been a lot of effort in encouraging and building capacity of smallholders to establish their own fodder, this study aimed at looking beyond the smallholders by focussing more on commercial fodder producers.

Smallholders risk facing a diminishing profitability in their dairy enterprises if they continue to feed low quality fodders supplemented with more concentrates (whose quality is also inconsistent). As compared to locally available fodder, dairy meals and concentrates are (more) expensive and cannot perfectly substitute forages in a dairy cow ration.
Some of the reasons why feeding practices have not improved, have been attributed to lack of information (knowledge) as well as ineffective extension and skill development practices. As a result, most smallholders continue to use traditional feeding systems (e.g. use of Napier grass), which clearly is of lower nutritional value compared to maize or other more energy or protein rich fodders.

A study referred to in this report shows that the exposure and awareness of different fodder crops is high amongst the smallholders. In practice however over 55% of the farmers in the survey had only two or three types of fodder on their farm. Usually only one was specifically established as fodder while the other crops would only be crop residue (leftover after harvesting for human consumption; e.g. maize or sweet potato vines). This discrepancy between awareness and practice indicates that it is not exclusively the level of awareness that determines whether a good practice is adopted or not. Other factors that prevent smallholder farmers from establishing (sufficient quantities of) fodder crops, include land space, shortage of labour and availability of seeds and/or clean planting material.

To capitalize on the demand for fodder and the inability of many farmers to establish and preserve fodder on-farm, a commercial fodder sector has emerged in Kenya. There are emerging models in the fodder business, such as:

- Large scale commercial fodder producers supplying farmers and dairy societies.
- Dairy societies' out-grower model, whereby dairy societies produce fodder through their own members, who are supported technically under a buy back arrangement.
- Dairy societies establishing their own large scale fodder production.

In all three models, the cross cutting intention is to bridge the fodder gap.

[1] Dr. Steve Blezinger in his publication on; forage quality, digestibility play an important role in cattle production.

The study also found extension models which include the lead farmer model, the service provider enterprise model and community's local technicians. One interesting model that is expected to stimulate sector growth is the development of middle level dairy farmers, who are willing to invest in mechanized fodder production, new fodder varieties and fodder preservation techniques. Those medium sized dairy farms with sufficient land to grow fodder on large scale, are selling their surplus to neighbouring smallholders, and some have also started collecting milk from them, and providing training and demonstration at a fee.

Based on the findings, the study recommends support for both the demand and the supply side of an emerging commercial fodder sub-sector. On the demand side, dairy societies and farmers who buy fodder in the market would be supported to set up efficient supply chains, storage and fodder distribution. This will go along with quality control mechanisms and access to fodder and feed analysis facilities. This form of support is expected to empower the farmers by strengthening their position as buyers on what quality of feed they need and receive. If this is implemented, the farmers will have a higher value for money as the incidences of supply of low quality fodder will reduce significantly.

On the supply side, the study recommends support to commercial fodder producers, including medium and large scale dairy farmers that want to produce fodder for the market, and dairy societies that want to produce their own fodder, through contract farmers or establishing own fodder enterprises.

The improvement of the fodder supply chain would include formal agreements between commercial fodder producers and dairy societies, where contracts stipulate the specifics of fodder required, including volumes, quality and delivery, different from the current system where the buyers takes what is available from the seller.

The study also recommends that KMDP establishes an information platform (ICT based) where dairy societies and suppliers are able to share data on both feed and fodder supply chains, in particular laboratory analysis, market information (supply/demand), successful models and generally educate each other on the subject of (feed and) fodder in the dairy sector.

1. INTRODUCTION

The BLGG consortium was contracted by SNV Kenya to carry out an Animal Feed and Fodder study in the context of the Kenya Market-led Dairy Program (KMDP). The goal of this study was to identify the gaps/bottlenecks that hamper the development and growth of the Kenyan feed and fodder sub-sectors, and as a result the Kenyan dairy industry (for further details on the consortium and objectives of this study see sub-report I: "Summary Report").

This comprehensive assignment was divided in a number of sub-studies which resulted in the sub-reports as listed below. This document is sub-report VI.

Study on the Kenyan animal feed and fodder sub-sectors: Overview of the sub-reports

No	Title	Author
I	Summary report	BLGG Consortium
II	Kenya dairy sector structure	BLGG Research bv
III	Kenya feed industry policy and regulatory issues	ABS TCM Ltd
IV	Interviews and HACCP audits of Kenyan feed manufacturers	BLGG Kenya Ltd/ AgriQ Quest Ltd
V	Quality analysis of animal feedstuffs and fodders in Kenya	BLGG Research bv
VI	**Trends in the Kenyan fodder sub-sector**	**Perfometer Solutions**
VII	Trends in the Dutch fodder sub-sector	BLGG Research bv

This sub-study VI looks at key issues and trends in the dairy industry with regard to the supply and quality of fodders or forages. The objectives of this study were:

a) To determine the potential financial gains of smallholder dairy farmers using preserved fodder such as hay and silage and in terms of optimum ration, cost reduction, increased and year round milk supply.
b) To describe and analyse the emerging commercialization of the fodder subsector for smallholder dairy farmers in terms of geographical concentration, product supply and demand business model, level of technology, degree of mechanization, investment level and quality control.
c) To benchmark the smallholder and large scale silage producers.
d) To document the prices and price trends of the main commercial fodder products.
e) To document the organizations and programs promoting fodder production within the dairy production systems in Kenya.
f) To document fodder crops, for hay, silage and ground fodder suitable and produced in different agro-ecological zones to meet the dairy cattle feed requirements.
g) To document the nutritional composition and economic value of major preserved and fresh forages.
h) To document dairy societies and private companies involved in commercial fodder production.

2. METHODOLOGY OF THE STUDY

List of objectives	Methodology
Objective (a)	The first objective was approached by sampling a number of feeds (dairy meals) and fodders, including maize silages, hay, Lucerne. The results are shared in a separate report (Sub-report V) of the animal feed & fodder study. This report only gives a comparison between maize silages of large and small scale farmers and benchmarks against internationals standards (see Objective (iii)).
Objective (b)	A questionnaire was developed. A group of 10 commercial fodder producers was identified to whom the questionnaire was sent. Replies were anonymized for the purpose of confidentiality; respondents were labelled CFP1, CFP2 and so on.
Objective (c)	This information was sourced from the analysis of maize silage. The results were divided into two categories, one category of large scale producers (some commercial and others subsistence), and one category of smallholders making maize silage for their own use. The graph in this section compares maize silage quality between the two categories on the following parameters; starch, net energy, OM digestibility, NDF and ADF.
Objective (d)	This information was obtained through interviews. The respondents were identified through the CBE's, who indicated where they sourced various products.
Objective (e)- (g)	This information was obtained from desk review of secondary sources.
Objective (h)	This information was obtained through interviews. The respondents were identified through the CBEs, who indicated where they sourced various products. The names emerging from the CBEs were then interviewed to validate the data given by the CBEs.

3. SMALLHOLDER DAIRY CONTEXT IN KENYA

3.1 Income and employment

Kenya`s dairy production sub-sector is dominated by the smallholder dairy farmers who keep an estimated 3.5 million dairy cattle and produce approximately 5 billion litres of milk annually[(2)]. The industry is quite dynamic, an important source of regular income and a means of asset accumulation for close to one million smallholder farmers. It is the largest in Sub-Sahara Africa.

The sector is valued at KES 170 billion (US $ 2 billion)[(3)] and accounts for 14% of total agricultural GDP, equating to 3.5% of Kenya's overall GDP. The Kenya Dairy Board (KDB) estimates that about 1.6 million Kenyans are engaged to some degree in the dairy value chain and the industry generates an estimated one million jobs at farm level in addition to 650,000 formal jobs. More than 750,000 jobs[(4)] are created in input supply and support services.

An estimated 80% of the total milk production comes from smallholder farmers who sell surplus milk consumed at home to traders, processors who have bulking centres in rural areas, or, , to farmer-owned dairy societies, also referred to as milk Collection and Bulking Enterprises. The remaining 20% is produced by the approximately 2,000 medium and large scale milk producers.

Typical smallholder farmers own 2-5 cows of varied breed, being mainly crossbreeds of Ayrshire, Friesian, Guernsey and Jersey. They produce 3-5 litres of milk per cow per day across regions and highlands 5-9[(5)] litres per day in high potential dairy areas in Kenya's highlands. This may drop by over 50% during the dry spells in some of the major milk sheds, notably Nyandarua/Nyeri and North Rift.

3.2 Smallholder production systems

Dairy production in Kenya is concentrated in the high potential rural areas with sufficient rain. Rapid population growth in the recent years has led to reduced land sizes available for production, limiting the potential of the majority of the smallholders to commercialize their production systems. On the other hand, Kenya`s urban growth and per capita income have lately been on the rise and this has increased demand for milk. Also, the surrounding countries in the region whose dairy sector is relatively less developed constitute new markets for Kenyan milk. The demand for milk is therefore on the rise. In the last two years, there have been campaigns targeting consumers aimed at increasing per capita consumption of milk and milk-based value added products like yoghurts, mala and cheese.

Production systems are rain-dependent with only limited awareness amongst farmers on using a proper feeding regime and low preparedness for dry periods. Thus, the majority of farmers produce and sell below their potential. Availability of quality fodder is a serious issue, particularly for resource-poor dairy farmers with little or no land for cultivation. The magnitude of this problem naturally varies from farmer to farmer, but it clearly is a sector-wide constraint.

[2] Kenya National census 2009
[3] USAID Dairy Sector Competitive Report, 2008
[4] Report on study of consumer milk quality perception/preferences and an assessment of willingness to pay for quality
[5] Extracts from 2012 regional baseline survey covering Kieni West District, Mukurwei-ini dairy co-operative and Nyandarua South District

For farmers with sizeable pieces of arable land, on-site fodder production and preservation should be considered. However, for farmers with less land fodder production has to compete with production of food crops. In this case, a well-functioning fodder supply chain combined with a proper storage facility would constitute a solution.

Most of the fodder available in Kenya, both on-farm and on sale, provides low energy and little crude protein. The common fodders in this case include Napier grass (mostly in central Kenya and parts of eastern region) and Rhodes and other grasses for free grazing and hay making (mostly in the Rift Valley). When cows are fed on Napier grass alone and if they are under good management, the milk production during lactation is at maximum 7 kg/day and 9–12 kg/day when the cow is fed on a Napier–legume (desmodium) mixture. On grass alone (e.g. Rhodes grass or Nandi setaria), an average milk yield of 5–7 kg/day has been obtained and 7–10 kg/day on a grass–legume mixture. Oats fed to a dairy animal can lead to a production of up to 12 kg/day[6]. So, if fed on Napier grass, production would only increase by complementary feeding of other sources of protein and energy rich fodder or concentrates.

Fodder trading is evident in both formal and informal segments. The formal segment is dominated by commercial fodder producers (covered elsewhere in the report), while the informal segment includes even the localized trading of fresh fodder (e.g. Napier grass) between one farmer and the other. Quality is an issue across the two segments with the informal trading most affected where farmers end up buying grasses harvested at very late stages, as well as crop residues with very low nutritional levels. Hay (Rhodes grass) and Lucerne are the most commonly traded, with Napier dominating the localized sales between farmers within close proximity. Commercial production and trading of maize silage is emerging in some parts of the country e.g. Ndykak farm in Nakuru County and Kruger Farm in Eldoret.

3.3 Factors limiting on farm establishment of fodder crops

An estimated 80% of the total costs of a successful dairy enterprise are incurred in feeding and management, with feeding alone constituting on average 68%. While feeding means both forages and concentrates, experience from practicing farmers indicate that a significant proportion of nutrition is met while using appropriate quality and quantity forages, rather than the more expensive concentrates. A dairy cow could produce up to 20 litres of milk a day on a balanced forage feed with no concentrates.
Yet, except for Napier grass, the use of other (preserved) fodder in the high-potential areas of Kenya has not been widely practiced. A number of constraints can be invoked to explain this.

3.3.1 Population pressure and lack of specialisation

In the high potential farming areas in Central Kenya and Eastern Province (notably Meru and Embu), a high population density goes hand in hand with subdivision of land into ever smaller plots. This implies that the space that could be used for growing fodder is progressively diminishing. At the same time fodder also competes on the same farm with food crops and also with cash crops like horticultural crops and industrial crops like coffee, tea and sugarcane.

[6] Source: Dairy Training Manual prepared by the East Africa Dairy Development (EADD) Program

While it is not necessarily a wrong practice to mix farm enterprises this way, farm planning could help to optimize production. The farmers in this category are either unable or unwilling to put in more investment in their dairy enterprises. This explains the high production costs and seasonal fluctuations in volumes, which could otherwise be addressed through additional fodder establishment either on their own farms or leased land space.

The farming actually reflects largely a subsistence system where the production is intended to primarily feed the family and then the surplus is taken to the market. A case in point is in Meru where one prominent farmer[7] collects and bulks milk to sell to a processor. In September 2012, the farmer was collecting 2,400 litres of milk from over 1,300 farmers, which comes down to less than two litres on average per farmer. The cooling tank installed by the processor in his farm was 3,000 litres in capacity and he had not been able to fill it up from this number of farmers. In order to fill this cooling tank to capacity, it would have required the intermediary to drive much further to reach more farming households, which would then work back on the commission as he would have to spend more time, more fuel and perhaps expose the milk to spoilage by taking longer to get it back to the cooler. This is a case in Meru which is one of the high potential areas for dairy in the country, but dominated by small scale farmers.

3.3.2 Research

The volume of past research on the agronomic aspects of high-potential-area fodders is significant. However, most of this is geared to smallholder zero-grazing dairy farming and on-farm fodder establishment for own use, rather than aiming at developing a specialised commercial and mechanized fodder sub-sector.

In addition, the research information available is not being disseminated to the smallholder farmer quickly enough and in a form that he can immediately utilize. Research needs to identify the type of material to plant in accordance with the climatic and soil properties and the fertilization practices of a given locality. Equally, optimum harvesting time needs to be known so that harvesting is done when dry matter and the nutritive value of the forage are at their optimum. Factors such as cutting height, frequency of cutting and methods of feeding need to be well understood by farmers as they affect the nutritive value and digestibility of the forages. Appropriate intermediate technology needs to be developed for the small-scale farmer to enable him to process his fodder and ensure maximum intake or to allow him to preserve it for dry-season use. The results of such research should then be communicated to the array of agricultural extension workers in the field.

3.3.3 Limited extension support

While large scale and sometimes medium scale farmers are able to access and interpret information on best practice dairy keeping, smallholders rely heavily on training and extension support. Government extensions services have reduced considerably since the Structural Adjustment Programmes in the 1990s, whilst the private sector and dairy cooperatives have not filled this gap.

The CBEs remain the best positioned to provide this service as the government supported mechanism is overstretched and cannot be relied on to bridge the extension gap in a fast growing sector. In the survey of five CBEs over 53% of all the farmers interviewed had either rarely or never met the extension officer. Only 20% indicated to have interacted with the area extension officer on a regular basis.

[7] Festus Kathendu who was then collecting milk for collection by Sameer Dairies (Daima Milk)

3.3.4 Information uptake

The fact that a majority of the smallholder farmers are not establishing or preserving fodder may not necessarily imply that they had no access to appropriate training. There could be other factors in play. For instance, among the 278 farmers interviewed in 2011, the majority was aware of many other fodder crops next to the commonly known Napier and maize stalks, including protein rich fodders like Lucerne. However, in practice only 55% of the same group had planted no more than two types of fodder crops, which then also were shared for human consumption (maize or sweet potato vines). This discrepancy is an indication that it is not exclusively the level of awareness that determines whether a good practice is adopted or not.

The farming population in rural Kenya is largely represented by the older generation, 55-60 years of age[8]. This is associated with a high illiteracy level making it even harder for development programmes. This also has an effect on the practice of fodder establishment.

A baseline report conducted in mid-2011 by SNV in Kieni West, Mukurweini and Nyandarua South in Central Kenya indicated that only 20% of the smallholders interviewed had any form of fodder preservation skills, despite continued sensitization on fodder preservation to counter seasonal fodder shortages. This again points to slow adoption of skills and uptake of information among the smallholder farmers. In the same report, less than 5% of the interviewed farmers were consistently making their own silage as part of their dairy farming practice. This observation explains that the disparity between the current levels of production and the potential capacity, can be attributed to poor feeding practices.

3.3.5 Labour

Labour on a mixed farm in the high-potential areas would be required to cut and carry forage, manage the animals and ensure an adequate water supply, among other requirements. The demand for labour is particularly intense in the zero-grazing system during planting and weeding of fodder, which also coincides with the peak labour requirements for other crops.

The labour constraint to the use of fodder is very much tied to the farm size. Studies undertaken in Kenya suggest that zero-grazing was justifiable only where the returns to increased output of surplus family labour were greater than the would-be income from off-farm employment. On the other hand, large scale fodder establishment and production requires a level of mechanisation which often is not within the financial capacity of the land owner.

3.3.6 Management

In many cases forage yields from planted fodder crops are low because repeated harvesting depletes the soil of nutrients which are usually not replenished. Farmers should, therefore, be educated on the value of fertilizer application for increasing fodder crop production and be advised to practice it either using chemical fertilizers, manure and compost.

Testing of animal feed or fodder to determine the nutritional value is not a common practice across the sector and as such it still remains difficult to confirm the claim on the label in the case of concentrate feeds.

[8] Food and Agriculture Organisation (FAO) report.

4. SMALLHOLDER PROFITABILITY TREND

4.1 Towards a diminishing producer surplus

With low access to energy and protein rich fodder or roughage and lack of innovation in this subsector, farmers are caught in a "diminishing producer surplus trend". Besides good dairy management practice, their net profits are largely determined by the cost of dairy meals and concentrates available in the market and the price processors are willing and able to pay for the milk produced, over which smallholders have no control. Whereas the milk price is largely determined by the dynamics in the local market, the costs of manufactured feeds are largely determined by price trends of feed ingredients in the world market. The latter have seen continuous increase in the last decade.

