the Friesian
dairy development company

Quick scan of the business opportunities for a commercial Fodder Production and Supply Centre in Kenya and Uganda

The Friesian, 15 August 2014

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SNV
Connecting People's Capacities

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1. Introduction

Kenya is the leading milk producer in East Africa. With approximately 5 billion litres of milk produced in 2011 by an estimated 3.5 million dairy cows, milk is daily food for Kenyan citizens. The average milk consumption per capita has increased in the last decade to 100 kg per year. High population growth and urbanization characterized by a fast growing middle class, present increased demand for milk and milk products.

Both Kenya and Uganda have large portions of underutilized fertile land (especially Uganda) and favourable climatic conditions with low temperature variability and good rainfall, and therefore high potential for dairy farming. A further growth and development of the dairy industry is hampered mainly by lack of year round access to protein and energy rich quality feed and fodder.

The Kenya Market-led Dairy Programme (KMDP), financed by the Netherlands Embassy in Nairobi and executed by SNV Kenya, supports the private sector to innovate and adopt international best practices in amongst others feeding and fodder management. KMDP has an Innovation Fund that can co-finance innovative business models and products in this and other areas of dairy development.
In Uganda SNV is also engaged in the dairy sector and aims to upscale these activities.

In this context The Friesian Dairy Development Consultants proposed – and were contracted by SNV - to carry out a feasibility study on the business opportunities for a Fodder Production Service Centre, for the year round supply of quality fodder products to dairy farmers in Kenya and Uganda.
This report presents a quick scan/analysis on the business opportunities for such a Fodder Production and Service Centre.

In Kenya the Mission took place from 22 April to 28 April 2014 and was undertaken by Mr Gjalt de Haan (The Friesian) and Mr Frans Ettema (Landfort/PUM), who were supported by Mr David Maina (Perfometer Consultants) and Mr Stanley Koech (Eldosirikwa). Coordination in Kenya on behalf of SNV/KMDP was done by Mr Anton Jansen.

The Mission in Uganda took place from 29 April to 3 May 2014 and was carried out by Mr Gjalt de Haan (The Friesian) and Mr Jurjen Draaijer (SNV Global), who were supported by Sarah Mubiru from SNV Uganda.

In Kenya the mission visited eight medium sized and large scale dairy farmers, two agricultural equipment and input suppliers and one commercial lucerne producer. The farms and businesses served as key informants and are located in the regions of Naivasha, Nakuru/Rongai and Eldoret. These regions are very suitable for large scale dairy farming as they are 1,600 meters above sea level and have sufficient fertile land and rainfall.

In Uganda visits and meetings were organised at 2 dairy farms, a dairy farm/processor, a machinery supplier and a government owned breeding/dairy farm.

In addition to these site visits, the Mission Team(s) also consulted SNV and PUM experts involved in KMDP and studied a number of reports made available by SNV Kenya regarding the status of the dairy industry and the feed and fodder sub-sectors. Particularly worth mentioning is the study executed by BLGG Research and partners under KMDP's Inception Phase.

2. Summary

Kenya

The dairy industry in Kenya is critical in supporting its economy. It accounts for about 14 per cent of the agricultural gross domestic product (GDP) and 4.0 per cent of the total GDP (2011 figures). Annual production is estimated at 5 billion litres per year (2011 figures) and approximately 80% of the total milk production comes from about 700,000 smallholder farms. Besides, Kenya has an estimated 3,000 medium and large scale dairy farmers who have 15-20 animals and above. Depending on the level of commercialisation and availability of land these dairy farmers practice zero grazing, semi-zero grazing or free grazing. For all systems it can be safely concluded that feeding of cows is a major challenge.

Milk production and productivity are highly influenced by the feeding regime and fluctuate sharply during the year depending on rainfall patterns and – consequently - availability of forages. This seasonal fluctuation in milk production both affects dairy farmers and processors and leads to a scenario that is not conducive for long term investments by either of them. Milk price fluctuations are largely due to the seasonality in milk supply, with the underlying cause being lack of access to year round quality forages (fresh and preserved). In addition to the issue of seasonal fluctuation in milk production and availability of forage, the quality of the forages and knowledge of feed rationing are generally low. Irregular supply and availability of forages and low quality of forage products undermine the competitiveness of the dairy industry.

It is the Mission Team's opinion that the key to unlock the huge potential and enhance the competitiveness of the Kenya dairy industry, lies with the improvement of feed and fodder systems, especially with respect to pasture management and preserved fodders. Inadequate and low quality feeding form the main reason for:

- Low milk productivity per cow
- Poor health, fertility and reproduction
- High variability in milk supply and consequently in pricing due to seasonality
- High production costs of milk: up to 65% of total costs are related to feeding
- Quality issues around contaminated milk, i.e. mycotoxins.

As for preserved fodders hay and maize (and to some extent napier grass and fodder sorghum), are the main fodder products preserved by dairy farmers. Both hay and maize production and handling (i.e. preservation, storage) have room for significant improvements and optimization, if management and mechanisation are enhanced. As for grass and hay, large improvements can be made in total kgs of dry matter harvested per acre, protein content and digestibility, if fertilized properly and harvested at the correct time or stage. Grass silage is largely unknown. There is also scope for improved fodder seed varieties.

On the demand side, it can be noted that there is a large demand and market for forages by progressive smallholders and by medium scale dairy farmers (15-30 cows). The demand for forages is high due to a commercialising and growing dairy sector in Kenya, fuelled by high milk prices and growing urbanisation and development of an affluent middle class.

The many smallholder and medium scale farmers that are engaged in commercial dairy production are usually unable to grow and preserve sufficient quantities on-farm due to lack of land size, skills and/or capital for mechanisation.

Also many large scale farmers with abundant land who grow and preserve fodder on-farm, lack the skills and machinery to optimize fodder production. This results in many losses in the trajectory from seed-to-feed and – most importantly – milk production and animal productivity.