Figure 1 illustrates the trend where increasing prices of concentrates against a largely constant price of milk as paid by the processor could, shrink the profit margin for the farmer. Given that the bottom line for the farmer is the net revenue that ends up in his pocket (the producer surplus), any trend that shrinks this surplus should be countered to keep the farmers in business. Without any intervention, the cost curve would overtake the revenue curve at the farmer level, though not necessarily at the co-operative.

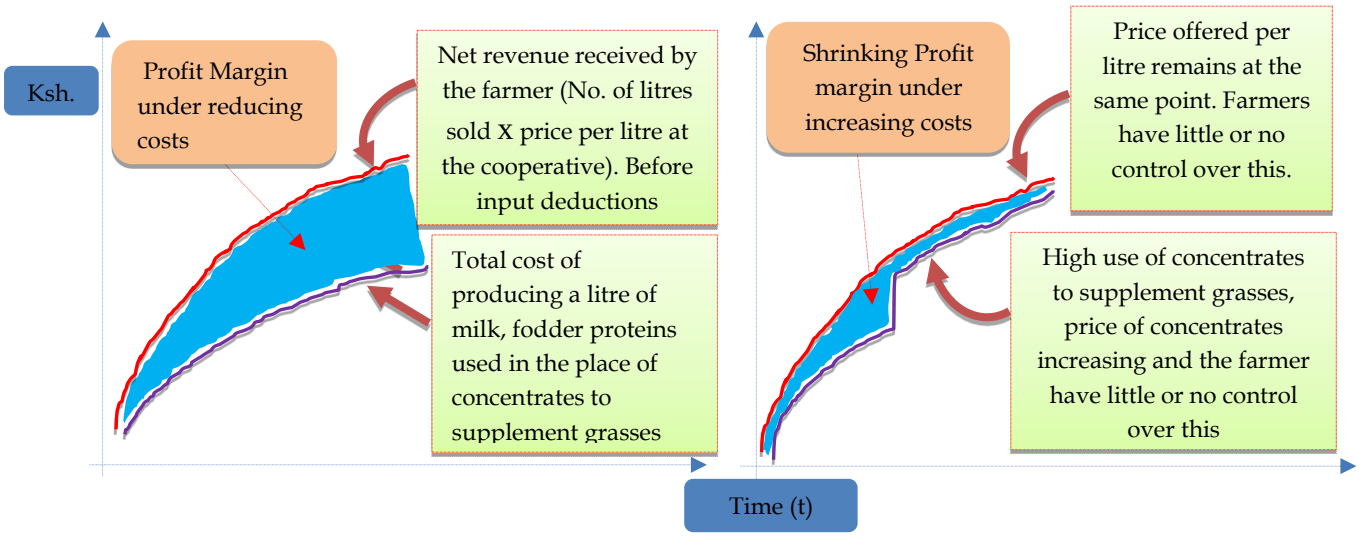


Figure 1. Diminishing producer surplus.

The case of low quality fodder availability is intertwined with poor feeding practices, both leading to low milk yields. Faced with a problem of low productivity, farmers have a tendency of feeding more concentrates whose prices are generally increasing. A case study of a farmer in Nyandarua delivering milk to Nyala Dairy Society showed that feeding alone constituted 67% of the cost price of milk. This figure is in line with research findings under the EADD program. With 67% of the total costs on feeding alone, the producer surplus could easily be close to zero.
The case where no concentrates are used is not any better: although total costs may reduce, production will decrease as well.

4.2 Key factors for increased productivity

The milk production capacity depends on a combination of factors. Key factors include: breeding, an optimum feeding regime, housing and general management (Figure 2).
Significant efforts have been undertaken to upgrade the breeds through importation of high quality genetic material and training of inseminators. However the typical smallholder is not knowledgeable regarding the best choices available for his breed and inseminators will generally sell him the semen that has the largest profit margin for himself. Hence, the baseline conducted in 2012 showed that farmers' perception is that the more expensive the semen the better[9].

In spite of this, herd improvement by introducing potentially higher yielding breeds, is a way to escape from the "diminishing producer surplus trap" and to increase productivity. The potential of good breeds remains however locked without changing to proper feeding regimes.

As for optimum and cost-efficient feeding of the cow, the challenge for the dairy industry is to innovate the fodder supply chain, through introduction and investment in energy and protein-rich fodder varieties and appropriate technologies and skills for (mechanised) production, harvesting, preservation and distribution. The emerging commercial fodder supply chain needs strong support, both in terms of innovation and optimization of productivity and quality, and with regard to linking the sector to dairy societies and individual farmers.

As for the latter, while it is true that a majority of the smallholders in different cooperatives around the country supplement their fodder supplies by buying from other sources (e.g. other farmers, intermediary fodder traders or direct sourcing from commercial fodder producers), the manner in which this is done indicates underdeveloped supply chains).

[9] Baseline conducted in 2011 – smallholders in central and parts of Embu (Eastern)

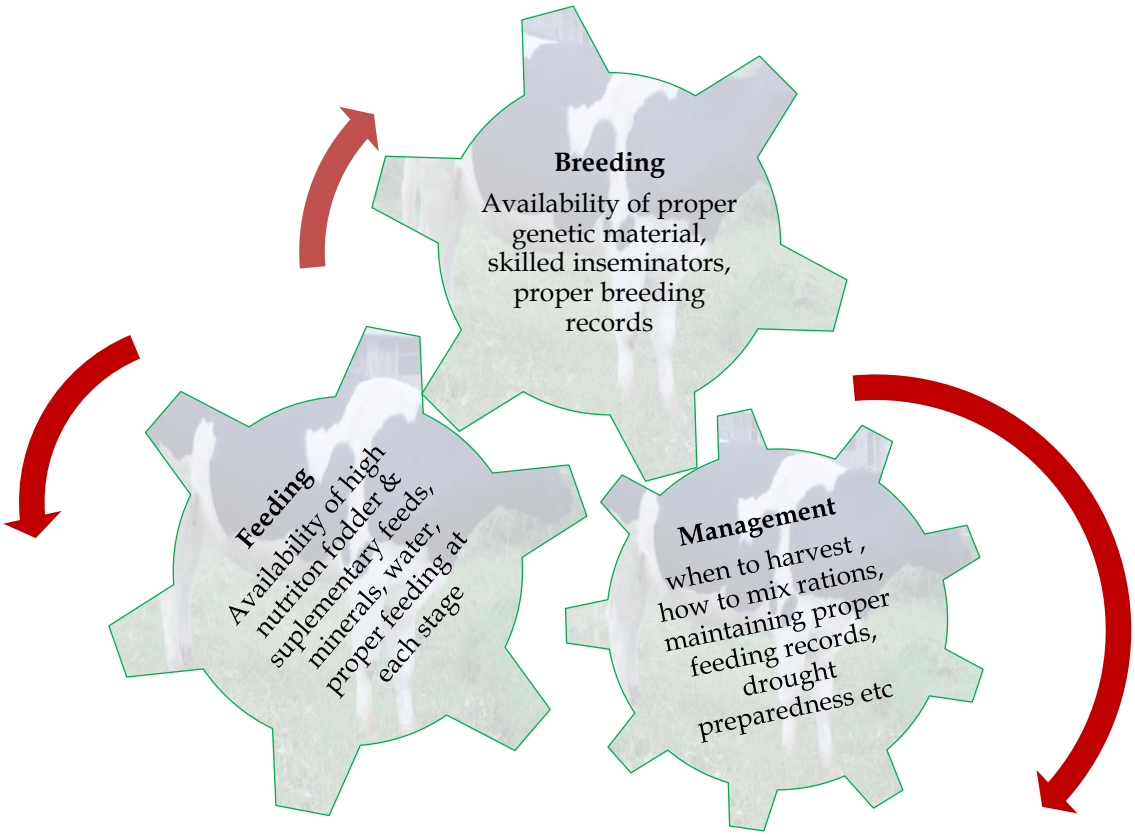


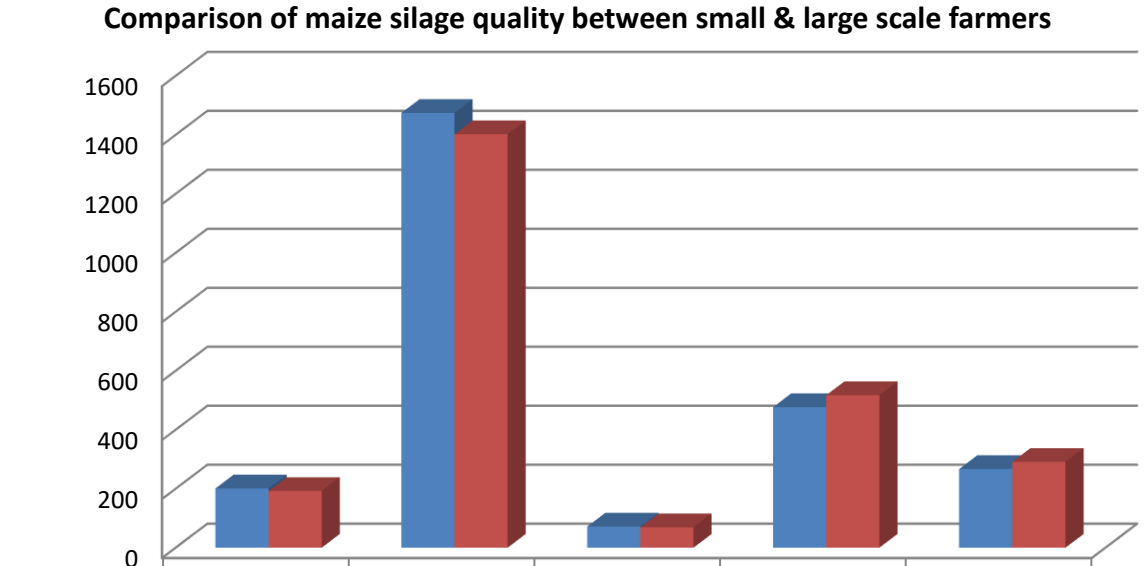
Figure 2. Key success factors in a dairy enterprise.

4.3 Progressive farmers

There is an emerging trend among the more progressive smallholders and medium-sized dairy farmers to plant and preserve more fodder and notably venture into maize silage. A small survey was undertaken by BLGG amongst smallholders and large-scale farmers that had prepared maize silage in Nyandarua and North Rift.

Maize samples analyzed by BLGG showed that the quality of silage from the smallholders was equal or even in some cases higher compared to that of the large-scale farmers (Figure 3). The key parameters considered for this comparison were Net Energy, Starch, Organic Matter Digestibility, ADF and NDF content.

The large-scale farms sampled for this comparison were situated in Naivasha, Nakuru, Njoro, Uasin Gishu and Kitale. The small- or medium-size farms sampled were from Mukurwe-ini, Narumoro, Uasin Gishu and Kitale. Apparently, large-scale commercial farmers can still improve significantly while small- and medium-scale farmers can, in principle, produce good quality maize silage.



	Starch	Net Energy	OM Digestibility	NDF	ADF
Small scale	201	1474.4	71.86	476.6	266.8
Large Scale	192.4	1402.2	69.16	517.4	291

Figure 3. Comparison of maize silage quality (large-scale commercial farms versus medium- and small-scale farms).

5. SYSTEMIC CONSTRAINTS DUE TO INADEQUATE FODDER SUPPLY

5.1 Effect of drought unpreparedness on milk intake by CBEs

Even in the high potential areas where rainfall is considered to be reliable, drought occurs regularly. This happens when instead of receiving two rainfall seasons as is the norm within such areas, one season fails and the dry spell extends. In Kenya one of the best references to indicate this effect is the year 2009. The CBEs registered a massive drop in production because the dry spell extended longer than usual. While it is true that milk production in Kenya is characterized by seasonal production from one year to another, the case for 2009 goes further to demonstrate how unprepared the smallholders are for such eventualities as drought.

5.1.1 Case 1: The 2009 effect on Nyala Dairy

Nyala Dairy was established in 2002 in Nyandarua county and is situated along the Nyeri - Nyahururu highway about 30 km from Nyahururu. It is a highly progressive dairy society especially in terms of membership and profitability compared to other CBEs in the same region. Its catchment cuts across two counties, Nyandarua and Laikipia, hence the name Nyala. The lower belt bordering Laikipia and Nyeri County (Kieni West) is drier than the upper belt bordering the Aberdare ranges. The latter reports low milk yields during the prolonged dry periods, while the lower belt in 2009 reported both drop in milk and deaths of stock (calves and then cows).

The CBE had experienced a steady growth mostly attributed to the aggressive recruitment of members and other suppliers. A major drop in production was experienced in 2009 when the actual daily production dropped from as high as 45,000 litres per day to as low as 4,500 litres per day (Figure 4: note that the figures used in the graph are monthly averages). This was a 90% drop. At this point Nyala Dairy was almost closing shop and had to lay-off staff and change terms of employment for the remaining staff from permanent to casual.

After this drop Nyala Dairy recovered, exceeding its peak daily collection of 45,000 litres a day (reached in 2008) by 15,000 litres to hit 60,000 litres daily beginning early 2011. This was mainly due to improved weather conditions, membership growth and an awakening among the members of the cooperative to begin preserving their own fodder as well as establishing more fodder on farm. This was evidenced by the manner in which the individual farmers demanded the services of SPEN, a private extension group that approached them to pay for fodder preservation services especially silage.

To further demonstrate the difficulties of the CBEs in addressing the fodder problem, it is important to highlight that there was no notable strategic or operational move by the Board or the management of Nyala Dairy, to support their farmers to prepare for a possible repeat of the dry spell experience .

However, in 2012 with the assistance of Technoserve, Nyala Dairy in a joint venture with Ndumberi Dairy, embarked upon a project for large scale mechanized hay production (wild oats) from a leased farm in Laikipia (measuring over 1,000 acres). Reports from Ndumberi Dairy indicated that Ndumberi alone sourced 55,000 x 16 kgs bales of hay during the period August 2012 – March 2013 alone for sales at KES 120 per bale to its members in Kiambu County. This significantly helped Ndumberi Dairy to establish milk intake from its members during this year's dry season.

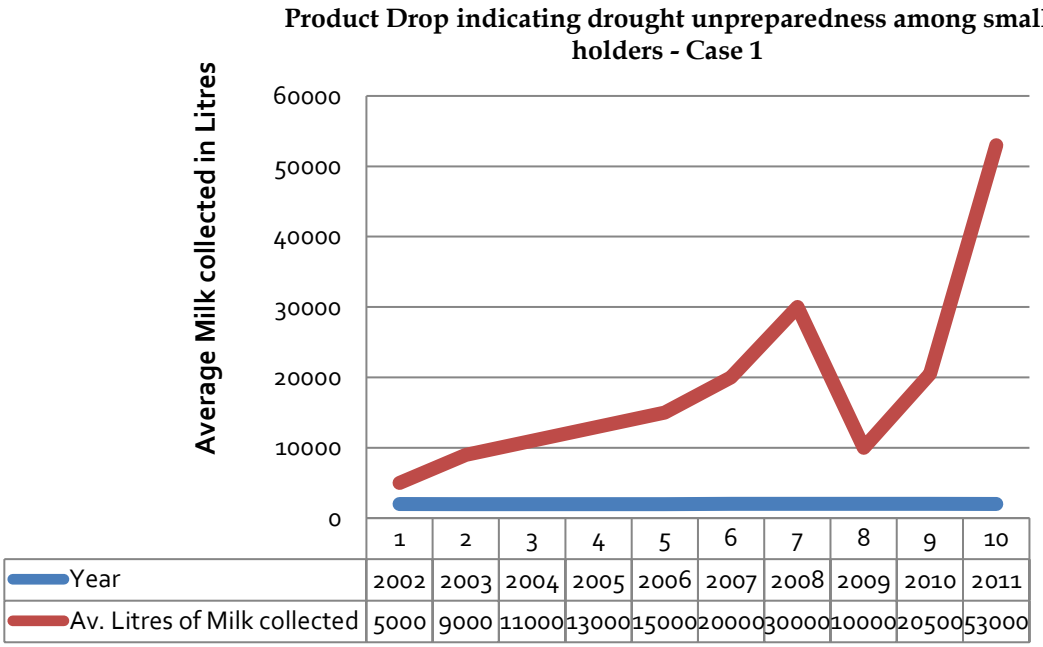


Figure 4. Drop in Nyala milk intake due to the 2009 drought.

5.1.2 Case 2: The 2009 effect on Kieni Dairy Products Ltd

This second case also serves to demonstrate the drought unpreparedness among smallholders and their CBE. This is indicated by the drop in milk production among the smallholders of Kieni Dairy Products Ltd (KDPL). The CBE is situated about 25 km from Nyeri and also had its lowest point in 2009 (Figure 5). The dairy has seven constituent cooperatives which deliver their milk for cooling and onward collection by the processor from the bulking and chilling point (KDPL). The constituent cooperatives are semi-autonomous in the way they run their operations separately, but they sell the milk collectively and all contribute their representatives to the KDPL board. Just like Nyala Dairy, their catchment has a section that is high potential and another part is relatively dry on the lower belt that borders parts of Kieni East and Narumoro areas.

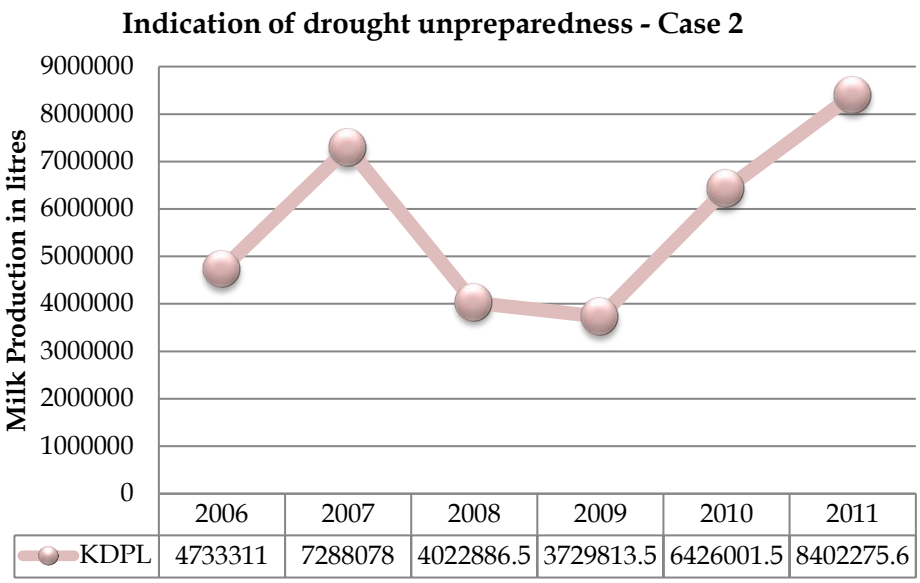


Figure 5. Milk drop in Kieni Dairy (2009).

5.2 Seasonality in milk production

The level of drought preparedness among the smallholders is also reflected in the oscillations of production levels between months (Figure 6a and b). In this case, there is oversupply during the wet seasons and undersupply of milk products during the dry spells. This shortage is reflected on the retail end of the chain where customers are limited on how many packets they can buy at one time, and during the oversupply season, shoppers get proportionate extra packets against the amount bought.

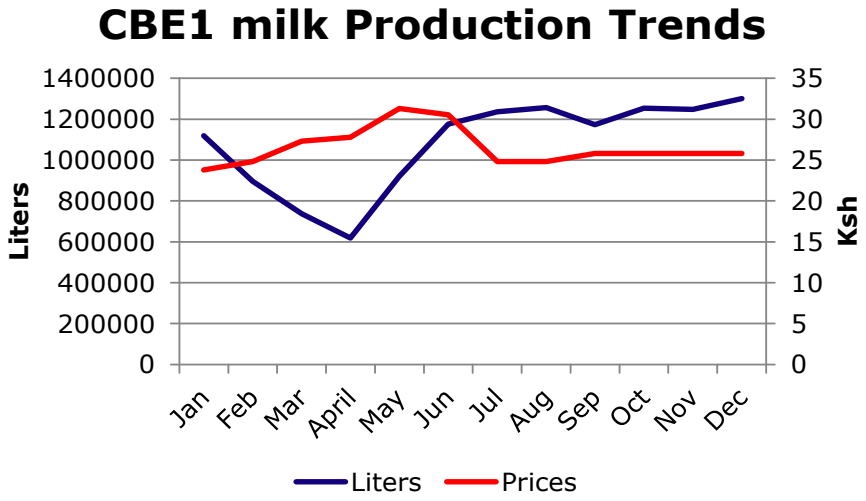


Figure 6a. Fluctuating seasonal production – CBE1 (Central Kenya)[10].

[10] Data sources from the stage gate evaluation conducted in 2013 by SNV

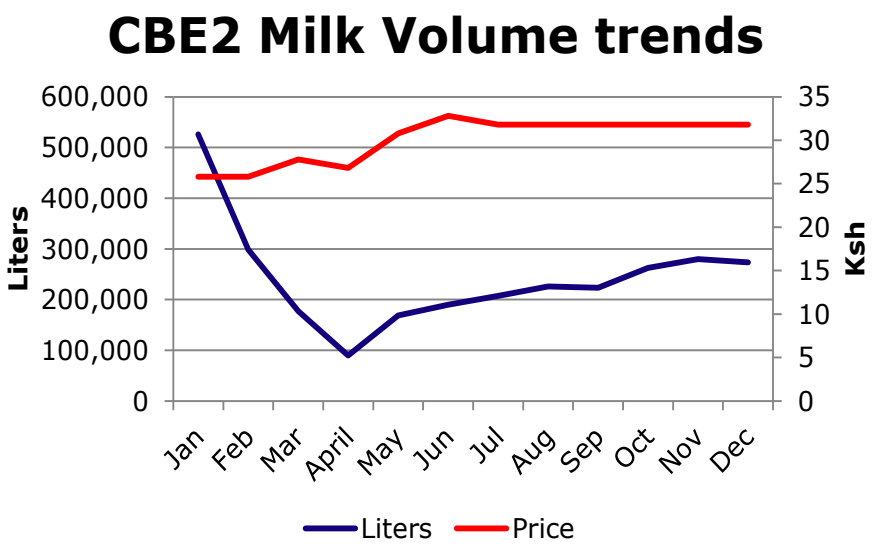


Figure 6b. Fluctuating seasonal production - CBE 2 (Rift Valley Region).

5.3 Effect on the dairy sector

The unpreparedness of many smallholder dairy farmers for the dry season and for exceptional droughts lead to annual and seasonal fluctuations in milk production and supply to CBEs, processors and eventually to consumers.

CBES and processors are faced with excess capacity and high operational costs for a good part of the year, thereby decreasing the profitability of operations and ability to invest in their businesses and the supply chain. This particularly is the case in those areas where farmers' owned CBEs (and processors) have no programs in place to cushion the effects of the dry season on local availability of fodder, and have set up fodder supply chains with fodder producing areas elsewhere in Kenya.

Those CBEs who complement efforts of individual members to establish and preserve fodder by having invested in fodder supply chains, including building storage facilities and putting in place distribution models to their members (including payment through check-off systems), have been more successful than others in stabilizing milk intakes over the year. Good examples of such CBEs are Kiambaa and Ndumberi Dairy Societies and Githunguri Dairy Farmers Cooperative Society all in Kiambu County where seasonal milk fluctuations has been minimized.

Processors may need to consider investing in large scale mechanised fodder production for sales to their supply chain to assure more stable supply of milk throughout the year, higher productivity and herd fertility (thus reducing intervals between lactation periods) and lower cost price of milk. Above all, this will be a way to build more loyalty in the supply chain.

6. FODDER COMMERCIALIZATION IN KENYA

6.1 Feasibility of collective fodder procurement

High population growth has resulted into greater need for food and infrastructure development, putting pressure on diminishing arable land and livestock production in Kenya's high potential areas. A growing (urban) population and wealthy middle class presents greater demand for marketed milk and milk products, and need for productivity increases per acre and per animal, and cost reductions along the value chain.

Year-round access to quality fodder is key for addressing both seasonality in supply to meet year round market demand, cost price reduction in milk production and unlocking the potential of high breed stock.

It is cost-effective for smallholder farmers to purchase fodder through their CBEs to enjoy economies of scale and, in addition, to simplify logistics. In a survey conducted by SNV across 35 CBEs[11] in different parts of the country, it appeared that 13 CBEs were buying fodder (only hay) collectively, while the remainder bought fodder individually. This corresponds with results obtained by interviewing the large-scale commercial fodder producers.

For most of the CBEs interviewed, the three most repeated sources of fodder were Nakuru, Naivasha and KARI Muguga. It is likely that in Naivasha the CBEs were referring to Marula and Delamere farms among others, while in Nakuru Technology Farm is another major source. There are however many other sources of fodder mentioned during the survey including Timau, Laikipia, Kitale ADC, Eldoret farms and parts of Kieni.

For both the suppliers and the consumers of fodder it would make sense if the CBEs to make bulk purchases on behalf of their members as opposed to where the farmers buy directly for themselves or farmers and CBEs buy through traders.

Table 1 summarises the major advantages of fodder sourcing by CBEs. Quality improvement would be a major score for the consumers. Buyers of fodder have no reliable ways of determining the nutritional levels either at sourcing hay or feeding and they may end up spending the same amount of money for a poorer quality bale of hay. Some farmers opt to weigh bales and buy the heaviest but this inconsistency is only known to knowledgeable farmers. The variations in the weights sometimes originate from the settings or the efficiency of the baling machines. Figure 7 represents the varying weights of 10 samples bales that were taken from different smallholders. The sampled bales were already at the farm ready for feeding.

[11] CBE's covered include: Wakulima, Gataragwa, Kimwe, Lelan, Moi's Bridge, Aspendos, Limuru, Tetu, Solian, Othaya, Nderi, Olenguruone, Kilgoris, Iten, Ndumberi, Eldama, Ainabkoi, Cherangani, Tulaga, Katheri, SOT, Muthiru, Muki, Kigane, Tarakoon, Kiambaa, Nyala, Watuka, Endarasha, Mweiga, Onesmus, Lelchengo, Lamuria And Thuruthuru

Table 1. Advantages of CBE fodder sourcing.

Advantages	DD (CBE's)	SS [Large scale producers]
Reduced transaction costs	Absence of middle men reduces cost. Transport cost is shared by a number of farmers.	Selling in bulk saves time as compared to serving many smaller customers
Traceability	Source is known, feedback can be given on quality. Where middlemen buy from different farms it is difficult to determine the source of fodder.	Can improve the product quality based on feedback received.
Higher production efficiency	Farmer gets fodder when he/she needs it, without necessarily paying more at different times as price is agreed on booking.	Fodder is produced based on booking, little wastage or reduced quality due to long durations of storage.
Personalized services	Farmers can get what they need in terms of nutritional value; CBE's can book for protein fodder or energy depending on their needs at the moment.	Production is market-led, only what is required or ordered is produced.
Higher sales	Lack of money at the moment of need does not prevent the farmer from purchasing fodder. CBE pays for it and charges the members through check-off system.	More farmers accessing fodder from the CBE would lead to higher sales, as new consumers could emerge.
Quality standards	Farmers enjoy reduced inconsistencies on e.g. weight and nutritional variations leading to higher value for money. Quality can be negotiated and agreed in advance.	With consistent feedback, the need to keep the customers would challenge them to invest in testing equipment.

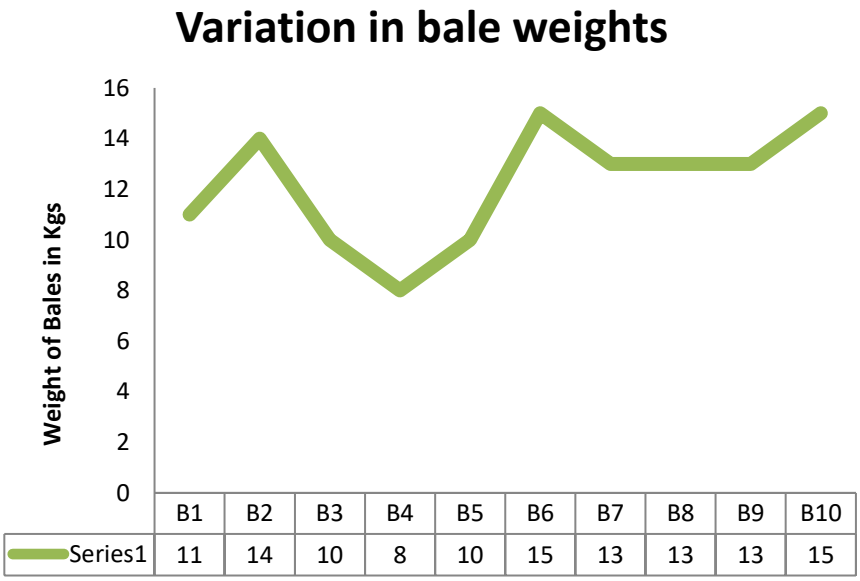


Figure 7. Variation in hay bale weight sampled at the farmers store.

The large variation (Figure 7) surprised the farmers, who usually plan their rations on number of bales as opposed to weight.

For example, a farmer who is a member of Kiambaa Dairy indicated that her cows fed on several bales of hay in a day and this is not necessarily translated into kilograms. The effect of this is that a dairy cow that feeds on 12 kg a day could be underfed by 50% if it was presented with a bale of 8 kgs. This would lead to lower productivity and lower income as a consequence.

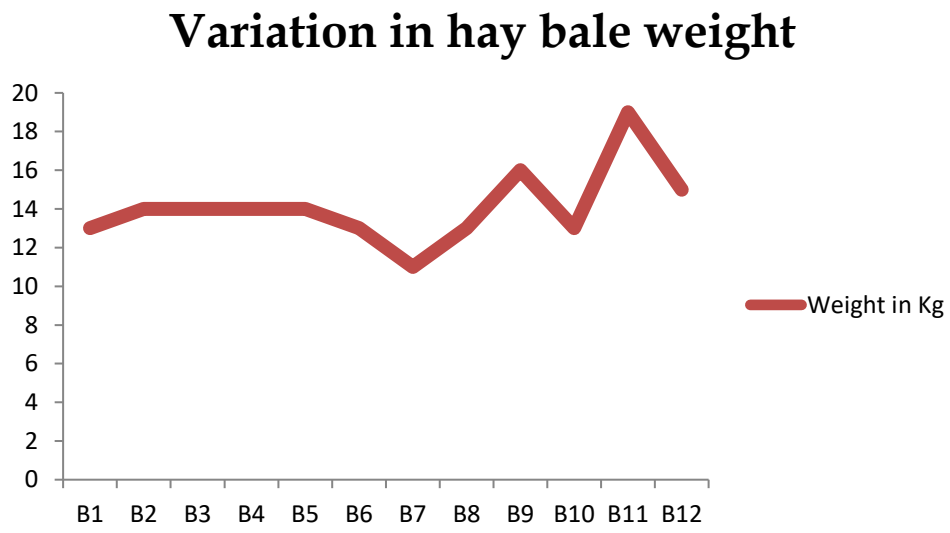


Figure 8. Hay bale weight variation at source (CFP).

7. FODDER BUSINESS MODELS

7.1 Large scale commercial fodder producers (CFPs)

Few companies with large tracks of land specialise in production of grass hay (Boma Rhodes), Lucerne and in some cases professional silage production for commercial sales. While most of these farms also operate dairy or beef cattle as an enterprise, they produce more fodder than they need and have commercialised this as a separate profit centre.

The established farms operating under this model concentrate mostly on production, with little effort noted in marketing the product beyond the farm gate. This could be explained by the fact that they manage to sell their product without the need to invest much in marketing and distribution as they usually even fail to meet the demand.

Examples of farms demonstrating this model include Morendat, Delamere, and Marula farms all in Naivasha. While there are many other relatively smaller farms (e.g. Ndykak farm in Rongai, Nakuru), the above three represent some of the largest players in this segment. In some cases, demand for their products outweighs supply especially for Lucerne which is much less produced as compared to grass hay across these farms.

Lack of effort to formally source markets from dairy societies is attributed to stable market forces where cases of oversupply are rare. The supply chain under this model has two main routes to market as illustrated hereunder as both (A) and (B) respectively (Figure 9).

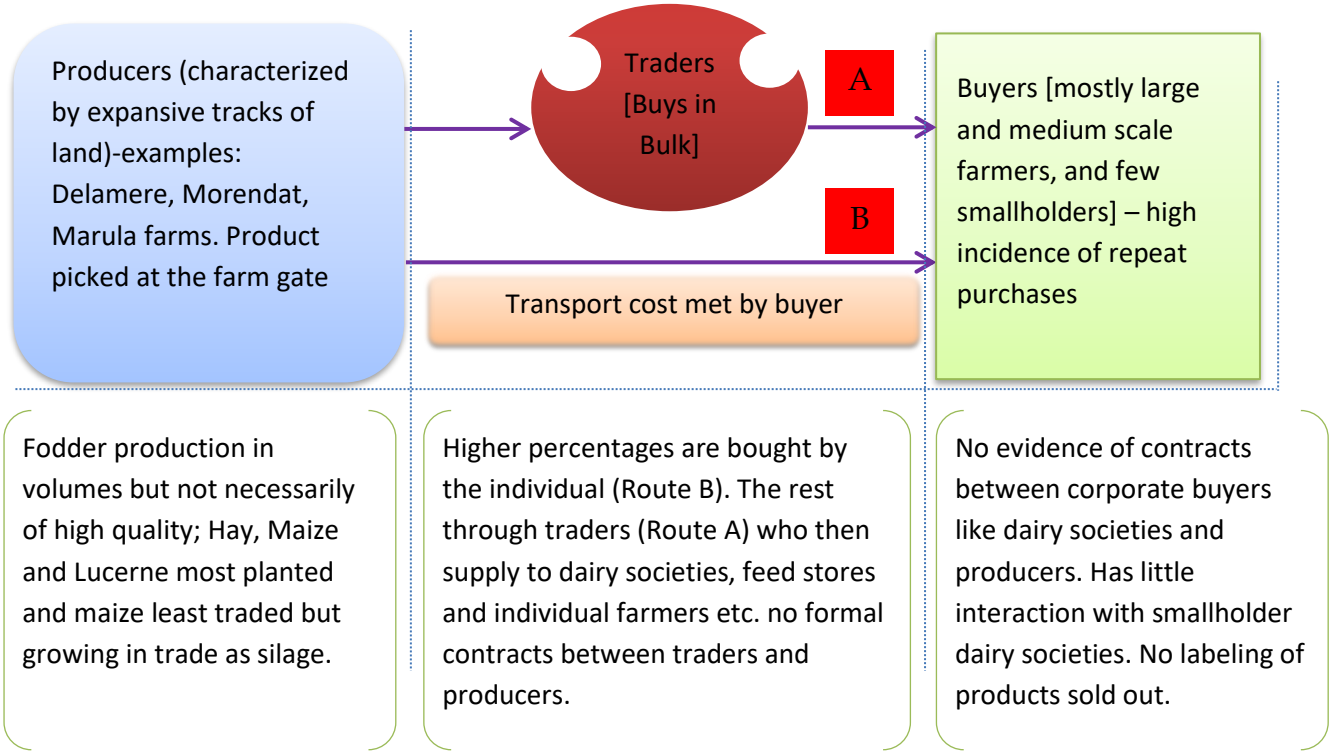


Figure 9. Sourcing of fodder from CFPs to farmers through intermediaries.

Hereunder, a description is given of the operations of four of these commercial fodder suppliers.

7.1.1 CFP1 - Large scale commercial fodder producer

The farm is located near Naivasha town on a total of 54,000 acres of land out of which 4,915 acres (9.1%) are under cultivation for fodder production. The farm produces Boma Rhodes and Lucerne for commercial purposes. Boma Rhodes occupies the bigger portion (600 acres) of the Naivasha farm with another 4,000 acres on a farm elsewhere in the region. Lucerne which is a newly introduced project in the farm occupies a total of 315 acres. The farm sources its fodder planting materials from Kenya Seed Company, a certified seed distribution company. The farm however feels challenged by inconsistent supply of the fodder planting material (especially Lucerne seed) and the unusual high seed prices. Soil sampling is considered crucial by the farm, necessitating routine sampling carried out once in every two years. The soil sampling pattern adopted by the farm allows for specific crop per sampled land size depending on the next land use needs. The farm employs 40 technical staff, where the highest academic level is master's in business administration

The farm owns farm equipment which includes a Lucerne planter, centre pivot irrigation system, Lucerne mower and baler machine among others. According to the management, the farm still requires more farm equipment such as modern baler and Lucerne dryer to facilitate value addition of the available fodders. This saves the farm from losses especially on Lucerne which occur during rainy seasons.