As a result commercial fodder supply chains have developed in Kenya. This has been the case mainly mainly for which is traded in huge volumes but also trading in low value farm residues like rice and wheat stalks/straw is common and locally napier grass is traded in the dry season. Some entre-preneurs have started commercial supply chains of unpacked maize silage. In addition by- products from agro-processing industries have found their way to dairy farmers.
In Kenya commercial fodder production and distribution has the potential to grow further within a well defined service-model or concept, and with proper management skills and mechanisation.
Most medium- and large scale farmers are required – but unable - to invest themselves in equipment for maize (and grass) planting, harvesting, crushing and ensiling, since agricultural contractors or service providers are scarce in Kenya. For many dairy farmers the agricultural service provider can be an important partner in optimizing costs/yields and quality of (preserved) forages.

The issue of healthy and productive soils has become a major issue in large parts of Kenya. Crop rotation, (efficient) use of animal manure and green-manuring (mulching) are almost absent. Disc ploughing is very common and negatively affects soils and yields. Soil testing/analysis and enhanced knowledge of the nutrient balance and level of organic matter in the top layer of the soil, are key to improve productivity in both feed and fodder crop production.

Feed testing and tracking and tracing is equally important to optimize insight in both nutritive and commercial value, to advise on optium feed rations, and to minimize contamination of feeds and fodders with undesired substances and residues.

To summarize: for efficient, cost effective and high quality fodder production several factors have to be in place and need to work together. This involves healthy soils, certified seeds, timely farm inputs, adequate and well operated/maintained farm machinery, proper preservation and storage and - most of all – know-how and management skills.
In a maturing dairy sector, the professional production, supply and use of fodder (and feed) is key and this requires specialized knowledge and service providers with adequate machinery and management skills. There is need for the development of a strong commercially driven “service infrastructure” for the dairy value chain. In particular this should be directed towards supporting the establishment and management of best practice mechanised fodder production, preservation, and – in case of commercial fodder supply chains – marketing, logistics and distribution.
These services could be combined in a Fodder Production and Service Centre (FPSC).

The main objective of the FPSC is to improve the regional availability of more and better feed and forage for dairy farmers. This is done through professional and controlled cultivation, harvesting, handling, preservation and storage of fodders - in central and/or farm-based silage storages - and the supply of ready-to-use quality fodder (mixed, in bulk or packaged) to dairy farmers, when needed, in the required volumes and at a reasonable price. The following services can be offered by this company:

a. Production and harvesting of high energy/high protein crops
b. Storage/conservation of own and/or purchased crops in silos at a central location(s)
c. Supply of ready-to-use fodder in bulk or baled/packed (i.e. maize silage, grass silage, lucerne, hay) to dairy farms
d. Sourcing, purchasing, storage of quality assured feed-ingredients

e. Preparation, packaging and distribution of (Total) Mixed Rations
f. Agricultural machinery contracting services to dairy farmers, for:
    i. Soil improvement and seedbed preparation
    ii. Crop protection
    iii. Harvesting
    iv. Storage and transport
g. Advisory and analytical services for soil and feed/fodder management

By combining these services in one business entity effective and efficient use of labour, know-how, skills and machinery can be achieved and economies of scale can be maximized. The focus shall be to develop a maize/grass silage-based (T)MR product of high nutritive value and of GMP-quality. The latter implies and assures maximum traceability and quality control.

In terms of market-reach for the *packaged product*, the market shall be divided into two segments:

a) Medium and large-scale dairy farmers who will purchase 300-400 kg compressed and wrapped round bales.
b) Smallholder farmers who will buy 25 kg square bales or briquettes through agro-dealers and dairy cooperatives.

The company should be located in one of the main milk production areas of Kenya, like for example Eldoret or Nakuru and should be characterized as a “pilot project” for proof-of-concept purposes. With the facilities and assets, like arable land, storages and machines in place, several fodder products and (T)MRs will be marketed and sold to farmers.
In addition to this agricultural machinery contracting services will be offered to farmers who wish to produce and preserve their own fodders at site.
Third, the FPSC also could serve as as a demo and training centre for machine operators, farm managers and dairy consultants, charging commercial rates and fees for training so provided.
In the suggested set up the following products and services can be offered at commercial rates:

a) Maize silage in bulk (unpacked and 300-400 kg round bales)
b) Maize silage in square bales (25 kgs)
c) (Total) Mixed Ration in bulk (unpacked and 300-400 kg round bales)
d) (Total) Mixed Ration in square bales (25 kgs)
e) Grass silage in bulk (unpacked and 300-400 kg round bales)
f) Grass silage in square bales (25 kgs)
g) Hay in bales (18 kgs)
h) Machine contracting services & advisory and analytical services

Chapter 5 of this report presents a detailed description of the proposed model and a feasibility study based on the production and marketing of the above mentioned products. This is based on a quick scan of the market prices for feeds and fodder and of the costs of production and the required machinery.

The product choice and quantities proposed can be varied during implementation of the product depending on the market and the location of the project. E.g. if soils and other conditions would be conducive for lucerne this could be added to the product range. The study shows that the proposed FPSC in the current set up (based on maize and grass silage) is commercially viable and would support a “go-decision” by interested investors.

In that case it is suggested that a more detailed businessplan is prepared, that will take into account local conditions of the area where the FPSC will be established both in terms of agro ecological conditions and market.

Uganda

In Uganda the current practice in feeding dairy cattle first needs a major transition, by moving away from “semi-pastoralism” to more intensified feeding and foraging systems. Therefore, before starting a pilot Fodder Production and Service Centre as suggested for Kenya, one or two regional farmgroup fodder pilot projects are suggested to show best practice in feeding.