The target market is apportioned into two categories: large-scale farmers (constituting 60% market share) and smallholder farmers (40%). Both the buyers and the intermediaries collect the fodder within the farm's premises. The farm in the past has attempted to reach out to cooperative societies as their corporate buyers. Dairy farming societies such as Ndumberi Dairy Society and Fresha Dairy Society partly constitute the customer base for the farm.

Quality of fodder is one of the priorities taken into account by the farms' management. The farm manager is charged with quality control, including annual laboratory analysis of fodder to ensure that it meets the required standards. According to the manager, the farm can improve in fodder production and conservation by ensiling Lucerne and using efficient Lucerne driers. Losses are experienced in fodder storage and conservation as elicited by the farm manager.

7.1.2 CFP2 - Large scale commercial fodder producer

It is also located in Naivasha and covers an area of 3,000 acres of which 380 acres are under cultivation (12.7%). The farm grows a number of fodder crops all of which are of their own use apart from Lucerne which is used for both commercial and own consumption. The fodder crops include: Lucerne (120 acres), maize (170 acres) and oats (50 acres). Beef cattle (450) are left to graze on 510 acres of natural pastures. Soil sampling is done on-farm depending on the acreage: 10 acres has 2 samples collected (20%) and 160 acres 20 samples are collected (12.5%). There several challenges encountered when sourcing for planting materials and seeds. This is mainly the scarcity of seeds and their high cost whenever they are available. The farm has several farm machineries and equipment, some of which are imported. Production is throughout the year as they use pivot irrigation.

Large-scale farmers are the most frequent buyers constituting an estimated 70% and medium-scale farmers at 30%. Most of the buyers come right to the farm stores to purchase the products. To ensure consistent production of high quality products, the farm uses the right equipment and harvest the fodder at the proper time. There are two personnel with technical skills in charge of the fodder and dairy business. Qualifications range between diploma and first degree level.

Currently there is no written business or strategic plan but the management has shared their road map with the personnel involved in operations. Feasibility studies are done by staff before embarking on new fodder projects. The farm team is skilled in terms of fodder establishment, animal husbandry, preservation and storage skills. As part of knowledge sharing, the key expert in the fodder business would be willing to offer training service to support other farmers if called upon. The farms' intention is to expand their beef business by increasing the herd to 1,500 animals. Major challenge experienced in the production system is inadequate water for irrigation, electricity supply, poor infrastructure, corrupt police (asking for bribes especially when transporting Lucerne), high costs of making hay silage for bagging and availability of chemicals.

7.1.3 CFP3 - Large scale commercial fodder producer

This is yet another farm located within the Naivasha area. It covers an area of 25,000 acres which is used for farming, cattle ranching and a Wildlife Conservancy that covers 20,000 acres. Part of the land has been leased to a company for growing horticultural crops for export. The main fodder crops grown are Lucerne (300 acres), Boma Rhodes grass (500 acres), a pilot for sorghum and hybrid maize (200 acres), that has currently been destroyed by the maize virus in Kenya. Lucerne and Boma Rhodes are produced in large volumes for commercial purposes and also for their own consumption i.e. their beef cattle ranch farm. The seeds for different fodder are mainly sourced from Kenya Seeds since it is among the few certified seed companies in Kenya. Soil sampling in the farm is conducted irregularly, it is estimated to be done once in about 3 years and one soil sample is taken as a representative of the entire piece of land being prepared for cultivation.

A major challenge in the production process is outbreak of diseases which led to a major loss in the maize (lethal necrosis). The maize turns yellow and dries up and the farm had not yet found a successful method to deal with it. Lucerne seeds are the most expensive costing Ksh. 1,600 per kg, sorghum seeds costing Ksh. 280 per kg and maize hybrid at Ksh. 145 per kg. Their products are available and enough in supply throughout the year. The majority of the buyers constitute medium-scale farmers at about 80%, while intermediary traders and smallholders are estimated to constitute 20%. Products are bought directly from the farm store as there are no other distribution channels available.

There is a manager in charge of quality control to ensure that the farm distinguishes itself in consistent production of high quality fodder products. There are 2 personnel in charge of production that have diploma level andfirst degree. The farm has a business plan and before embarking on new projects in the farm there are feasibility studies conducted, this is done by use of their own staff. There has been no attempt to approach a dairy society or processors to become corporate buyers for their products. The main reason that this has not been done is to avoid making commitments and failing to fulfil them due to seasonal shortages and unpredictable harvest, this is especially for Lucerne.

This farm prides itself on good performance and minimal losses are experienced in terms of the fodder preparation, storage and conservation skills. Constant staff training is scheduled for skills improvement. The farm plans on expanding the business in years to come. Currently it would appreciate external support to enable them to penetrate through to dairy societies to increase market share.

7.1.4 CFP4 - Large scale commercial fodder producer

This is Technology Farm an enterprise owned by Rift Valley Institute of Technology (RVIST), located in Nakuru County about 10 km from Nakuru town. The total land area is 7,400 acres of which only 855 acres is cultivated. The farm grows a variety of fodder crops for own consumption and for sale. Boma Rhodes occupies 351 acres of land followed by yellow maize for silage which occupies 110 acres. The other fodders are sorghum and Sudan grass both apportioned 20 acres each (Figure 10). The farm sources all planting materials from Kenya Seed Company other than the yellow maize which is multiplied within the own farm. The farm management cited availability and high prices for sorghum and Lucerne seeds respectively as the most pressing challenges.

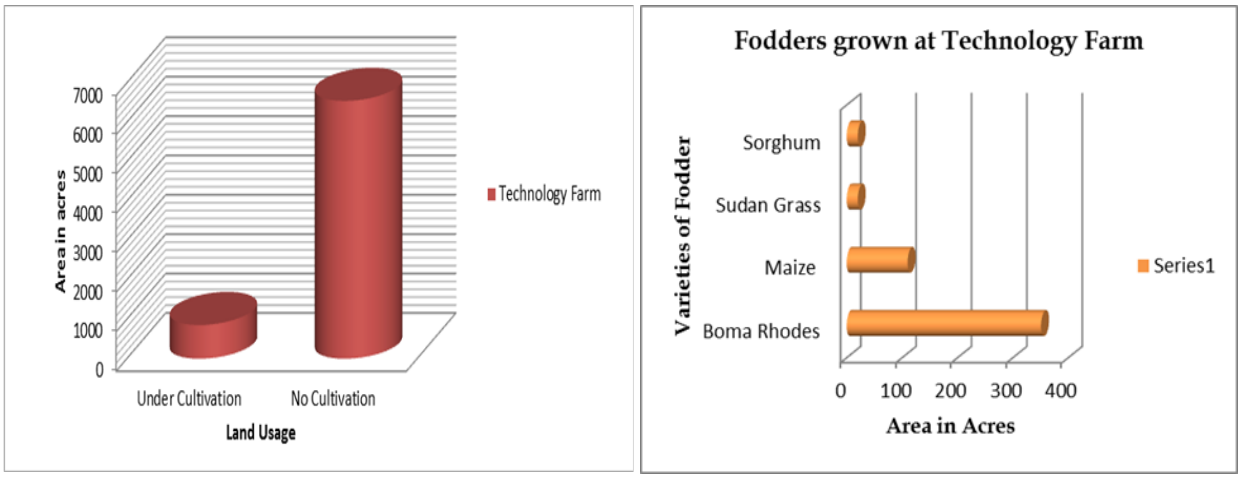


Figure 10. Land usage and allocation for different fodder crops at Technology Farm.

Soil sampling is done after every three years based on the cultivation plan. Though the farm currently has a number of farm machineries, the farm manager noted that operation in the farm will be more efficient if additional machineries are sourced. A higher horsepower tractor (150 HP), boom sprayer, hay baler and forage harvester are some of the currently lacking but very important equipment to the farm.

Intermediary fodder traders and individual farmers constitute the fodder buyers on a 50-50% basis. The majority of buyers access the fodders directly from the farm premises. In order to boost sales and promote the distribution mechanisms, Technology Farm is involved in farmer's field days. The farm has attempted in the past to approach dairy societies to be its corporate buyers. In order to ensure quality of their fodder, they have assigned a QA Manager. To track the quality and assure it is within acceptable standards, fodder samples are taken to the laboratory for analysis. The top technical personnel charged with running the daily affairs within the farm are four in total. All have undergone technical on-the-job training and academic credentials ranging from diploma and above.

Technology Farm rates its technical skills vis-à-vis fodder preparation, storage and conservation as above average, with the only challenge of technical expertise to repair and fix farm machinery, especially the baling machines.

The farm intends to advance to the next stage by selling packed silage for ease and convenience of sale and transportation. In addition to silage packaging, the farm's other big dream lies in its core dairy business; adding value to milk produced in the farm instead of selling it raw.

7.1.5 CFP5 - Large scale commercial fodder producer

The farm is located in Rongai in the Nakuru County and covers an area of 210 acres in Rongai, 20 acres in Ngata and 30 acres in Njoro. Out of the 210 acres in Rongai 110 acres is under continuous cultivation (52.4%). The rest is in use for apiculture, fish ponds, offices and stores and a forest area (18 acres). There is fodder production on the farm for both commercial and own use. The fodder crops include yellow maize (20 acres), beans (40 acres), Boma Rhodes (50 acres) and Sudan grass (100 acres). The Sudan grass is in the process of being phased out. The yellow maize is used for silage making which is sold in 90 kg tubes at Ksh. 900 per tube. Dried and chopped up bean pod and leaves are mixed together with dried Sudan grass to make hay, which will be replaced by Boma Rhodes. In addition maize cobs are grinded and mixed with hay.

Kenya Seed Company is the main source of fodder seeds. Soil sampling is conducted once every two years; in each section a representative sample is taken depending on the cultivation plan. Among the key challenges experienced are high production costs due to high price of seeds and fertilizer. The cost of Boma Rhodes seed was reported at Ksh. 600 per kg, yellow maize Ksh. 100 per kg and Sudan grass Ksh. 150 per kg. The farm has several farm machineries and equipment, though of concern are the ones currently lacking which include a boom sprayer, a bigger tractor (100 HP) and a chisel plough.

The farm management team has technical skills in terms of fodder preparations, storage and conservation skills with very minimal losses experienced. However they would appreciate a chance to exchange ideas and learn from other experts in this field. They singled out international benchmarking for the quality of their products as their next most prioritised step.
Their products are available throughout the year but with occasional shortfalls. Medium-scale farmers constitute the largest percentage (50%), smallholder farmers are next (40%), traders who sell elsewhere (7%) and lastly some large-scale farmers (3%.). Some buyers come right into the farm store to purchase the products, but the farm also has set up a distribution system to different destinations. Attempts have been made to approach a dairy society for example Eldama Ravine as a corporate buyer.

In order to ensure production of high quality fodder products, the farm has a manager in charge of quality control, three technical staffs in charge of the fodder, and one dairy business manager to manage the own dairy section. The qualifications range from diploma level, academic training as well as practical training on-farm. Fodder samples are taken regularly for lab analysis to ensure tracking of product quality. The farm has a business plan in place so as to achieve set targets. Before embarking on any new fodder project a feasibility study is always conducted by the farm staff.

Their next level involves a number of projects that include cultivation of Boma Rhodes grass to replace Sudan grass and expanding the Practical Dairy Training Centre that was established by the owner. The farm has been involved in training through farmer field days, radio programs and exchange visits for farmers who come to the farm from different parts of the country.

The farm is mostly known for its silage trading business which has become the entry point of interest to most farmers. The silage is packed in 90 kg plastic tubes and the sales are operated from the model dairy farm situated at the heart of Nakuru town, thereby supplying other peri-urban farmers with fodder, while also supplying milk to Nakuru milk bars.

7.1.6 Similarities in the business operations of CFPs

A look at the business operations of the above CFPs indicates several similarities. It is important however to note that CFP4 has a much smaller land space and is involved more in the silage trade than anything else. Common features are:

I. Large tracks of land with over 60% of the total space left uncultivated.
II. Semi-mechanized farm operations with known mechanisation and skill gaps .
III. In-house large scale beef or dairy enterprise running alongside the fodder sales enterprise,
IV. Multiple fodder crops established on farm: commonly maize, Boma Rhodes and Lucerne. In some cases like CFP4 there is yellow maize and beans, and CFP2 has oats in the place of Boma Rhodes.
V. Farm gate sales with little effort to push the product beyond the farm gates towards the market destination; the demand trends normally influence the marketing efforts.
VI. Large- and medium-scale dairy farmers constitute the majority of the buyers with evidence of few smallholder farmers, although CBEs also order large quantities of hay bales with some of the CFPs mentioned.
VII. Intermediary traders and CBEs feature across the board as a common link between CFPs and the smallholder farmers.
VIII. Proper husbandry practices applied across the board with need for technical support to upgrade the fodder quality to highest standards possible (international benchmarking).
IX. Absence of formal contractual linkages between the CFPs and the dairy societies or CBEs. In some cases, attempts to establish formalized structural supply relationships between the CFP and the dairy societies have been made but were not established. It is important however to note that dairy societies continue to purchase fodder from the CFP4 but the buy and sell relationship between them remains largely informal. The lack of aggressiveness on the part of CFPs could be attributed to the fact that they are able to sell off all the fodder available for sale with some (e.g. CFP4) not being able to meet the demand for Lucerne.
X. Minimal interaction with farmers. The farms do not readily open up for farmer to farmer learning, but the technical people interact with other farmers in field days and trade fairs.
XI. The availability of fodder across a normal year[12] was recorded as in the table below: effectively, the large scale fodder businesses have the ability to provide different types of fodder to the dairy farmers throughout the year. This is also facilitated by the use of irrigation (i.e. pivots).

[12] Normal year is used to mean on that will have normal seasons e.g. no prolonged dry spells or wet seasons

Table 2. Fodder availability across the year (5 CFP's).

Months / *Businesses*	J	F	M	A	M	J	J	A	S	O	N	D
CFP1	■	■	■	■			■	■	■	■	■	■
CFP2	■	■	■	■	■	■	■	■	■	■	■	■
CFP3	■	■	■	■	■	■	■	■	■	■	■	■
CFP4	■					■	■	■	■	■	■	■
CFP5	■	■	■	■	■	■	■	■	■	■	■	■
NB: shaded months represent times when fodder is availability												

7.1.7 Emerging issues among CFPs

CFPs demonstrate different gaps at different stages, as illustrated below.

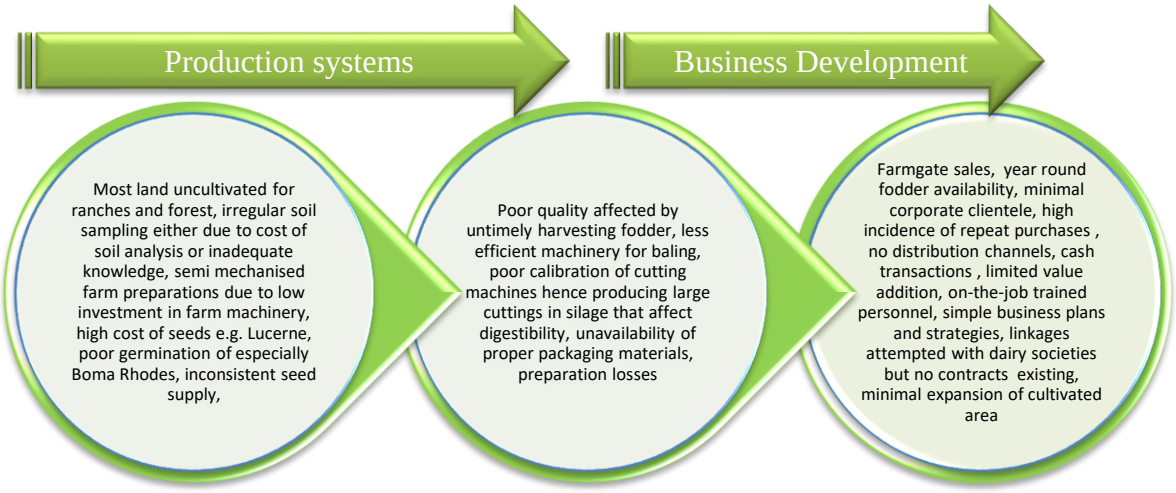


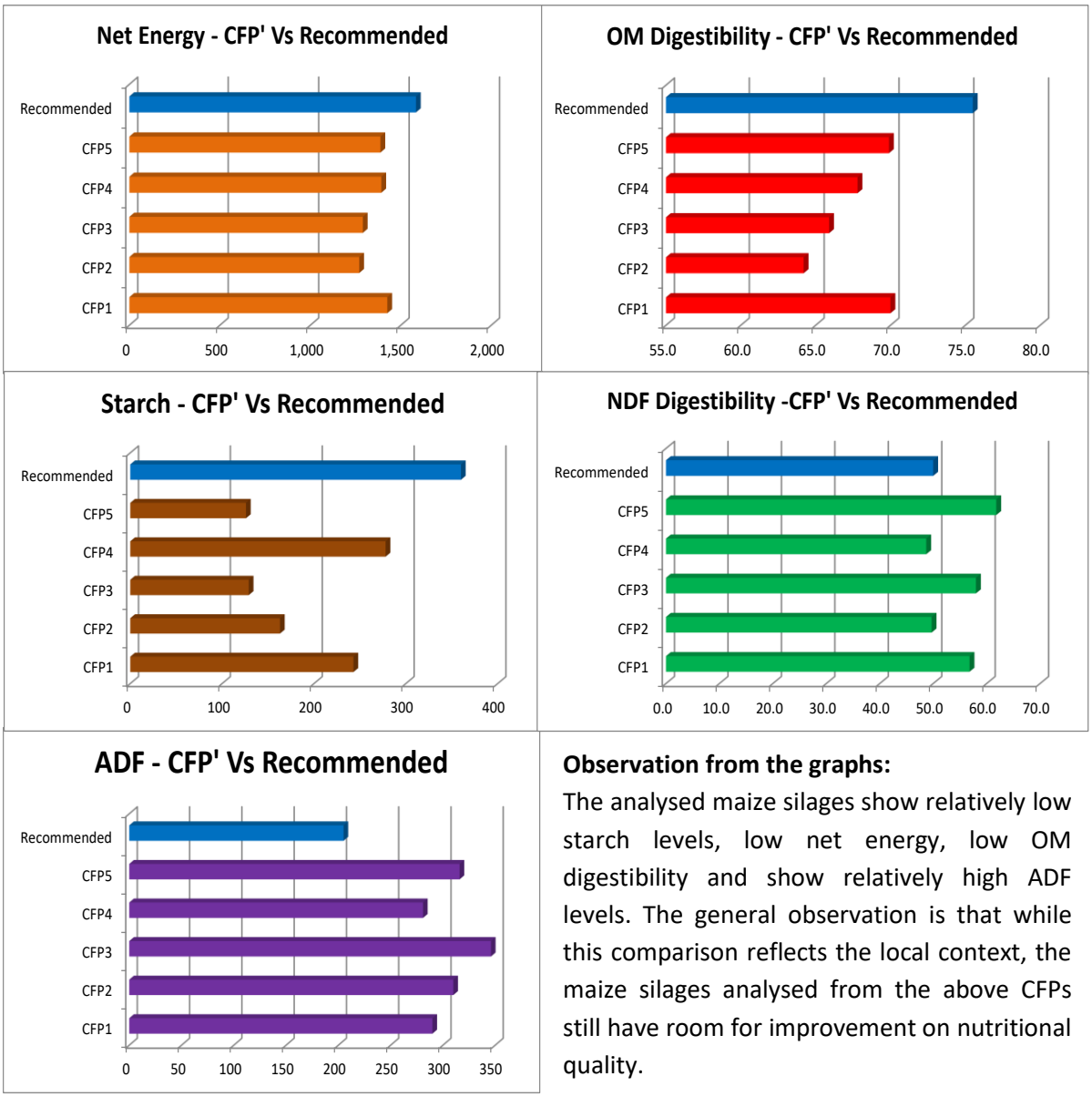
Figure 11. Issues in the business operations of CFPs.

7.1.8 Nutritional comparisons CFPs versus recommended levels

The following bar graphs (Figure 12) illustrate the comparisons between the recommended and the actual nutritional levels in three fodder materials analysed[13]. For silage only the key parameters are featured in this comparison.

The recommended levels for each parameter may be viewed as 'optimistic' as they have been benchmarked with the more developed dairy sector of the Netherlands. They however provide a reasonable basis for comparison. In the five parameters analysed, it is only in the case of NDF digestibility, that the local farms fall within the recommended range.

[13] Analysis on various fodder materials was conducted at the BLGG laboratories



Observation from the graphs:

The analysed maize silages show relatively low starch levels, low net energy, low OM digestibility and show relatively high ADF levels. The general observation is that while this comparison reflects the local context, the maize silages analysed from the above CFPs still have room for improvement on nutritional quality.

Figure 12. Variations of nutritional levels of maize silage across key parameters between different CFP's and recommended levels.

Note: A more detailed insight in the nutritive value of various dairy meals and fodder crops and silages is presented in Sub-report V (Quality analysis of animal feedstuffs and fodders in Kenya).

7.1.9 Opportunities for interventions among the CFPs

Notably, most of the farms considered in this study have only cultivated less than half of the available space. With a combination of a growing dairy sector, sensitization about better feeding practices and shrinking smallholder land space for cultivation, it is foreseeable that the remaining land could still be utilized for fodder cultivation. In some cases the land is used for ranching, or forestry, but still there remains a wide space for expansion. With a proper market linkage system where the critical mass of the buyers is guaranteed, the space under fodder production could be increased significantly.

There is room for optimization of the fodder production and preservation techniques, including investments in traditional farm equipment and skill development for operation and maintenance of machinery. But also piloting new fodder crops (e.g. sorghum), and entry of innovative farming equipment for example to fast-dry hay, reduce volume so as to reduce transport costs (better balers, pelletizing) and ensiling of grass, Lucerne, maize and sorghum in round sealed bales that can be transported over far distances.

The linkage between the large-scale commercial fodder producers and the dairy societies is underutilized or completely unexploited. There are a number of dairy societies whose members experience a drop in milk production every dry spell and whose ability to meet their dairy feeding needs is limited by the equally shrinking land spaces. Given that there is evidence of smallholders buying fodder especially hay from this market, it implies that the demand supply relationship between dairy societies and the fodder producers can easily be enhanced and formalized.
This could include farmer field days to create more awareness on different types of fodder crops and their benefits. For example Ndykak Farm has set up a Training Centre to boost his business and generate extra income from both training and sales of fodder.
Fodder producers can penetrate this market directly through to different dairy cooperatives, ensuring that middle men are wiped out.

7.2 Other fodder business models

7.2.1 Out-grower model

As indicated elsewhere in this report, most of the smallholder farmers face a limitation on the extent to which they can establish their own fodder. As their dairy enterprises grow their fodder needs increase proportionately. As a way of addressing gaps in the provision of fodder at the CBE level, some dairy societies identify farmers in the community (incl. amongst their members) with excess land to grow fodder on contracting basis. The fodder is grown on a buy-back arrangement by the CBEs – which could also provide soil analysis, fertilizer, ploughing services, seeds and so on - and gets stored as a fodder bank to sell to the members in the dry season.

In this case, the management estimates the fodder needs for their farmers and targets to establish the same amount of fodder on outsourced farms. This model allows the CBEs to:

(i) Provide fodder as an extra service or facility besides milk collection and marketing, thereby enabling the farmers to improve their productivity. This promotes loyalty especially when this is provided through a credit based (check-off) system.
(ii) Control how they want the fodder to be cultivated, thereby determining the quality and the quantity of fodder as opposed to buying fodder from other external sources.
(iii) Get the fodder for their farmers when it is needed, thus reducing the risk of scarcity or unpreparedness in the face of dry spell, which may cause drastic drop in milk production and at times death of stock.
(iv) Promote specialization among the identified fodder growers who are given an assured market by the CBE. Such farmers could maintain the fodder enterprise as their source of revenue without necessarily operating a dairy enterprise alongside the fodder enterprise.

This model is being piloted by Muki Dairy Farmer's Cooperative Society in Nyandarua County. The uniqueness with this model is that the CBE sources for fodder from within its members and then to sell it to the other members which allows mutual enterprise support between those with more those with limited land space.

7.2.2 CBE-owned fodder enterprises

The distinction between the above (out-growers) model and the CBE owned fodder enterprise is that the CBE is directly involved in fodder production, for example on leased land. In this case, the CBE owns and manages the fodder enterprise and sells to its members. The CBE undertakes the cost of production and only recover their money when the farmers buy the fodder. This model is being piloted by Nyala and Ndumberi in the on-going DFIP-MAP project with the support of Technoserve. The two CBEs have already sold bales large quantities of wild red oat hay to their farmers.

Besides addressing the fodder availability gap, the CBEs have 100% control over the process. The model relieves the farmers from incurring further transactional costs by sourcing for fodder on their own. The CBE builds loyalty amongst its members, especially when the individual farmers are allowed to take fodder on check-off system.

7.2.3 Processor facilitated fodder supply chains

Although yet to be established, Buzeki Dairies in Molo is planning to develop two 10 acre plots for fodder establishment at two of the dairy cooperatives they buy milk from. In this model Buzeki would assist with leasing the land and making available seeds, fertilizer and farm machinery.

8. EXTENSION MODELS SUPPORTING FODDER PROVISION

Fodder provision remains a big agenda in the dairy sector in Kenya. Several models have been applied to bridge this gap and so far have largely focussed on on-farm smallholder fodder establishment, rather than on emerging fodder supply chains. While all of the training and extension models have recorded successes, it emerges that these successes have been modest and less effective than hoped for. The approaches include but are not limited to:

8.1 Farmer to farmer extension model (lead farmer model)

This involves the identification of large blocks of smallholder dairy farmers in high potential areas and selecting from within a few progressive farmers. The progressive farmers are then exposed to more skills than the average smallholder and become a "model farm". This extension approach is designed to equip a few, who are subsequently expected to equip others through community interactions and becoming facilitators of training, demonstrations and exchange visits to their model farms. This model operates very much like the Farmer Field Schools (FFS) apart from the fact that in the FFS model the farmer-trainers grow from within the group and graduate to eventually become facilitators of the group training.

A key similarity with FFS is that learning takes place primarily between one farmer and the other. The fodder agenda features as part of the curriculum where the farmers are sensitized on proper feeding methods. While this model has been to a large extent effective, it has been faulted on the basis of low rate of knowledge and skills transfer. This stems from the fact that the lead farmers so selected for capacity development are busy in their farms and are therefore not able (or willing) to deliberately share skills with others. Instead, they come back to their farms after training and develop it accordingly.

Given that most of these skills are technical, the neighbouring farmers may not learn through sight or explanations alone, it has to be demonstrated perhaps several times for the skill to transfer in a way that it can be successfully applied.
This is a very common approach used by the Ministry as well as development organisations and has contributed to the introduction of improved fodder varieties, sensitization on proper feed and improved genetics.

8.2 The service provider enterprise (SPE) model

The Service Provider Enterprise Model refers to a single individual or a group of practitioners trained in a given skill offering services as an enterprise at a fee. Being an enterprise and charging a commercial fee it is rated and appreciated by farmers on performance. This makes the model more sustainable than government or donor driven training and extension services. It also helps to ensure that the business keeps upgrading the skill level of its employees or associates so as to offer the highest quality of services and latest technologies. It plays the role of bridging the information gap between the research or training institutions and the farmers mostly in the rural areas. In order for these agro businesses to grow, they charge a fee in exchange for their services and deliver or sell also inputs needed by the farmers in the production process as part of their business model (e.g. seeds, PVC plastics, and molasses).

In some high potential dairy areas SPEs have been very resourceful in offering fodder preservation services at a fee, acting as agricultural contractors, as well as using demos on establishment of new fodder varieties. While SPEs can take on any service as long as it is profitable and they have the requisite skills, the fodder business ranks highest in its ability to generate a high volume of business from the dairy farmers. As such this has proven to presents the shortest route to demonstrating concrete benefits for a dairy enterprise.

SPEN Ltd is an example of a rural enterprise that operates through the service provider enterprise model. It is active in Nyeri, Nyandarua, Kinangop and parts of Embu. This model evolved around providing youth with initial technical training by SNV and sometimes dairy societies in the area. The latter view them as partners in achieving increased milk intakes in their area of operation. It is expected that the technical training offered to the SPEN acts like seed capital, and the enterprise owners are expected to continually develop their capacities to offer services to farmers beyond the life of the project that first trained them.

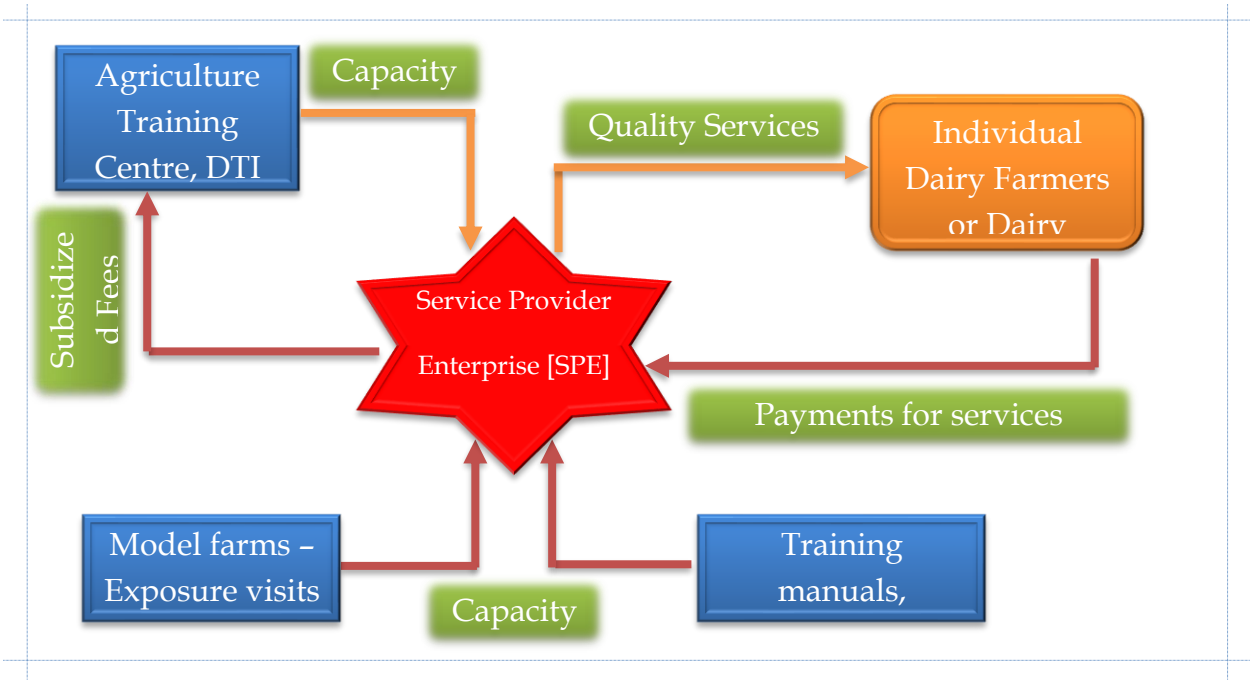


Figure 13. The service provider enterprise (SPE) model.

8.3 Community local technicians model

This model, although not expressed as such, was applied during the East African Dairy Development program (EADD). Fodder management has been a key component in this program, being spearheaded by the International Centre for Research in Agroforestry (ICRAF). In order to reach the smallholders in all the target regions, the program identified officers with agricultural training who had left public service either due to retirement, or for any other reasons. Based on generally wide knowledge gap on feeding practices in the smallholder section, the experts were specifically hired to undertake scheduled training activities to raise awareness on improving feeding practices. This approach was however costly, and the adoption rate was lower than anticipated. Another problem not anticipated was that activity (and consequently paying) of trainers was based only on the number of participants to training session and not on improved knowledge or changed attitude of the participants. This model has therefore been discontinued.

8.4 Integrated services model farm (emerging)

This study identified a group of established and emerging dairy farms that have developed a hybrid model of interaction with near-by smallholder farmers. This takes the form of collecting milk from smallholders and bulking and selling it with the farm's own milk to a processor, to selling fodder, leasing agricultural equipment for fodder harvesting and preservation, and organizing demo's and exposure visits and training at a fee.

Farms include Mawingu Farm (Nyeri), Mariro Farm (Mweiga), Amboni Farm (Nyeri), Kruger Farm (Eldoret), Baraka Farm (Eldoret), Ndykak Farm (Rongai Nakuru), Gogar Farm (Rongai Nakuru), Festus of Nkubu in Meru, Endakano Farm (Kitale), and some other large scale farms in Eldoret. One example is Endakano Farm, situated on 25 acres in Kitale and is developing a fully commercial model farm, demonstrating the best practices in fodder production, feed formulation, housing, animal health care, feeding, milk handling and record keeping. The farm has a strong partnership with Wielink Agricultural Trading Company Ltd based in the Netherlands. Wielink has over 40 year of experience in production and trade of forage and moist fodder by-products, including implementing full TMR for large scale dairy farmers.

Through cooperation with SNV, Endakano has opened the farm for training and demonstration, including testing and sharing results of new fodder varieties, mechanisation and preservation techniques. Endakano is planning to extent its business model to selling fodder (maize and grass silage) to smallholder farmers on a buy back arrangement for milk and production of yoghurt. It also started on a small scale with leasing of equipment for maize harvesting and silage making for large- and small-scale farmers as part of agricultural contracting work.

There are other emerging investors whose business structure are designed similarly. Festus farm in Nkubu at Meru for example is a dairy entrepreneur collecting and chilling milk from smallholders as an intermediary for processor. To boost his business and that of the dairy farmers, he is engaging in large scale fodder production for sales on buy back arrangement of milk from the same farmers.
EDFA (Eldoret Dairy Farmers Association) is an initiative of 50 medium and large scale dairy farmers in Eldoret. These dairy farmers also aim at using their dairy business as a hub to sell feed and fodder to surrounding smallholders, and collect milk from the same to create economies of scale in chilling and transport.

Figure 14 brings together most of the possible points of business interactions between smallholders and a model farm. Naturally not all the services outlined in Figure 14 are provided simultaneously. Smallholders would benefit immensely from this kind of business relationship.

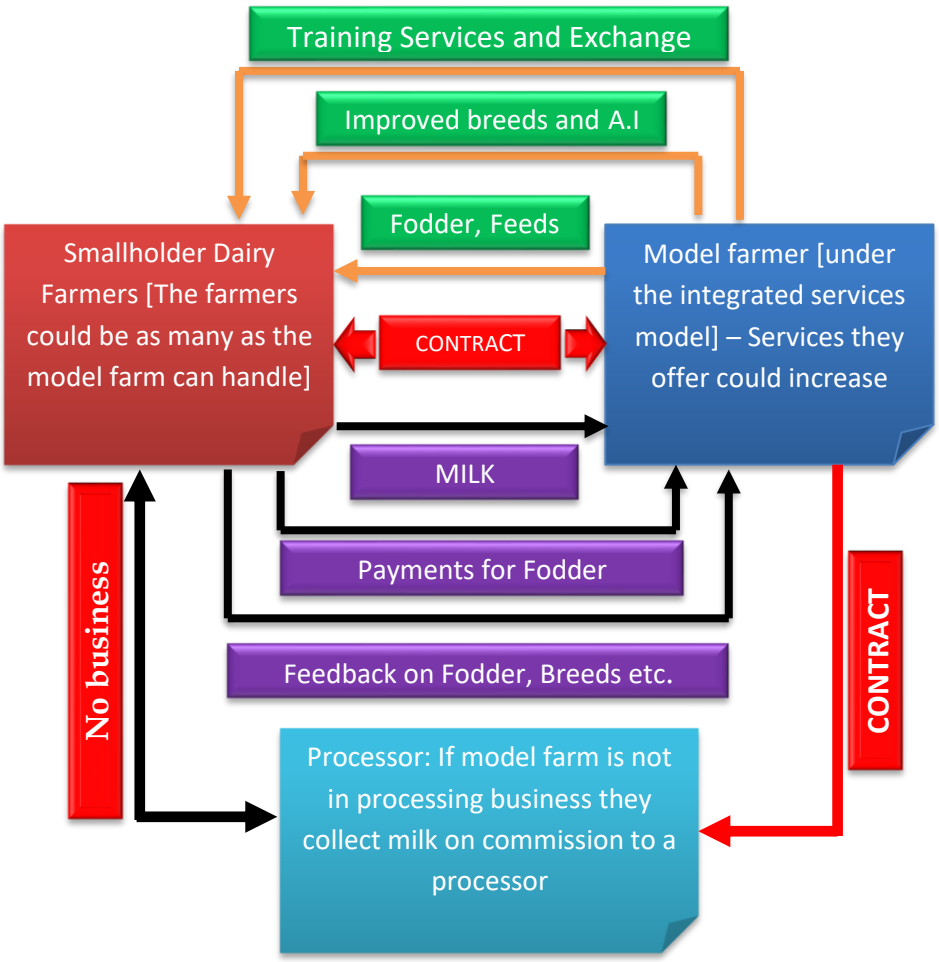


Figure 14. Integrated services model.