It is suggested to demonstrate ‘on-the-spot’ the effectiveness of a different farming and feeding system by piloting zero grazing. This can be done in cooperation with one or two large scale lead farmers with sufficient land resources. By setting up a feeding and fodder crop demonstration project in one or two regions - linked to an increasing (controlled) milk production - the concept of ‘feeding costs-precede-milking benefits’ can be demonstrated in practice. An important aspect of this project is to pilot alongside the effect of fertilizer in virgin Ugandan pastures.

Another crucial element of this project will be to demonstrate a more cost-effective and easy manner of making silage pits, and to change from underground pits to surface pits with proper earth walls and drainage. Potential partners for this pilot are:

a. The Reline Renaissance Livestock Farmers Network and in particular the farm of Emmanuel Tayebwa. This typical lead-farmer is based in Mbarara (South West of Uganda).
b. Jesa Dairy Farming, owned by Geoffrey Mulwana. This innovative and professional organized dairy farm and milk processing company, is eager to source more quality milk from other farmers and is based just north of Kampala.

3. The Dairy Sector in Kenya and Uganda

3.1 Dairy farming

The Kenyan dairy industry is critical in supporting the economy. It accounts for about 14 per cent of the agricultural gross domestic product (GDP) and 4.0 per cent of the total GDP (2011 figures).
Annual production is estimated at 5 billion litres per year (2011 figures) and approximately 80% of the total milk production comes from about 700,000 smallholder farms who own 2-4 dairy cows, mainly cross breeds, with an average production of 6-7 litres per animal per day. An estimated 50% of the total milk production is marketed of which 25% as processed milk and milk products.

Smallholder dairy farmers operate in mixed farming systems and can be found in all major milk-sheds in Kenya in North and South Rift, Nyandarua/Kinangop, Central Province and part of Eastern Province (Meru and Embu). Depending on the level of commercialisation and availability of land these smallholder farmers practice zero grazing, semi-zero grazing or free grazing.
For all systems it can be safely concluded that feeding of cows is a major challenge.

These smallholders market their milk partly through hawkers and traders, and partly through farmer owned dairy cooperatives that collect, bulk and market the milk to the end-consumers (raw) and to processors. Within the smallholder segment only a modest percentage of farmers can be considered as commercial dairy farmers who run their dairy operations as a (core) business. Yet commercialisation is rapidly increasing and in absolute numbers this constitutes still a large market, with high concentration of commercial smallholder dairy farmers around the larger urban centres.

Next to smallholders, Kenya has an estimated 3-4,000 medium and large scale dairy farmers who have 15-20 dairy cows and above, mostly of exotic breeds. Dairy farming attracts important investments from the wealthy middle class with formal employment in urban centres who rely mainly on farm managers. Hence the expression telephone farmers. Many of these farms have ample land and capital for fodder production and preservation, yet due to a large skills and mechanisation gap the production per acre and the quality is on average low. Others – especially in peri-urban areas - have invested in 20-30 high breed cows but only have a small acreage of land and rely almost entirely on purchased feeds and fodders.

For the purpose of this study – which was largely to understand the status and feasibility of commercial mechanized fodder production in Kenya/Uganda - a number of large scale dairy farms were visited which varied in size from 40 to 600 dairy cows, mainly Friesian (Holstein) breeds. Milking is done by hand or in a mechanised milking parlour.
The daily milk production on the large scale farms in Kenya and Uganda varied between 8 litres and 25 litres per day per cow depending on the grazing/feeding system applied, with lowest yields noted in Uganda where most dairy farmers practice a low input-low output type of dairy farming.
During our visits we were told that there are only 12 to 15 dairy farmers in Kenya delivering more than 5,000 litres of milk on a daily base.

3.2 Seasonality

Milk production and productivity are highly influenced by the feeding regime and fluctuate sharply during the year depending on rainfall patterns and – consequently - availability of forage.
Low quality feeds and forages heavily affect productivity per animal and cost price of milk, and seasonality equally affects total production and pricing of milk during the year.

Since milk processors have to deal with huge variations in milk supply, depending mainly on the availability of fodder and water, milk prices are adapted sometimes overnight and frequently without further explanation.
This seasonal fluctuation in milk production both affects dairy farmers and processors and leads to a scenario that is not conducive for long term investments for either of them. Although one of the main obstacles for dairy farmers in planning for investments and growth is uncertainty and variation in milk prices, yet these price fluctuations are largely due to the seasonality in milk supply. With the underlying cause being lack of access to year round quality forages (fresh and preserved).

In addition to the issue of seasonal fluctuation in milk production and availability of forage, the quality of the forages and knowledge of feed rationing are generally low. This in turn leads to a high cost price of milk and low productivity per animal, which reduces the competitiveness of the industry and the growth potential as regards the market-end as the high cost price affects the retail price of milk(-products) and its affordability .

Finally, in Kenya increasingly food safety issues are raised regarding feed and fodders in connection to the presence of mycotoxins (e.g. aflatoxins) in milk and milk products.

Aflatoxins are naturally occurring toxic and carcinogenic mycotoxins that are produced by soil fungi. Aflatoxins can be found in food grains (maize) and also in milk caused by animals fed contaminated feed.

3.3 Importance of feed and fodder

The Mission observed and concludes - and this is confirmed by various other studies - that the key to unlock the huge potential and enhance the competitiveness of the Kenya dairy industry, lies with the improvement of feed and fodder systems. To summarize the above mentioned challenges, inadequate and low quality feeding forms the main reason for:

- Low milk productivity per cow
- Poor health, fertility and reproduction
- High variability in milk supply and consequently in pricing due to seasonality
- High production costs of milk: up to 65% of total costs are related to feeding
- Quality issues around contaminated milk, i.e. mycotoxins.