9. STUDY FINDINGS AND RECOMMENDATIONS

9.1 Demand side - individual smallholder farms

- ✓ Most of the smallholders in the high potential regions are organized in CBEs for milk collection, marketing and other services. These smallholders incur high feeding costs which undermines their ability to make profits.
- ✓ The farming systems are mostly rain-fed, and therefore they suffer shortage of fodder during the prolonged dry seasons.
- ✓ There is little evidence of modern fodder preservation/storage facilities. If stored, it is done in uneconomical volumes at small scale, usually with high losses. Open storage units are common in farms.
- ✓ Dairy cows are fed with low nutritional fodder materials like Napier grass; this is one of the main reasons why optimal milk production is not reached even with high potential dairy cows.
- ✓ There is still inadequate information on farm planning and dairy management caused by ineffective training and extension. A problem connected to this is the relative high age of smallholder farmers.
- ✓ Land space is limited and fodder is always in competition with other food or cash crops, limiting the growth of the individual dairy enterprises.

Opportunities for KMDP

- ✓ To identify and promote effective extension training models that are embedded in CBEs as separate units with sufficient resources and logistics, financed by the milk profits.
- ✓ To support medium scale farmers to invest in "innovative" fodder demos, and production and preservation technologies, and to promote commercial fodder businesses amongst farmers with excess land.
- ✓ To sensitize smallholder dairy farmers of the role that their dairy society could take up in developing strong commercial fodder supply chains for its members, thereby achieving economies of scale.

9.2 Demand side - CBEs

- ✓ CBEs can provide several services to their members: collecting, bulking and marketing of milk, selling dairy meals and veterinary supplies. With the exception of larger CBEs, most CBEs leave other services unattended, notably in providing preserved fodders and training and extension.
- ✓ Most CBEs have not invested in training and extensions services; consequently there is still a considerable knowledge gap amongst the farmers on, e.g. best feeding practices.
- ✓ An increasing number of larger CBEs buy fodder (hay) in large quantities for their members, while others are complementing this by establishing fodder production systems themselves or through contract farming. Still, however, over 50%[(14)] of members of CBEs purchase fodder on their own, thus weakening the position of CBEs to procure quality fodder in high volumes at affordable prices.

[14] Estimates from survey carried out at CBEs

- ✓ Those CBEs that procure inputs like dairy meals, concentrates, minerals and fodder (mostly hay) usually have no mechanism to determine the quality of such products.
- ✓ There is limited interaction and cooperation between CBEs to invest in fodder production, mechanisation and commercialisation.

Opportunities for KMDP

- ✓ To sensitize and assist CBEs in setting up sustainable training and extension services.
- ✓ To link CBEs with commercial fodder producers through formal arrangements and do forward planning regarding the fodder needs and distribution.
- ✓ To assist CBEs in developing their own fodder production or to set up contract farming schemes.
- ✓ To facilitate CBEs in developing protocols for feed and fodder testing and to link them to credible laboratory for analysis and advice.
- ✓ To develop an ICT platform (hub) where CBEs and feed and fodder suppliers can subscribe for sharing information of feed/fodder analysis, and a market place for demand and supply of fodder.

9.3 Supply side – established and emerging CFPs

Although the established large scale commercial fodder producers described in this study appear to be well-equipped and skilled, there is room for optimization. The emerging commercial fodder producers more often are hampered by one or more of the following gaps in operation:

- ✓ Fodder quality is inconsistent due to gaps in fodder management.
- ✓ Products have no guaranteed minimum nutritional level and customers usually take what is available.
- ✓ There are only limited formal contractual agreements between the CBEs and the producers. The supply chain is characterised by informal linkages between the producers and the buyers and poor forward planning.
- ✓ Sub-standard quality/variety of seeds, soil sampling, fertilization, harvesting and preservation techniques, which affect production per unit, nutritional content and market value.
- ✓ Lack of skilled personnel to carry out different processes on the farm or to advise production schedules.
- ✓ Lack of adequate farm machinery and skills for operation and maintenance.
- ✓ Lack of equipment for testing products to determine the nutritional levels before selling.
- ✓ General lack of innovation.

Opportunities for KMDP

- ✓ Explore a development fund to promote professional practice in the fodder business by facilitating capacity for enhanced business performance and innovation.
- ✓ Stimulate and facilitate new entrants in the fodder supply chain, either as investors or as producers, such as feed manufacturers, processors and CBEs.
- ✓ Link CFPs (including CBEs) able and ready to invest for expansion and innovation to KMDP Innovation Fund, other Private Sector Challenge Funds and financial institutions for access to affordable soft loans and/or grants for capital investments in machinery and storage facilities.

9.4 Demand and supply side: The missing middle

The category of dairy farms keeping between 20 and 50 cows demonstrate a willingness to put up huge investments on their enterprises. These are sometimes referred to as the "missing middle", as they are relatively rare in Kenya.

These medium scale farms could provide valuable functions to smallholder farms - as explained under the Integrated Services Model - because they stand close to smallholders, who could benefit strongly by learning and establishing business relations. These medium scale farms also are likely to have strong links to fodder production, and have ability to pilot innovations and best practices for the sake of the entire dairy sector. Also they may have good contacts with CBEs from which smallholders may profit.

Endakano (20 cows) is a good example of this and has already shown to be able to attract a lot of interest from smallholders, CBEs, medium and large scale farmers and even processors from Kitale and North Rift, through a number of field days and follow up visits by individual dairy farmers.

The impact of these field days and demonstrations was significant and amongst others triggered the formation of the Eldoret Dairy Farmers Association. EDFA as a platform for medium and large scale dairy farmers aims to organize farmers for peer learning, accessing to international best practice, finance and importation of innovative farm machineries. So far linkages have been established between EDFA and Chase/Rabobank and a Dutch consortium of input and service providers in the dairy sector (NABC 2g@there project).

<u>Opportunities for KMDP</u>

- ✓ KMDP can identify a number of medium scale farms in the major milk sheds where it operates, and support them in joining the EDFA platform or in establishing their own platforms.
- ✓ KMDP can link these farmers to national and international knowledge, input suppliers and service providers to innovate and grow their business, including fodder preservation and optimum feed formulation.
- ✓ The KMDP program should facilitate linkages for learning and doing business between these farms and smallholder dairy farmers in their surroundings.

ANNEX 1. INVENTORY OF PROGRAMS SUPPORTING THE FODDER SECTOR

Kenya Agricultural Research Institute (KARI)[15]	As part of their mandate, they are involved with animal production and range research on dairy, beef, small ruminants, poultry, pigs, pastures and fodder crops, and range. Fodder crop is a component under the wider theme of animal production. KARI hosts the largest number of livestock scientists in their different centres, with the majority of those dealing with fodder, based at KARI-Naivasha, which is the Regional Dairy Centre of Excellence. In the process of carrying out trials on ecological suitability and adaptability of the various fodder varieties, KARI experts are involved in dissemination albeit on a much smaller scale for only the areas which are identified for trials. The findings are then written simply in 'how to' brochures which are then (expected to be) distributed to the ministry of the livestock for onward dissemination to producers. KARI headquarters hosts a library where all publications are available, including the ''how to" brochures. It also hosts AIRC (the agriculture information resource centre) which has several video documentations on on-farm feed formulation, fodder production and conservation. KARI Naivasha (mentioned above) is equipped with an analysis laboratory. In a laboratories report carried out through the support of Winrock International in their collaboration with AKEFEMA, a group of animal feed industry participants provided a ranking of the labs they used in Kenya. From the report the KARI Naivasha Lab was ranked between third and fifth (out of five where first would be the best), in the category of capacity, ranked fourth in the category of chemical analysis, and was not ranked at all on the category of microbial analysis where only SGS and Analabs were ranked as first and second respectively. In the same exercise SGS was ranked in the same category. Despite this average ranking KARI lab is a busy station with samples from the industry as well from other research and academic institutions.
Ministry of Livestock Development	Involved in the dissemination and training programs for new technologies to farmers. The challenge for the ministry is the limited number of staff and financial resources that hinder their ability to access the producers in their farms. The fodder business is a key agenda in their work especially at establishment or production stages.
Micro Enterprise Support Program Trust (MESPT)	Majority of the reports of MESPT are on Dairy, however there is none that expressly carries the issue of fodder as its key theme.

[15] KARI Nairobi, Communication Department

East Africa Dairy Development Project	This is a consortium of organizations comprising of Heifer International, Technoserve, World Forestry Centre (ICRAF), and ABS. The consortium came up with a feeding manual titled "Feeding Cattle In East Africa"
Egerton University & University of Nairobi	Training institutions with no specific programs in Fodder but involved in research activities both on consultancy and especially on policy through Tegemeo Institute. Study programs at both masters and PHD levels. The supervisors are animal nutrition specialists.
Tegemeo Institute	Contributes to knowledge through research – on a wide range of subjects without any specific emphasis on fodder
ICRAF	See EADDP's contribution (explained above). The institution has however been spearheading the fodder shrub as a way of increasing the forest cover while bringing value to the dairy farmers at the same time.
Heifer International (HPIK)	See EADDP's contribution (explained above). Is the lead organization in the steer fattening project in Suswa (RAMAT Ltd) where they practice range management with a view of enriching the pastures. HPIK is a shareholder of Ramat with a shareholding of 10% with one representative of HPIK sitting in the board. HIPK has been providing technical and financial support to Ramat and all the projects i.e. water weir used in harvesting of rain water, feeding lots 125m long on either sides, holding grounds for livestock separate from that of small stocks, and the company offices which are 100% based on grants and currently managed by HPIK. HPIK intends to empower Ramat to buy off its 10% shares in Ramat, to hand over the entire project back to the community. The major shareholding however shall remain with the two Maasai communities (Keekonyokie and Loita). This is an on-going steer fattening enterprise which is targeted at exporting good quality meat but not milk.
ABS-TCM	Has a laboratory, some of their clientele comprise of animal feed manufacturers. The laboratory is able to perform full nutrition analysis on feeds.
Technoserve	Currently Involved in pilots of large scale hay production by cooperatives to boost productivity at the hubs. No other programs specific on fodder
Land O' Lakes	No programs specific to fodder. Many publications on the dairy work especially on the performance of cooperatives

ANNEX 2. PUBLICATIONS RELATED TO FODDER

Title of Publication	Content	Institution
Feeding Dairy Cattle; (Manuals and Guides); for smallholder dairy producers and extension workers in East Africa	Fodder establishment and conservation, pictorial illustrations of dairy practices including zero- grazing.	International Livestock Research Institute (ILRI)
Feeding Dairy Cattle in East Africa	Fodder types, ecological adaptation, nutritional classifications, conservation	East Africa Dairy Development Project
Better Forage	Establishment of legumes for coastal lowlands (5pgs)	KARI
Calliadra as a supplement for Milk Production in the Kenya Highlands (12 Pgs)	Ecological suitability, establishment, nutritional value and proper feeding.	Tropical Animal Health Production – Printed in the Netherlands
Cultivation and utilization of Napier grass (4pgs)	Establishment and proper feeding methods for Napier	KARI Resource Centre
Grow Desmodium for Seed	Proper production methods, ecological suitability, and seed production techniques.	KARI Resource Centre
Draft Animal feed report (32 Pgs)	The case for animal feeds sector in Kenya.	APF - KENFAP
Cassava Leaves as feed (How-to brochure) 2 pgs.	Feeding Cassava Leaves to dairy cattle during the dry season	KARI Resource Centre.
Feeding For Fertility (4pgs)	Boosting fertility through feeding	KARI Naivasha
Forage and Grasses (65 Pgs)	Different types of forage including grasses, establishment, nutritional value and feeding	Author not indicated. Material found at the KARI Resource centre.
Better forage for more milk (3pgs)	How to reduce the cost of fodder by feeding good forage without losing milk productivity. A “How to” brochure.	KARI Resource Centre
Growing Maize for Food and Fodder	Production of maize for duo purposes of feeding cattle and humans. A “How to” brochure.	KARI Muguga
Livestock Fodder from sorghum and sweet potato vines (2pgs)	Establishment nutrition and feeding methods	KARI Resource centre
Low cost homemade supplement for dairy cows (2pgs)	Feeding regimes – mixing proportions in homemade dairy meal	KARI Resource centre
Using Maize Forage (3pgs)	A “How to” brochure.	KARI Resource Centre
Make Hay	A “How to” brochure.	KARI
Milk in Dry Season (4pgs)	Feeding dairy cattle during the dry season	KARI Resource centre
More Milk and Meat	How to plant good pastures	KARI Resource Centre

Silage quality and losses	Losses due to ensiling of Napier, grass, Columbus grass and maize stover under smallholder conditions in Kenya	National Dairy Development Project (1983-1989), NAHRC Naivasha
Cassava roots as Feed	Processing cassava roots for dairy cattle feeding	KARI
Make Silage for more milk (3pgs)	Stepwise explanations of how to make silage	KARI
Disease control in Fodder	Controlling smut disease in Napier grass	KARI
Sweet potatoes as animal Feed	Sweet Potatoes in the crop livestock system in Kenya	International potato centre (CIP),
Tree Lucerne as Livestock Fodder	Establishment, nutritional and feeding	KARI
Using Vetch to Feed Livestock	Establishment, nutritional value and feeding of vetch	KARI
Fodder shrubs in central Kenya	The adoption and dissemination of Fodder shrubs in central Kenya	Agriculture Research and Extension Network (AGREN)
Fodder and Livelihoods	Enhancing livelihoods of poor livestock keepers through increased use of fodder	Fodder adoption project – IFAD (2011)
Feeding a Dairy cow, Dairy Animal feeds and Feeding and the Dairy enterprise Training manual	Proper feeding practices for dairy cows, Gross margins at a dairy farm, cultivation of different fodders	IFAD funded Smallholder Dairy Commercialization Program (SDCP)
Dairy Feeding Manuals	Types of fodders and best practices in Dairy Feeding	East Africa Dairy Development program
Study Report on and conservation in Dry land Areas of Kenya	Report covering the work of NALEP in the fodder promotion in the dry areas	Ministry of livestock, National Agriculture and Livestock Extension Program

ANNEX 3. INVENTORY OF FODDER-RELATED INPUT SUPPLIERS

Name of the Firm	Location	Type of Machines	Remark
Massey Ferguson	Nairobi, Nakuru, Eldoret , Mombasa	Grass Harvester/2 Row maize Noguera	Mostly bought by large farms
		Noguera mill	Mill Stover's, grass, straw and also crush maize silage
		Hay baler	Tractor driven hay baler mostly for commercial use
BRAZAFRIC	Nairobi	Tractor driven silage chopper /grinder & engine driven machines	Small to large farms. Machines available are of different sizes
Rapture Machinery Services	Nakuru	Fabricated machines	Mostly bought by small to medium scale farmers. Machines for crushing silage and milling crop residues
Spring Valley Machinery	Nakuru	Fabricated machines	Mostly bought by small to medium scale farmers Engine driven machines for crushing silage and milling crop residues
Eldama Machinery	Nakuru	Fabricated machines	Mostly bought by small to medium scale farmers Engine driven machines for crushing silage and milling crop residues
Molo Farm Machinery	Nakuru	Fabricated machines	Mostly bought by small to medium scale farmers Engine driven machines for crushing silage and milling crop residues

Ndume Limited	Gilgil	Farm Machinery (ploughs, harrows, cultivators, seeders & planters), grinding machinery (manual and powered)
Farm Engineering Industries Limited	Kisumu	Hay making equipment (hay balers), planters , combine harvesters
Dakmach Farm Machinery Services	Nakuru, Litein	Chopper, chaff cutter, broadcast seed sower, feed mixer
Benmwao Enterprises	Nakuru	Chopper, chaff cutter, feed mixer
Simlaw Seeds [subsidiary of Kenya Seed Company]	Nairobi and major towns	Fodder seeds; oat, sorghum, Lucerne, desmodium sunflower, etc.
Kenya Seed Company	Nairobi	Fodder seeds; oat, sorghum, Lucerne, desmodium, fodder barley, sunflower etc.
KARI Ol'jor-orok	Ol'jor-orok	Purple vetch, planting materials [KK 1,2 & 3], white lupine, oat, tree Lucerne
PANNAR Seed Company	Kenya (Tel: +254 (0) 20820121; Fax: +254 (0) 20820161; Cell: +254 (0) 72 2202051)	Clover, Forage cereal crops, kikuyu grass. Teff, weeping love grass, smuts finger grass, Rhodes grass, guinea grass, rye grass, tall fescue, cooks foot, Japanese radish
Hygrotech East African ltd	Nairobi	Fodder seeds, fertilizers & feeds
East African Seed Company	Nairobi	Certifies fodder seed varieties

ANNEX 4A. COMMERCIAL FODDER PRODUCERS (CFPS) INTERVIEWED

Name of the Firm	Location	Products	Packaging	Source
Morendat Farm	Naivasha	Lucerne Hay	400kgs bale	On-farm
Marula Farm	Naivasha	Lucerne Hay	20kgs Bale	On-farm
Delamere Farm	Naivasha	Lucerne alfa alfa	20Kgs Bale	On-farm
Technology Farm	Nakuru	Silage & Rhode Hay	Bags/bale	On-farm
DYKAK Farm	Nakuru	Silage	90kgs bag	On-farm
Kruger	Eldoret	Silage	-	On-farm
SPEN	-	Silage	-	Farmers

ANNEX 4B. INTERVIEWED CBES PROCURING FROM CFPS

Name of the CBE	Location	Products	Packaging	Cost/Unit [kshs.]	Sources
Ndumberi	Kiambu	Hay	Bale	150	Delamare & Nyala
Nderi D.F.C.S	Kiambu(Kikuyu)	Hay	Bale	150	KARI-Muguga
Limuru Milk Processors	Limuru	Hay	Bale	150	KARI-Muguga & Delamare
Endarasha	Kieni west	Hay	Bale	180	Kieni Members
Mweiga	Kieni	Hay	Bale	130	Mweiga-members
Mukurwe-ini	Nyeri	Hay	Bale	180	Nanyuki
Tetu Dairy	Nyeri	Hay	Bale	150	Kieni
LESSOS	Nandi	Hay	Bale	180	Eldoret
Moi's Bridge	Moi's Bridge	Hay	Bale	150	Eldoret Members
Lelchengo	Mosoriot	Hay	bale	180	Mosoriot-Members
Olenguruone Dairy	Olenguruone	Hay	Bale	170	Nakuru
Lelan Dairy	West Pokot	Hay	Bale	150	Kitale-ADC

ANNEX 5. MAIN FODDER CROPS/PRODUCTS (DRY MATTER AND ASH)[16]

Feed	Class	DM	Ash
Banana Leaves	Crop Residue	12.20	8.80
Banana Pseudo stem	Crop Residue	5.10	14.30
Banana Thinning	Crop Residue	13.00	13.10
Caliandra leaves	Tree (shrub) Fodder	25.00	4.30
Couch Grass	Grass	30.20	7.40
Grazing	Grass	28.00	7.00
Hay	Grass	90.00	5.60
Maize (Green Thinning)	Crop Residue	25.00	4.50
Maize (Whole)	Concentrate	90.00	1.70
Maize Bran	Concentrate	85.40	2.20
Maize Germ	Concentrate	88.00	4.20
Maize Stover (Dry)	Crop residue	85.00	7.00
Maize Stover (Green At Harvest)	Crop residue	13.00	8.50
Nappier Grass	Grass	15.00	13.00
Nappier Grass (2 M)	Grass	18.70	12.90
Nappier Grass (> 2 M)	Grass	24.00	13.00
Rhodes Grass	Grass	90.00	9.10
Sesbania Leaves	Tree (shrub) Fodder	28.00	4.50
Star Grass	Grass	30.00	11.60
Sugar Cane Tops	Crop residue	30.50	9.10
Sweet Potato Vines	Other	25.00	9.40
Wheat Bran	Concentrate	88.00	2.40
Wheat Straw	Crop residue	86.00	9.40

[16] 2012 Feeding manual, Feeding dairy cattle in East Africa by EADDP

ANNEX 6. FODDER CULTIVATION BY AGRO-ECOLOGICAL ZONE[17]

Area	Altitude (Metres)	Rainfall	Legume	Fodder Grasses	Grasses
Semi-arid;	1000–1800 m;	< 650 mm	Siratro		1. Andropogon gayanus 2. Cenchrus ciliaris 3. Chloris roxburghiana 4. Eragrostis superba 5. Panicum maximum
Warm and Wet Medium Altitude areas	1200-1850 M.A.S.L (metres above sea level)	1000-2500 mm p.a. (bimodal or unimodal)	Desmodium spp Stylosanthes guianesis Dolichos lablab Leucaena spp Calliandra calothyrsus Sesbania sesban Neonotonia wightii Stylosanthes guianensis	Giant panicum Giant setaria Ipomea batatas (Sweet potato) Napier grass Sorghum almum (Columbus grass) Sorghum sudanense (Sudan grass)	1. Chloris gayana (Boma & Elmba Rhodes) 2. Coloured guinea 3. Panicum maximum 4. Seteria sphacelata (Nandi and Nasiwa)
Cool and wet medium altitude areas	1850-2400 M.A.S.L	1000-2500 mm p.a.	1. Desmodium spp 2. Stylosanthes guianesis (Stylo) 3. Dolichos lablab 4. Lupinus albus 5. Lupinus angustifolius 6. Mucuna spp 7. Medicago sativa (Lucerne) 8. Vicia spp (Vetch) 9. Neonotomia wightii	1. Avena sativa (oats) 2. Columbus grass 3. Congo signal 4. Giant Panicum 5. Giant panicum 6. Napier grass	1. Chloris gayana (Rhode grass) 2. Coloured guinea 3. Guatemala grass 4. Pennisetum (Kikuyu grass) 5. Seraria sphacelata (setaria grass) 6. Cynodon dactylon (Star grass)

[17] 2012 Feeding manual, Feeding dairy cattle in East Africa by EADDP

Area	Altitude (Metres)	Rainfall	Legume	Fodder Grasses	Grasses
Cold and wet: high altitude	2400-3000 M.A.S.L	1000-2500 mm p.a.	1. Trifolium semipilosum (Kenya white clover) 2. Vicia spp (vetch) 3. Medicago sativa (Lucerne)	1. Avena sativa (oats) 2. Festuca arundinacea (tall fescue) 3. Lolium perenne (perennial ryegrass)	1. Kikuyu grass

Recommended Domains of Major Fodders

Agro-Ecological Zone Potential Fodder/Pasture Grasses	Upper Highlands (Uh)	Lower Highlands (Lh)	Upper Midlands (Um)	Lower Midlands (Lm)	Inland Lowlands (Il)
Fodder(Ley) Grasses	Kikuyu grass, Rye grass, Cocks foot, Tall fescue, Blue grass	Kikuyu grass, Napier grass, Nandi setaria, Rhodes grass, Congo grass, Signal grass, Rye grass, Paspalum, Andropogon.	Star grass, Napier grass, Nandi setaria, Rhodes grass, Maasai love grass, Sudan grass, Congo grass, Signal grass, Giant panicum, Guinea grass, Rye grass, Columbus grass, African foxtail, Star grass, Themeda, Sweet pitted grass.	Napier grass, Maasai love grass, Giant panicum, Guinea grass, Buffel grass, Columbus grass, Enteropogon, Guatemala, Plume Chloris, Columbus grass, Themeda, Sweet pitted grass.	Themeda, Sweet pitted, Maasai love grass, Buffel grass.

Agro-Ecological Zone Potential Fodder/Pasture Grasses	**Upper Highlands (Uh)**	**Lower Highlands (Lh)**	**Upper Midlands (Um)**	**Lower Midlands (Lm)**	**Inland Lowlands (Il)**
Fodder Legumes	Lucerne, Kenya white clover, purple vetch, common stylo, glycine.	Stylo, Desmodium, Lucerne, Purple vetch, Lablab, Lupins, Glycine, Velvet bean.	Siratro, Stylo Desmodium, Glycine, Lablab bean, Velvet bean, Purple vetch, Lupins, Butterfly, Pea, Townsville Lucerne.	Stylo, Siratro, Glycine, Lablab, Velvet bean, Lupins.	Stylo, Butterfly pea, Siratro, Glycine, Lablab, Velvet bean, Lupins, Mauritius beans.
Root Crops		Sweet potato vines, Fodder beets, Fodder radish.	Sweet potato vines.	Sweet potato vines	Sweet potato vines, Vigna lanceolata, Winged beans.
Fodder Cereals	Oats, Fodder barley	Oats fodder barley, Fodder sorghum, maize.	Fodder sorghum, Maize.		
Fodder Trees and Shrubs	Calliandra, Leucaena	Calliandra, Leucaena, Mexican wild flower.	Calliandra, Leucaena, Sesbania, Cassia, Mexican wild flower.	Leucaena, Calliandra, Mexican wild flower, Sesbania, Gliricidia	Saltbush, Gao tree, Mesquite.

Definitions of Ecological Zones[18]

UPPER HIGHLAND ZONES (norm. above 2300 m a.s.l.) - Central and Eastern provinces in Kenya

This zone is cool and usually has reasonable amount of rainfall - at least where the forests have been preserved to a certain extent. There is risk of frost at times so sensitive crops like maize are usually not attempted on a large scale. Good fodder production plans include grasses and legumes as listed below, which can be either cut and carried, grazed (Lucerne does not like being grazed by animals) or made into hay or silage. For grass pastures it is usually a good idea to fence off part of the grazing area early in the rainy season, and let the grass in fenced off plots grow tall for hay making, while the cows graze the rest. After making hay, the fenced off grass is left to grow again and if the other part of the pasture is by now grazed low, the animals can be let onto the re-growth of second pasture, while the first sector gets a chance to recover.

Short season grain crops like barley and oats make excellent silage either alone or intercropped with purple vetch or peas/beans. Seed of peas and beans are expensive, but purple vetch can be grown on the farm for seed production. The addition of legumes in the fodder crops will boost milk and meat production and save on expensive feed concentrates. Also a few fodder trees can be grown in highland areas as Hedges or borders between other crop sections. It is advisable to ask your nearest forestry officer which varieties are more productive in your area.

The lower highlands of Kenya have great potential for growing an abundance of fodder crops. In this section of the country there is really no excuse for having hungry livestock. Maize can be grown for silage, and the shorter season barley and oats are also ideal silage crops possibly inter-planted with purple vetch, peas or lablab beans. The various grasses can be cut, dried and stored as hay, and suitable fodder trees can produce green leaves year round. Napier grass also grows very well in this zone and can be intercropped with Desmodium to produce high yields of premium fodder.

UPPER MIDLAND ZONES (East of the Rift Valley between 1 300 and 1 800 m)-Central and Western Kenya

Also the upper midland zone of Kenya has a wide variety of suitable and productive fodder crops. Also in this region it is possible and highly advisable to make hay and silage from a large selection of crops. Upper Midland zones often extend into semi-arid areas where storage of fodders is even more important for feed security than in the high potential highlands.

LOWER MIDLAND ZONES (norm. between 800 and 1300/1500 m a.s.l)-Central and Eastern Kenya

The lower midland zones in Kenya are a lot drier that the upper zones and fodder production is more of a challenge. Still well managed pastures and plantations of Napier grass in the slightly wetter areas or where crops can be irrigated are still possible. We are now entering sorghum and millet zones, and these crops will outperform maize most years. Sorghum and millet are also ideal for silage, and the smaller grasses can still be conserved as hay. For legumes the shrubbier Stylosanthes is suitable and can give livestock much needed protein and the soil a boost of nitrogen fixed from the atmosphere.

[18] 2012 Feeding manual, Feeding dairy cattle in East Africa by EADDP

INNER LOWLAND ZONES (norm. between 100 and 800 m a.s.l.) 3)-Eastern and North Eastern Provinces

The inner lowland zones are semi-arid and hot and grade cows or milk goats are not normally kept in these areas, mostly suited for beef production. These are mostly pastoral areas where pastoralists graze their flocks over large areas and retreat to wetter pockets during times of drought. In many cases natural pasture has been eradicated by overgrazing and land degradation has set in as a result. Overgrazing puts the balance between grass and bushes to the bush side. Bush or *shrub encroachment* can finally finish the grazing potential. *Shrub encroachment,* in its first stage has poisonous or bitter herbs establishing and thrive abundantly, which are not eaten by livestock, leading to some sort of "green degradation". In AEZ 6 (see agro-ecological zones) the eradication of grass by overgrazing promotes at first dwarf shrubs (dwarf shrub encroachment), then in the better subzones thorny low shrubs grow up.

The grazing potential has severely decreased, only goats as browsers remain. In a final stage, due to overuse and soil denudation, the shrubs disappear and desertification becomes evident. Reseeding fenced plots before it is so bad is now practised. Another problem that is aggravating not only the cropland but even the grazing land is soil degradation. The animals take in nutrients through the vegetal material they ingest and release the same through dung. Farmers need to utilize this dung on their fields in order to replenish the depleted soil nutrients

ANNEX 7. SURVEY TOOL COMMERCIAL FODDER PRODUCERS (CFPS)

Name of the Farm:		Located in:	
Name of contact person(s) being interviewed			
Name of the Interviewer/ Research assistant from SNV.			

LAND USAGE

What is the total land space owned by this farm (add any other land owned by the company in this area)	
How much of this land is under cultivation? (Total land minus the range land)	

How many fodder crops do you produce in commercial volumes at your farm? List them:

Any Remarks?

	Type of Fodder	To sell or for own consumption (write on

Out of the total acreage cultivated, how much of this is occupied by different fodders above:

Any Remarks?

	Type of Fodder	Av. acreage occupied (now or last year

What is the main reason that the remaining land (the uncultivated section), has remained uncultivated this long?	

PRODUCTION SYSTEMS

What is your source of seeds for different fodders listed above?

Any Remarks?

	Type of Fodder	Source of Seeds/planting materials

Do you conduct soil sampling at all (tick one)	*Yes*	*No.*

If No (above), what the reason why you do not do soil sampling on your farm? (Tick one option)	*I do not see the need for it*	
	I find the process expensive	
	I do not know about soil sampling at all?	
	I just don't think about it	

How often do you sample your soils? (Annually, once in 3 years, 5 years etc.)	

How do you take your soil samples (Tick one)

One soil sample for the entire piece of land	
A sample for different sections of land depending on what is to be planted.	

Do you experience any challenges with seeds/planting materials for various fodders?

Type of Challenge	Fodder seeds associated with this challenge
Scarcity/less than needed	
Quality of seeds	
Prices (unusually high)	

What is the cost of seeds per unit (per kg?) for different types of fodder on the farm?

Any Remarks?

	Type of Fodder	Price per Kg of seed

What different types of farm machinery are available on farm? List type of machinery and its function(s):

Name of Equipment	Estimated Value (Ksh.)	Function(s)/Purpose

Are there any important farm equipment, which would be very useful for this farm but they are currently lacking? If Yes, which ones?

Name of Equipment	Estimated Value (Ksh)	Function(s)/ Purpose

What is the one greatest challenge in the production process? Labour, machinery, seeds, other inputs – please specify.	

How would you rate the availability of your products on sale across the year;

Month	J	F	M	A	M	Jun	Jul	A	S	O	N	D
Available/enough supply												
Low volumes/ Low Supply/Scarce												
NOT available/No supply												

How would you classify your [most] frequent buyers?

They are large scale farmers	%
They are medium scale farmers	%
They are traders who go to sell elsewhere	%
They are smallholder farmers	%

Research assistant To allocate % that add up to 100%, to the different options depending on the responses given.

Where do your buyers find the fodder products e.g. hay?

They come right into the farm store	
I take some fodder out to the highway as a way of marketing/promotion	
I have a distribution system to different destinations	
I have an arrangement with a dairy society who buy our fodder	

Notes to the above:

……

……

……..

QUALITY CONTROL

Which steps have you taken to ensure high quality fodder products consistently:

I have a manager in charge of quality control	
I take samples of my fodder to the lab for analysis every year to establish quality	
I have no system in place at the moment	
I do not take any steps but I know I have good quality of fodder products	

PERSONNEL

How many technical staff (diploma level and above), do you have in charge of the fodder business/Dairy Business	
What is the highest skill level/education level among your technical staff? E.g. MBA, First degree in Agriculture, Diploma in Extension etc.	

BUSINESS SUPPORT SERVICES

Do you currently have a business plan or a strategic plan for this business? Indicate Yes or No	
If No above, why don't you have any of these?	

Do you conduct feasibility studies before starting a new fodder project?	
If yes (above), do you use your own staff or you hire an external consultant?	
Have you ever attempted to approach a dairy society or a processor to become a corporate buyer for your products	
If no (above), why haven't you done that as a way of consolidating your demand.	
TECHNICAL SKILLS	
How do you rate your fodder preparation, storage and conservation skills?	
We are doing very well in our assessment, we have very minimal losses	
We experience losses, we need to improve our conservation skills	
Which do you feel is the missing skill in your business (most needed but missing)	
BUSINESS GROWTH & PROGRESSION	
What is your next phase of business if any, e.g. new business, business, expansion plans?	
In which specific areas of your current business do you feel that you need external support in order to grow your business to the next level?	
What efforts have you made so far (successfully or unsuccessfully) to get this missing support	

Additional notes to the interviews:

Smallholder Questionnaire

Objectives: To determine the baseline status on feeding systems, access to extension & marketing processes

IDENTITY			
1. Full Names	Mr/Mrs/Miss		
2. Gender [Please tick one slot]?	Male	Female	
3. Which zone or location in your area do you come from?			
4. Are you the household head in your family	Yes	No	
INCOME SOURCES			
5. What is the main source of your income at the family level? [Please rank the following income sources from the most to the least significant? By indicating 1, 2, 3….]	Selling Milk - Dairy		
	Selling of other farm produce		
	Salary from employment		
	Support from family members		
	Others? Please specify…		
6. If dairy (selling of milk) is your main source of income [ranked 1 or 2], please answer the following questions			
PRODUCTION LEVELS			
7. How many dairy cows do you have?			
8. How many litres of milk/ Kgs of milk do you produce in a day?			
9. How is this milk distributed into different uses, and in which proportions?			
a. Number of litres sold per day?			
b. Number of litres consumed at home per day?			
MARKETING PROCESSES			
10. Do you belong to any farmer group?	YES	NO	
11. How many members are you in the group			
12. Why was the group formed? – Purpose of the group?			
13. Do you sell milk as a group as an individual? Tick one?	Group	Individual	
14. Who do you sell your milk to?	Neighbours	Brokers	Direct to Processors
15. How much do you get in exchange for a kg of milk?	Ksh.		
16. Do you belong to a farmer's cooperative that helps you in marketing milk?	YES	NO	
17. If yes, what is the name of the cooperative?			
18. If No, why are you NOT a member of a Dairy Cooperative?			
19. If you joined a Dairy Cooperative, what kind of benefit would you like to receive from it?			