3.4 Uganda

The Ugandan dairy sector is - compared to the Kenya - less developed, but shows higher growth figures, i.e. 10% per annum. 3% of the GDP of Uganda comes from dairy. Daily milk consumption per capita is around 50 litres but will increase strongly in the near future according to FAO-studies.

Dairy in Uganda is mainly pasture based (free-grazing or in paddocks) and consequently very low in cost of production. The total dairy cattle population of approximately 1.5 million produces around 1 billion litre of milk per year. Unlike the Kenyan genetic base of dairy cows, half of the dairy herd in Uganda is indigenous. Dairy business in Uganda can be characterized by a strong focus on low input-low output. A so-called ‘cattle corridor’ from the North East towards the South West contains 5 milksheds. The highest number of dairy cattle is based in the western part of the country.

Like in Kenya, milk prices vary heavily over the year due to seasonality in rainfall, availability of fodder and production of milk. Recently farm gate prices dropped to Ush 350/litre (US $ 0.14) which is too low even in a low cost dairy sector like Uganda. The retail price for one litre of processed milk

varies from Ush 3,500 (Sameer) to Ush 3,900 (Brookside/Jesa). Fresh unprocessed milk is sold at Ush 1,000 till Ush 1,500 (Kampala) per litre.

Although at a lower level of development, the Ugandan dairy sector faces the same challenges and opportunities as the Kenyan. One of the main differences with the Kenyan situation is that the availability of land in the major milk sheds is higher and land is less expensive. It is mainly used for extensive and low cost grazing.

4. Production and Use of Feed and Forage

4.1 Feeding

The daily feed intake of dairy cows depends on the feeding regime being applied and consists generally of the following products:

a) Fresh grass for grazing: Boma Rhodes and Kikuyu grass. Grass silage is not practised with the exception of a few individual large scale farms.
b) Hay from Boma Rhodes or Kikuyu grass, wild oats and occasionally lucerne.
c) Napier grass, desmodium, lucerne and vegs for cut-and-carry stall feeding and crop residues like maize stovers and banana leaves (sometimes ensiled).
d) Full maize silage and increasingly also forage sorghums for fresh feeding and silage
e) Dairy meal (and/or –in Uganda- concentrates like brans, cakes and brewers' grains).

Feed rations depend on availability and prices and are not managed in relation to the demand and potential of milk production. There is no registration of the feeding process on a daily base.

4.1.1 Grazing systems

a. Zero grazing	no grazing, all year stall-feeding, controlled supply of feed/fodder
b. Semi zero grazing	paddocked grazing during the day, additional feeding during milking
c. Extensive grazing	free grazing on (communal) grasslands, no or limited extra feeding

Zero-grazing

High breed productive dairy cows perform best under a strict, controlled and consistent feeding regime, i.e. zero-grazing. The system of zero grazing can also contribute to reduction of veterinary costs of the dipping- and vaccinations programs (against worms, ticks etcetera). The zero grazing system is, on the other hand, the most expensive feeding regime.
Pure, highly efficient and optimized zero grazing systems as found in more developed dairy industries in Western Europe are rare in Kenya, and can only be found at some of the commercial dairy farms especially those with limited land size in peri-urban environments.

The system of keeping 3-4 dairy cows on the homestead in simple stalls on "zero-grazing" was introduced under the Dutch funded National Dairy Development Programme (1980-95), in the densely populated parts of Central and Eastern Kenya. The farmers who practice it have mixed farming systems with cash crops like coffee and tea, and food crops for home consumption and sale. Dairy is one of the farm activities and not always core business. However, in this part of the country smallholders may be considered as being quite commercially-oriented and many have exotic or crossbreed animals, but on-farm fodder establishment and preservation is usually limited and constrained by the small farm sizes and lack of knowledge.

For feeding the cows, these farmers rely heavily on Napier grass and crop residues from their own farm, complemented by external supply of dairy meals and fodder. As a result commercial fodder supply chains are common for different products like Napier grass, hay and lucerne. In the milk sheds near Nairobi farmers also feed by-products from agro-processing companies like brewer's grain and pineapple pulp (Delmonte in Thika).

Semi zero-grazing

The semi-zero grazing feeding system is a widespread system in all milk sheds and applied by almost by all farmers at different intensity. It varies from smallholders who graze their cows during the day along road sides and on communal lands and keep their dairy cows in a zero grazing unit at night for milking and complementary feeding, to medium and large scale farmers with enclosed pastures.
As for the former, it is a very common system practised by smallholders in the less populated milk sheds in Nyandarua/Kinangop and in North and South Rift. As was explained above, also these smallholder farmers usually have mixed farming systems with dairy being one of them. Fodder establishment usually has to compete with production of food crops. A small percentage of farmers invests in dairy as core business and are at a more advanced stage of fodder establishment and preservation.

As for the medium and large scale farmers with abundant land, most of them graze their cows during the day in enclosed pastures. With access to enough fenced grazing land around the dairy farm this system is, unlike the former zero-grazing system, more cost effective since cows graze during the day and are fed at night and/or in the morning after/during milking with maize silage, hay and concentrates. Part of the available farm land in this system is used for fodder production: mainly fodder maize and Boma Rhodes hay. This system is mostly applied by the medium and large scale dairy farms in Nyandarua, Nakuru and North Rift, but has potential for significant improvement e.g. in regard to pasture management and silage practices. With respect to grazing there is very little knowledge and experience on grassland management in general and paddock management in particular.

Some large scale dairy farms combine several systems. At Technology Farm (Nakuru) for example two systems are in place:
a). extensive (or 100%) and paddocked grazing (around 200 dairy cows) with mobile milking parlours
b). semi-zero-grazing (1 group of 80 dairy cows).
Daily milk production in the first group is more than 30% lower compared to the semi-zero-grazers: 15 litres per day against 25 litres per day.

Extensive or free grazing

Extensive or free grazing is the common system for subsistence smallholder farmers who have access to large tracks of communal land and have not commercialized dairy farming. Grazing is done on communal land and sideways of roads. These smallholders are largely subsistence farmers or so-called cattle keepers mainly concerned with food security at the household level. The skills level is lowest in this group of farmers who usually do not grow and preserve fodders or buy dairy meals, but rely solely on rain fed grazing and crop residues for feeding their cattle.

4.1.2 Fodder supply chains

The majority of the medium- and large scale dairy farms with ample land use part of their land for the cultivation of crops like maize and grass to be harvested for silage and hay making. Hay and maize silage are the main fodder products preserved by this segment of dairy farmers. This is complemented by dairy meals or concentrates which are often mixed on-farm by the larger dairy farmers. Although a limited number of dairy farmers did start commercial fodder production and supply to the market – i.e. grass hay and lucerne bales - the majority of forage being harvested by these farms is for own use.

Both hay and maize silage production have room for significant improvement and optimization if management and mechanisation is enhanced. Grass silage is largely unknown.

There is also scope for improved fodder seed varieties, but even with the current varieties that are in the market, large improvements can be made in total kgs of dry matter harvested per acre, protein content and digestibility, if fertilized and harvested in time.

Commercialisation of hay as a commodity by private hay producers and by dairy societies on leased land is a fast growing business activity in Kenya. Most of the farmers buy roughage at any one time in the year (they are feed deficient). One of the leading sellers of hay in Eldoret for example sells an average of 600,000 15 kg-bales of hay per year at an average price of KSH 200 per bale (the poor quality notwithstanding), yet he never meets the market demand. This translates to an average price of KSH 13/kg. For the farmer to meet nutritional needs of his cows with low quality hay rather than more nutritious fodders like ensiled or fresh maize and grass, he has to spend more on concentrates (which average KSH 32/kg).

These commercial grass hay producers sell either directly to individual farmers, or they sell to dairy societies that collect, bulk and sell milk for their members. In addition to that these societies buy veterinary drugs, manufactured feeds and increasingly also hay and lucerne in bulk to be resold to their members. Often this is done in a so-called check-off system, whereby the feeds or fodders are sold on credit and get repaid through the delivery of milk. The number of dairy societies that have more than 500 members is estimated to be over 100 and the largest 20 have 2,000 active members or more (Githunguri near Nairobi has for example 7-8,000 active members).

As regards to production skills, quality and logistics, the outlook of commercial hay production is still at its infancy. Quality of hay is on average poor as it is low in protein and high in non-digestible fibres, whilst size and weight of the bales are not standardized and logistics and storage need improvement.

Some farmers or traders have engaged in selling maize silage but with a low dry matter and starch content, poor conservation practices and consequently low nutritional value.
A large scale farmer who abandoned dairy farming (Kruger Farm near Eldoret) to focus fully on its arable farming and maize drying business, sells its maize silage (with low starch content) at Ksh 3.60 per kg (farm gate price) loaded on pickups even to customers coming all the way from Nairobi.
Another farmer/trader in Nakuru sells poor quality loose silage maize in hand filled (not air tied) plastic bags at Ksh 10 per kg! His market consists of largely peri-urban farmers in Nakuru and Nairobi where milk prices are high.
A large scale dairy farmer near Nakuru is in the process of setting up a professional packaging line for sales of 25 kg sealed maize silage brickets. This project is co-funded by KMDP's Innovation Fund but is yet to take off (equipment has been ordered). The business plan works with a sales price of the packed maize silage of Ksh 10 per kg ex-works.

Lucerne is commercially produced under pivot irrigation and distributed by a number of specialized companies in Naivasha (for example Marula Farm, Morendat Farm and Delamere Farm). The market largely consists of medium and large scale dairy farmers, and some dairy societies. The demand for lucerne has surpassed the supply and at least one of these farms is planning for a significant expansion.

By-products from agro processing companies commonly traded in Kenya are brewer's waste or spend grain and brewer's yeast from the major breweries (all located in Nairobi), pineapple pulp (Delmonte in Thika) and in smaller quantities vegetable waste from "pre-cut and pre-packed" vegetables for export to European supermarkets. Prices of these by-products are low as compared to their nutritional value and important improvements can (and need) to be made in connection to valorisation, handling and storage (mycotoxins).

On the demand side, it can be noted that there is a large demand for forages by progressive smallholders and medium scale dairy farmers (10-30 cows). These farmers are engaged in commercial dairy production but are usually unable to grow and preserve sufficient quantities on-farm, due to lack of land size, skills and/or capital for mechanisation. This is especially the case in the high density milk sheds in Central Kenya and the peri-urban areas around the other main towns across the country, where dairy farming is lucrative due to closeness to the market. Here farm gate milk prices vary between Ksh 35 and 45 per litre respectively if sold to processors or hawkers who sell raw milk to end-consumers.

It is also worth noting that many large scale farmers with abundant land who grow and preserve fodder on-farm, lack the skills and machinery to optimize fodder production. This results in many losses in the trajectory from seed-to-feed, which for example for maize silaging includes the following steps: land preparation-planting/fertilization-cultivation-harvesting-chopping and crushing -ensiling-feeding. The same however applies to the chain of production of hay (see also par. 4.2 below). In addition – and this was noted above - grass silage is not practised at all in Kenya and yet it is richer in protein, is more palatable as hay and easier to manage in terms of drying period.

In general commercial fodder production is growing – and it has potential to grow further with enhanced management skills and proper mechanisation. The demand for forages is high due to a commercialising and growing dairy sector in Kenya, but also due to the high costs of dairy meals and raw materials/feed ingredients imported from neighbouring countries. Sales prices of preserved forages are equally high, especially if taking into account the generally low quality of the products.

For a more detailed overview of the trends in the Kenya forage sub-sector reference is made to the SNV/BLGG study that was conducted during KMDP's Inception Phase.