20. If you became a member/a shareholder of the cooperative today, how much would you be ready to be deducted to build the cooperative out of one litre/kg of milk?			
EXPOSURE AND ACCESS TO SKILLS			
21. Have you ever attended an exchange visit	YES	NO	
22. If YES, where did you visit?			
23. If YES above, what was your greatest personal lesson that you learnt from that visit?			
24. Which organization supported you to attend the above visit			
25. Have you ever attended a farmer training session on dairy?	YES	NO	
26. If YES, Which organization had supported you towards that training?			
27. Have you ever been trained about fodder preservation?	YES	NO	
28. Who trained you on the above?			
PRODUCTION SYSTEMS			
29. Since when have you used AI for breeding, Instead of a local bull? – Indicate the year.			
30. Do you preserve fodder for your cows at your farm?	YES	NO	
31. If YES above, in what form do you preserve your fodder? Please tick the right category.	Hay		
	Tube Silage		
	Surface silage		
	Others?		
32. What is your total acreage – farming area			
33. How much of this farm is devoted to (pure) fodder crops?			
34. How many types of fodder crops are found in your farm?			
35. Where do you buy your fodder seeds when you want them?			
36. Do you know how to prepare surface silage, so that you can do it yourself?			
37. Do you know how to prepare tube silage yourself?			
38. Do you know how to make hay?			
39. Do you know how to treat maize stovers?			
40. If YES on any of the three questions above, who trained on you the skills required?			
41. How many other fodder crops – do you know besides Maize stalks, Napier grass – list them?			
42. Do you have a zero grazing unit?			
43. If No, why don't you have one?			
44. How often do you meet the extension officer from the ministry of livestock?			
45. Who would you go to, if you needed support on fodder production, preservation etc.			

46. When feeding your cow, what do you place on the feeding trough	Wet Napier	
	Dry feed	
	Open grazing	
47. If someone was to preserve fodder for you, how much would you pay per 1000kgs of preserved fodder e.g. Surface silage		
48. If your cooperative was to deduct you to pay off for extension support, so that you can access extension support whenever you want it, how much out of Ksh. 28 per litre would you be ready to pay per litre, per day		
Thank You for your cooperation in filling up, the information will be very useful to support the sector for your benefit		

ANNEX 8. INVENTORY OF VARIOUS TRAINING MATERIALS

Booklet				
Title	**Author**	**Institutions**	**Type**	**Number**
Caliandra for livestock		KARI, ICRAF and KEFRI	Booklet	2
Financial planning and management of Dairy Farmers Self Help Groups /Societies			Booklet	1
So fire wood can wreck a home			Booklet	1
On farm milk processing		MoALDMand NDDP	Booklet	1
Tropical forage seed Production		ILCA and ICARDA	Booklet	1
Seed Processing –Audi Visual training Module		ILRI and ICARDA	Booklet	1
Rear your own heifer to replace your old cows	T. Lanyasunya, T.A.Onyango, M.Owango,K.Muriuki, K.Otienoand A Orodho	KARI, DFID, MoA and G.O.N	Booklet	1
Cattle Judging		MoALDM and KARI	Booklet	1
Kenya Boran cattle		BCBS	Booklet	1
Caliandra calothyrsus(Nursery establishment and management)		ICRAF, KARI, SLP and FRP	Booklet	1
Sigma feeds			Booklet	1
Establishment of bull a scheme		NDDP and MoARD	Booklet	1
Uses of tree by livestock		NRI	Booklet	1
The main breed of dairy cattle in Kenya	Carl Von Linne	Rockefeller foundation and MoA	Booklet	1
Feeding of the Dairy cows		MoALDMand NDDP	Booklet	2
Housing		MoALD&M, and NDDP	Booklet	7
The management of Napier grass		MoALD&M, and NDDP	Booklet	10
Organisation of Dairy groups		MoA and NDDP	Booklet	11
Artificial insemination (A.I)A guide for farmers		MoA and NDDP	Booklet	13
Ticks and their control		MoA and NDDP	Booklet	14
Fodder tree management		MoALD&M and NDDP	Booklet	14
Calf rearing		MoA and NDDP	Booklet	15
The fertility of dairy cow		MoALD&M, and NDDP	Booklet	18
Good hand milking		MoALD&M, and NDDP	Booklet	19
Sugar cane	Alicia Calle D.	TACIN	Booklet	1

ALIMENTACION EL GANADO PARAFINCAS CAMPESINAS	Alicia Calle D.	TACIN	Booklet	1
ADIESTRAMIENTO DE ANIMALES DE TRATABAJO	Alicia Calle D.	TACIN	Booklet	1
Focal Area extension planning	F.M.baiya	MoARD	Booklet	1
Donkey work easy		LPP and DFID	Booklet	1
Healthy sheep pay the medical bills		KARI, DFID	Booklet	1
Good calf, Good cow		LPP, MoA&RD, DFID	Booklet	1
Healthy cow more milk		KARI/MoALDM/ILRI Small holder dairy project	Booklet	1
Better manure, better crops		KARI, NRSP and ILRI	Booklet	36
Tethered Goats, less work		LPP, MoA&RD, DFID	Booklet	1
Family cooperation: The basis for greater development		NDDP and MoALD&M	Booklet	74
Feed resources and dairy cattle management in Uganda		LSRP and NARO	Book	1
Developing forage technologies with small holder farmers	Peter M Horne and Wener W.Stur	ACIAR and CIAT	Book	1
Holstein sires 2000-2001		Cooperative Resource International	Book	1
Complete catalogue 2002		www.cab-publishing .org	Book	1
Work plan	Sida	MoARD	Book	1

Draft				
Title	**Author**	**Institutions**	**Type**	**Number**
Happy donkey, happy home	The donkey Sanctuary	KSPCA and IDPT	Draft	1
Housing		MoALD&M and NDDP	Draft	1
Desmodium dreen leaf		Queens land beef industry institute	Draft	1
Preparation of technology information package for the extension workers using Desmodium as an example	Christian Diaz	ILRI	Draft	1
Uses of tree by livestock Prosopis		NRI	Draft	1
Fodder tree management			Draft	1
The fertility of the dairy cows		MoALD&M and NDDP	Draft	1
The management of Napier grass		MoALD&M and NDDP	Draft	1
Calf rearing		MoALD&M and NDDP	Draft	1

Calliadra calothyrsus, nursery establishment and management	C. Wambugu	ICRAF, KARI, SLP (CGIAR) And OFI	Draft	1
Caliandra for livestock		ICRAF, KARI and KEFRI	Draft	1
Ruminant feeds	Dr.Mwedia Mbaka		Draft	1
Feeding of the dairy cows		MoALD&M, NDDP, and FITCA	Draft	1
Better manure for Healthy crop	F.Kihanda, L.Chege, S.Kimani, J.Kihanya and John Lekas	MoARD and DFID	Draft	3
Zero grazing (Farm demonstration package)		MoALDM MoALDM	Draft	1
Ticks and their control diseases they transmits		N.D.D.P (PRIVATISATION UNIT) AND MoA	Draft	1
Dirty water	Pauletta Edward		Draft	1
Cholera crisis			Draft	1
Not just a cold			Draft	1

Disseminating research finding to farmers	**B.Lukuyu**	**DFID**		
Napier management section module 1: basic management guidelines			Fact sheet	1
Module2: choosing the right variety			Fact sheet	1
Module 3:propagation and establishment			Fact sheet	1
Module 4:day to day management			Fact sheet	1
Module5: fertilizer application			Fact sheet	1
Housing section Module 1:why do cow need housing?			Fact sheet	1
Module2: housing according to grazing system			Fact sheet	1
Module 3:Overall design of the housing			Fact sheet	1
Module 4:Outside dimension and roof			Fact sheet	1
Module 5:The resting cubicles			Fact sheet	1
Module 6:The milking stall			Fact sheet	1
Module 7:The calf pen			Fact sheet	1
Module 8:The walking area			Fact sheet	1

Module 9:Feed and water troughs			Fact sheet	1
Module10 :Manure and compost			Fact sheet	1
Module 11:Other optional additions			Fact sheet	1
Module12: required materials			Fact sheet	1
Module 13; construction of the unit			Fact sheet	1
Calf section Module 1:Management of the calf			Fact sheet	1
Module 2: The birth of the calf (calving)			Fact sheet	1
Module 3:feeding of the calf			Fact sheet	1
Module 4: Calf housing			Fact sheet	1
Module 5:features of a healthy calf			Fact sheet	1
Module 6:disease control			Fact sheet	1
Module 7:Basic rules for good calf rearing			Fact sheet	1
Fodder conservation section Module1:Types of fodder conservation			Fact sheet	1
Module 2:Hay			Fact sheet	1
Moduel3:Silage			Fact sheet	1
Module 4;dried forage			Fact sheet	1
Artificial insemination (A.I) for dairy cattle section Module 1:what is A.I			Fact sheet	1
Module 2;Semen production			Fact sheet	1
Module 3:Semen handling			Fact sheet	1
Module4;Types of packing semen and mode of transport			Fact sheet	1
Module 5;Heat or oestrus detection (see also the fertility of the dairy cow booklet)			Fact sheet	1
Module 6:Insemination and ensuring conception			Fact sheet	1
Module 7:proper records s as requirement for successful A.I. service.			Fact sheet	1
Module 8;Do and don’ts in A.I.			Fact sheet	1
Module 9 List of A.I equipment			Fact sheet	1
Household dynamics (gender issues Strengthening cooperation at household level			Fact sheet	1

Participatory extension methods and techniques			Fact sheet	1
1.Importance of farmer participation			Fact sheet	1
2. The role of the extension worker in enhancing farmer participation			Fact sheet	1
3. Extension method and techniques to strengthen farmers participation			Fact sheet	1

Disseminating research finding to farmers	**B.Lukuyu**	**DFID**		
Report on the Smallholder Dairy dissemination Workshop			Fact sheet	16
How to prepare the feed			Leaflet	1
Taratibu ya upanzi(Keeness during planting			Leaflet	1
Maziwa zaidi (Extra milk)			Poster	1
Stop milk wastage			Poster	1
Utoaji wa maziwa wa adhiriwai(production of more milk is being negatively affected)			Poster	2
Dairy at risk			Poster	1
Utoaji wa maziwa wa adhiriwai(production of more milk is being negatively affected)			Booklet	1
Plant fodder trees for more milk and cash			Fact sheet	1
Better manure for healthy crops			Draft	1
Disseminating research finding to farmers	**Dannie Romney**			
The small holder Dairy dissemination workshop			factsheet	23

Factsheet				
Title	**Author**	**Institutions**	**Type**	**Number**
Feed Lupine seed with Maize for cheaper Dairy feeds	Dr.F.N.Munyeko and Dr.E.A.mukisira	DFID, GoN and MoA	Factsheet	1
Fresian Sahiwal crossbreds for more milk in the dry areas			Factsheet	1
Get more milk	A.Masinde and M.Ojowi	KARI, DFID, MoA and GoN	Factsheet	1

How to get more milk in the dry season	V.Mason andDr.F.Luswet i	KARI, DFID, MoA and GoN	Factsheet	1
Make hay for more milk, more meat and fewer death in the dry season			Factsheet	1
Make silage for more milk during the dry season			Factsheet	2
Tumbukiza a better way to grow Napier grass for more milk			Factsheet	1
Fertile cows give More milk and More calves	I.Lokwaleput and R.de Jong	KARI, MoA and GoN	Factsheet	1
Stop Newcastle disease			Factsheet	1
Discover hidden treasures in local chickens			Factsheet	1
Grand slam for “picture for perfect” udders!		Cooperative resources international	Factsheet	1
Plant fodder trees for more milk and cash			Factsheet	1
Plant fodder tree for more milk and Cash	G.M.Karanja and C.M. Wambugu	KARI, MoA and ILRI(Small holder dairy project	factsheet	2
Sigma daily milk record card			Fact sheet	1
Target chest girth (cm) and live weight (Kg) in fertile cows			Fact sheet	3
target growth chart calf/heifer(cm and Kg)			Fact sheet	1
Your feed shortage problem: Use maize forage			Fact sheet	1
Green Maize forage	Dr JN Methu& EM Kiruiro	KARI, DFID, MoA and GoN	Fact sheet	2
How to get more milk in the dry season			Fact sheet	1
Get more milk and meat from your farm			Fact sheet	1
More milk from better Forages for coastal low land	A Ramadhan and P Bakari	KARI, DFID, MoA and GoN	Fact sheet	2
Fertile cows give ore milk and more calves			Fact sheet	2
How to get more milk and meat in the dry season	V.Mansion and Dr.F Lusweti	MoA, DFID and GoN	Fact sheet	1
Use tumbukiza for your Napier grass	Dr. Munyekho and D.T.Chruiyot	KARI, DFID, MoA and GoN	Fact sheet	1
Feed Lupine with seeds for cheaper dairy feed			Fact sheet	1
Napier grass for semi-arid areas	Dr F Wandera	KARI, DFID, MoA and GoN	Fact sheet	1
Grow Desmodium for seeds and make more money			Fact sheet	1

More and better forage	D.M.Mwangi	KARI, DFID, MoA and GoN	Fact sheet	1
Rear your own heifer to replace your old cows	T. Lanyasunya, T.A.Onyango,M .Owango,K.Mur iuki, K.Otienoand A Orodho	KARI, DFID, MoA and GoN	Fact sheet	8
Make Hays	F Wandera	KARI, DFID and MoA	Fact sheet	2
Water the real thing collects it all!	Dr.D.K.Tuitowe k, Dr.S.F.O. Owido and Dr.S.S China	KARI, DFID, MoA and GoN	Fact sheet	4
Control worms and increase productivity	G.Mulira	KARI, DFID, MoA and GoN	Fact sheet	2
Treat mange now! the new way	J.K.Nduati	KARI, DFID, MoA and GoN	Fact sheet	3
Control ticks and reduce cattle loss		KARI, MoA, DFID and GoN	Fact sheet	3
Drink roof water	Dr.D.K.Tuitowe k, Dr.S.F.O. Owido and Dr.S.S China	KARI, DFID, MoA and GoN	Fact sheet	3
Making silage in plastic tubes		Land O Lakes	Fact sheet	1
Get more from maize			Fact sheet	3
Plant fodder trees for more Milk and cash	C.M.karanja and C.M.Wambugu	MoA and KARI	Fact sheet	1
Feed Desmodium for more milk and money	D.M.Mwangi	KARI, MoA and DFID	Fact sheet	5

Leaflet				
Title	**Author**	**Institutions**	**Type**	**Number**
Your fed shortage problem	EM Kiruro, JN Methu and AN Abate	KARI, DFID and MoA	Leaflet	1
Control ticks and reduce cattle loss		KARI,MoA,DFID and GoN	Leaflet	1
Identification and control of Striga in Kenya			Leaflet	1
Treat mange now! the new way	J.K.Nduati	KARI, DFID, MoA and GoN	Leaflet	4
Grow More Desmodium and prevent Striga weeds (Kuza Desmodium na uzuie kwekwe la Striga)			Leaflet	1
Make hays	Dr F Wandera	KARI, DFID, MoA and GoN	Leaflet	3

Mtu yeyote aweza kuuza maziwa apate faida (Anybody can sell milk and get profit)		Media for education and development (KBC/Swahili)	Leaflet	10
Discover hidden treasure in local chickens	BM Mburu and HO Ondwasi	KARI, DFID and MoA	Leaflet	2
Fertile cows give more milk and more calves	I Lokwalet and R de jong	KARI, DFID and MoA	Leaflet	3
How to get more milk	V Mansion and Dr F Lusweti	KARI, DFID and MoA	Leaflet	3
Control smut disease in the Napier grass	Dr FN Lusweti	KARI, DFID and MoA	Leaflet	1
Stop New castle disease	H.O. Ondasi	KARI, MoA and GoN	Leaflet	3
More milk from cows fed better forages for coastal land	A Ramadhan, P bakari, GM Wambua and PT Busiene	KARI,DFID ,MoA and GoN	Leaflet	1
Mbolea safi ya kutosha kuzidisha mazao (Enough clean manure to increase the productivity)		Media for education and development (KBC/Swahili)	Leaflet	69
Feed lupine seed with maize for cheaper dairy feed	Dr. Munyekho	KARI, DFID, MoA and GoN	Leaflet	1
Weed Control in mixed crops of Maize and beans		KARI,MoA,DFID and GoN	Leaflet	2
Grow more Maize and Napier (Kuza Mahindi na Napia Zaidi)		MoA, KARI, IACR, ICIPE and GCF	Leaflet	1
Make silage for more milk in the dry seasons	EM Kiruro, JN Methu	KARI, DFID and MoA	Leaflets	2
Sigma feeds			Leaflet	1
Tumbukiza a better way to grow Napier grass for more milk			Leaflet	1
Cut cost of feeding stover		ILRI, Reading University and Natural resource institute	Leaflet	4
Control of smut disease in Napier grass	F.N.Lusweti	KARI, DFID, MoA and GoN	Leaflet	4
Choosing the right variety			Leaflet	1
Clean hand clean milk		LPP, MoA and DFID	Leaflet	1

Poster				
Title	**Author**	**Institutions**	**Type**	**Number**
Utoajiwa maziwa wa adhiriwa (Milk production is being negatively affected)	D.M.Mwangi, S.W.Mwedia and E.Mwadime	MoaRD, KARI and DFID	Poster	13
Stop milk wastage		MoA (SDP) and KARI	poster	10

The main Breed of cattle in Kenya		Mazingira Institute	Poster	1
Dalili za ugonjwa "HEADSMUT"			Poster	1
Extra milk	Dr. John Kariuki and Margaret Wambugu	KARI, MoA, ILRI(Small holder dairy project) and DFID	Poster	4
simlaw seed planting guide		Kenya seed company	poster	1
planting guide		Kenya seed company	poster	1
increase milk in cold areas			poster	1
Dairy industry association of Kenya		Land O' lakes	Poster	1
The fertility chain			Poster	1
Ohlsens enke seeds promotion			Poster	1
Stop Milk Wastage		MoaRD and KARI	Poster	1
The main Breed of cattle in Kenya			Poster	1