The figure below gives an overview of the actual market prices for fodders in Kenya.

Trading prices for commercial fodders (excl. VAT)					
Hay (square bales of 16-20kg)	80% DM	per bale	ex-works	Ksh	220.00
Maize silage	30% DM	per kg	ex-works	Ksh	3.60-10.0
Lucerne	85% DM	per bale	ex-works	Ksh	352.80

Figure 4.1 Fodder trading prices in Kenya

4.1.3 Dairy meal

Dairy meal and concentrates are only used in zero-grazing and semi zero-grazing systems. During all visits and interviews we learned that the dairy meal produced by commercial feed companies was expensive and inconsistent. The Kenyan feed industry highly depends on imports of by-products from neighbouring countries such as cotton seed cake, sunflower cake and fish meal. Soy is mainly imported from India and other soy producing countries, yellow maize is banned.

As for the price of feeds, in 2013 a new VAT Bill was enacted which put a 16% VAT on manufactured feeds (and forages) that were up to then zero rated. Currently Government is considering redressing this due to the effect on the consumer price of milk and other basic food from animal origin.

Lack of trust in feed quality combined with high prices make that many larger farmers make their own dairy meal. The main ingredients for this 'farm-made' dairy meal are:

a) Maize meal
b) Cotton seed cake
c) Sunflower cake
d) Wheat and maize bran
e) Fish meal
f) Lime and mineral concentrates

The SNV/BLGG-study on nutritional value of animal feeds (September 2013) showed that 35% of the dairy meals that were analyzed did not meet the KEBS-standard on crude protein, being its main component. Levels of crude ash found were above the KEBS standard in almost all samples.

By grinding dairy meal on the dairy farm (usually 1 ton at a time, enough for 1 or 2 weeks for a medium scale dairy farm of 20-40 dairy cattle), the price of a bag of 70 kgs amounts approximately Ksh 1,700. Sales prices of manufactured dairy meal are between Ksh 2,200 (for ordinary dairy meal) to Ksh 2,600 (for high yield dairy meal). The daily ration of dairy meal varies between 4 and 6 kgs per cow during milking.
One of the leading feed companies Unga Feeds Ltd recommends 1 kg of its high yield dairy meal (Maximilk) for 2.5 litres of daily milk production.

4.1.4 Uganda

The feeding/grazing system in Uganda is basically a pastoral system, with cattle grazing on coarse pasture and sometimes planted and fenced pastures, throughout the year. Some commercial dairy farms supplement the daily feed ration with dairy meal and silage (maize/Napier grass). A limited number of large scale dairy farmers practices the fenced semi zero-grazing regime.

In this system that is dominated by pastoral grazing, Jesa Dairy Farm (north of Kampala) is one of the very few dairy farms feeding a Total Mixed Ration in a zero-grazing system. Generally land used for grazing is not suitable for mechanised planting and harvesting.

Contrary to Kenya, mechanised fodder production and formal trade in forages do not - or hardly - exist in Uganda. The occasional forage traded between dairy farmers is mainly locally and pricing depends on local circumstances.

Indication of trading prices for commercial fodders and feed in Uganda					
Hay (in square bales)	80% DM	per bale (16kg)	Delivered	Ush	15,000.00
Maize silage	30% DM	per bag (40kg)	Ex-works	Ush	25,000.00
Napier grass	85% DM	per MT	uncut in field	Ush	20,000.00
Brewers grain		per MT	Delivered	Ush	190,000.00
Maize bran		per MT	Delivered	Ush	400,000.00
Banana Peals		per bag (40kg)	Delivered	Ush	10,000.00
Dairy Meal		per kg	Ex-works	Ush	1,250.00

Figure 4.2 Indicative prices for fodder and feed in Uganda

Silaging is done manually in Uganda, except for some large scale dairy farms like Jesa. Occasionally maize plants (often without cobs) are chopped with stationary semi-automatic equipment and put into polyethylene bags for preservation. Also Napier grass, sometimes mixed with legumes, is preserved in silage pits. A typical Ugandan low cost by-product from the staple food 'matoke' (plaintain) fed to cattle is banana peels.
In an urbanised area like Kampala and its suburbs, smallholders graze their cow(s) on sideways and roundabouts and sometimes buy bunches of fresh cut grass for Ush 4,000/bunch.


Maize silage: no starch..


Extensive grazing


Legumes


Banana peals

Next to the above mentioned forages also by-products from food processing industries, like brewers' grain and maize bran, are used for feeding dairy cows, but only at business-oriented medium and large scale farms.

4.2 Main fodder crops

4.2.1 Maize and fodder sorghum

Maize is Kenya's staple food and therefore competes with maize silage for animal feed. Ensiling maize (and to a lesser extent sorghum) for animal fodder is commonly practised by medium and large scale dairy farmers, but only a small percentage of smallholders have adopted this technology. Most smallholders only feed the maize stovers to their cows, but this is changing rapidly as many smallholders have seen the benefits of ensiling the entire maize plant (including the cob).

Medium and large scale farmers use tractor-driven forage harvesters. Only very few farmers have crushers that can crush the maize seeds and therefore common practice is to harvest the maize at milky stage. This gives a high sugar but low starch content.

Increasingly, progressive smallholders are also using part of their maize crop for silage but chopping is done by hand or semi mechanised. Silage is done in plastic tubes or in pits. Under KMDP smallholder dairy farmers are trained on the advantages and the techniques of ensiling maize. In doing so KMDP makes use of SPEN - a local company of private extension workers that works directly with farmers and also makes silage on-farm at a fee.

Yellow maize is banned in Kenya and certified yellow maize seed is not available. Yet some individuals and farms have brought in yellow maize seed into the country but the source is non-traceable and not transparent. In 2013 Kenya experienced a relatively new maize disease called Maize Lethal Necrosis (MLN). It is spread by insects and is threatening the Kenyan maize industry. However, recently new maize varieties have been released by KEPHIS which are resistant or have a high resistance level to MLN.

Maize is preserved and compressed in silage pits with molasses added for improved conservation and covered with polyethylene. A soil cover is usually applied for compression and protection. The maize silages we saw were of reasonable quality at first sight (temperature, odour). However the farms we visited were amongst some of the top-farms in Kenya and not typical for the average situation amongst the medium and large scale dairy farmers.
BLGG Research showed that on average starch content and energy value of examined maize silage were below expected and recommended values. This was also confirmed by PUM experts who visited a good number of farms across the country and inspected many silages.


Many plants are missing…


Maize silage pit


Low capacity per hour

Crop protection with herbicides and pesticides is done with a boom sprayer, usually once.
Maize is planted mostly with 3- and 4-row planters. Seedbed preparation –after ploughing- is executed with disk harrows. Per hectare 65 till 70 thousand seeds are planted, which corresponds to roughly 25 kg of seed per hectare. Per acre approximately 75-100 kg of fertilizer (DAP/NPK) is used.

Harvesting is done with a tractor-pulled one- or two row forage harvester and one tractor+tipper for transport to the silage pit and compressing. Due to the very low capacity and sometimes bad drainage (after rains) it takes weeks before a maize silage pit - containing around 30 acres of maize - can be covered. This implies that the first losses due to overheating already have occurred. Maize is harvested when the plant/cob dry matter content is around 30%.

Total production costs for 1 ton of maize is between Ksh 2,600 and Ksh 3,300 depending on yield and machine pricing (including lease of land). Prices are based on actual market prices as used by agricultural service providers. Costs of own mechanisation are usually higher.

Cost price calculation Maize Silage			costs/acre
Land Lease		Ksh	10,000.00
Soil preparation	Drainage	Ksh	0.00
	Ploughing	Ksh	3,000.00
	Seedbed preparation	Ksh	2,000.00
Planting		Ksh	1,500.00
Seeds		Ksh	1,500.00
Fertilizers		Ksh	3,000.00
Crop protection	Spraying	Ksh	1,000.00
	Herbicides	Ksh	1,750.00
Harvesting	Silage harvester	Ksh	10,000.00
	Transport	Ksh	1,750.00
	Compressing	Ksh	750.00
Silage Covering		Ksh	25.00
Total costs per acre		**Ksh**	**3,500.00**
Cost price per kg	**12,500 kg per acre**	**Ksh**	**2.84**

Figure 4.3 Cost price calculation maize silage

4.2.2 Grasses

The other important forage is grass, mainly Napier grass and Boma Rhodes or Kikuyu grass.
Napier grass is grown mostly in the Central and Eastern provinces by smallholder dairy farmers who practice (semi) zero-grazing. It is cut and chopped manually and fed fresh and also traded between smallholders. Some farmers also ensile napier grass, usually together with maize stovers.

Rhodes and Kikuyu grasses are mostly used for free grazing and hay making. These grasses (as is the case with Napier grass) can be characterized as fibrous and low in crude protein. BLGG's analysis of several grasses in 2013 confirms this. Although this is partly due to the genetic profile of these grasses (and especially the local varieties available in Kenya), it also results from the fact that no fertilizer is applied.
Pastures are fenced and used for controlled grazing and hay making. Pasture management in terms of weeding, fertilization and optimum rotation is unknown in Kenya. As is grass silage.

Grass is preserved only as hay; on medium and large scale farms it is cut with disc- or drummowers. A limited number of large scale farmers have equipment for this and usually cutting, racking and baling is outsourced to an agricultural contractor.

Hay mowing and baling by agricultural contractors is usually done in a fixed contract pricing system, whereby the contractor is only prepared to start mowing when the grass is at maximum length rather than the recommended < 10% flowering stage, in order to have as much bales as possible per acre. Because of this practice grasslands which are fully used for hay baling are mowed only twice a year. As a consequence nutritional value is low due to the high fibre and low protein content.
The contracting for hay making is priced as indicated below:

Contracting prices for hay making			
Grass cutting			
Recking			
Square baling	around 16-20 kg		
Total costs per bale		**Ksh**	**60.00**
Cost price per kg		**Ksh**	**3.75**

Figure 4.4 Prices for hay making (excluding bale handling)

4.2.3 Lucerne

Lucerne is grown by a limited number of specialized companies mainly in Naivasha that has favourable soils and climate for this crop. Lucerne is a typical commercial fodder crop with a high content of crude protein (17-20%/kg DM). Commercial lucerne production requires a hot and dry climate, pivot irrigation, levelled terrain, a minimum soil-pH of 6, good drainage systems for water discharge and mechanised harvesting, racking and baling.

The advantage of a legume like lucerne is that it extracts nitrogen from the air and consequently doesn't need fertilizers. It is very positive for soil fertility since the rooting system of the plant stimulates the organic matter content and nitrogen level of the top layer of the soil. It is for this reason an interesting crop to rotate cultivation with crops like maize or wheat.

In the Naivasha region an average of 8 or 9 cuts per year is reached. Cutting is done by tractor with disc-mower. After on-field drying of approximately 2 days the lucerne is raked (with a minimum loss of leaves) and compressed in square bales. The lucerne hay is then stored and sold. Lucerne is fed as part of the Total Mixed Ration, usually 4-5 kgs per cow/day.

The sales price for lucerne hay bales is Ksh 420.00 per bale (inclusive 16% VAT) or Ksh 352.80 per bale (excluding VAT). Below is indicated how the average yield per hectare (ha) can be calculated for lucerne hay. Revenues are estimated at Ksh 282,240 per ha per year, based on an annual production of 100 small square bales per ha/per cut, with a weight of 18-20 kg per bale (85% DM). With 8 cuts per year the total DM yield per ha would be around 11,500 – 13,500 kg. At this price and number of cuts per year lucerne is a profitable commercial crop.

The BLGG study showed that the nutritional value of the examined samples was high, due to good scores – next to the high protein content - on digestibility and net energy. However visual inspection revealed that the bales did not have a good stem/leaf ratio and it is therefore assumed that much can be improved in harvesting techniques, and subsequently quality of the bale.

Lucerne is the most expensive fodder crop and probably for this reason fed by only a limited number of business-oriented dairy farmers.


Mowing of lucerne


Pivot irrigation


Baling and transport


Raking machine

Cost price calculation for commercial lucerne hay production			**price/ha**
Land Lease		Ksh	15,000.00
Soil preparation	Drainage (10 yrs)	Ksh	11,400.00
	Ploughing	Ksh	750.00
	Seedbed preparation	Ksh	1,000.00
Planting		Ksh	1,000.00
Seeds		Ksh	13,200.00
Irrigation	Diesel	Ksh	35,000.00
	Pivot/borehole (20 yrs)	Ksh	27,800.00
Crop protection	Spraying	Ksh	750.00
	Herbicides	Ksh	850.00
Harvest	800 bales/ha	Ksh	96,000.00
Bale handling		Ksh	3,500.00
Total costs per ha		**Ksh**	**206,250.00**
Cost price per kg **15,000**	**kg per ha**	**Ksh**	**13.75**

Figure 4.5 Cost price calculation for commercial lucerne hay bale production

4.3 Mechanisation

Many medium- and large scale farmers are required to invest themselves in equipment for maize planting and harvesting, since service providers like agricultural contractors are scarce in Kenya. These agricultural contractors usually offer their machinery services to a limited number of clients, within a servicing distance of around 25 km. They only offer a limited number of mechanised services; for example some only do hay baling. In general mechanisation in fodder crop production in the dairy sector is targeted at:

a. Ploughing, harrowing and planting
b. Mowing, raking and baling (small square bales)
c. Crop protection with boomsprayers
d. Harvest with forage harvesters (1 or 2 row)
e. Transport

For smallholders and medium scale dairy farmers the agricultural service provider can be an important partner in optimizing costs of cultivation and maximizing yield per acre.
The figure below gives an indication of current prices for agricultural contracting services in Kenya:

Mechanised Agricultural Service Centre Nundoroto-Eldoret		
No of customers	150	
Agricultural land per customer (average)	10	acres
Size of land of its biggest agricultural customer	50	acres
No of tractors	6	
No of employees	15	
Prices machine services		
Diskploughing	3,000	Ksh/acre
Harrowing (seedbed preparation)	2,000	Ksh/acre
Planting (maize)	1,500	Ksh/acre
Boomspraying	1,000	Ksh/acre
Forage harvesting (maize)	12,500	Ksh/acre

Figure 4.6 Size and prices of an agricultural contractor in Eldoret

4.4 Inputs: seeds, fertilizers and herbicides

Inputs for fodder crops can be purchased through local companies and agents/distributors of international input suppliers (fertilizers, herbicides, seeds, machinery etc.). As regards seeds, Kenya is lagging behind in research and availability of high energy and protein rich fodder seed varieties for various agro-ecological zones. Examples are non-availability of certified yellow maize seed, rye grasses and new varieties of lucerne and fodder sorghums. Even improved varieties of Boma Rhodes grass from e.g. South Africa and Australia are not available in Kenya.

New seed varieties have to be certified and registered by KEPHIS (The Kenyan Plant Health Inspectorate Service). Both national and foreign seed companies import and multiply seed in Kenya. The focus of these companies has been on food crops. However there is a growing attention and interest for the market of fodder seeds (e.g. by PANNAR Seeds South Africa and DFL). Yet new – for Kenya very promising - varieties of lucerne, rye grasses, fodder sorghums and also (yellow) maize have yet to be registered and undergo National Performance Trials. KEPHIS has however a window for using new seed varieties on-farm and for own-use (no seed multiplication and distribution is allowed) and this may offer an opportunity to trial new seed varieties on larger scale.

Most artificial fertilizers are imported into Kenya and distribution and sales is largely controlled by five government-linked companies. Registration is done by KEPHIS. Fertilizers are widely used in Kenya, mainly for maize and wheat, and subsidized by government (see pricing in figure 4.7). Unfortunately composition and use are not customized to the fertility and nutrient balance of the (top-) soil, which is generally low in organic matter and Ph (4.5-5.5).

The issue of healthy and productive soils has become a major issue in large parts of Kenya including the major milk sheds of North Rift and Nyandarua. Year after year production of maize without rotation and mulching of the soils have contributed to this situation. The issue is less critical in those milk sheds in Central and Eastern that have rich volcanic soils.

Soil testing/analysis and enhanced knowledge of the nutrient balance and level of organic matter in the top layer of the soil, are key to improve productivity in both feed and fodder crop production.

The SoilCares initiative (funded by the Dutch Government under the FDOV Facility) deploys mobile soil testing labs with Mid-Infrared technology giving almost real-time fertilisation advice. This will help farmers to make better decisions on use of fertilizers, enriching the soil's organic matter and Ph (e.g. through application of lime, manure, compost, mulching), cultivation practices and production plans. The availability and use/application of manure is another important area of concern and is negatively affected by the free grazing and semi-zero grazing systems in use.

Kenya does not have professional and reliable feed testing facilities in the country. The same SoilCares FDOV project however has budgeted for an internationally certified and accredited NIR-feed laboratory that will be linked to BLGG AgroXpertus feed and fodder data base.

Weeding is sometimes done manually on smaller plots of land. However the medium and large scale farmers generally use boomsprayers for weeding and crop protection. A number of certified and registered herbicides and pesticides are distributed by local input suppliers.

Specification and prices of inputs for fodder crops						
Seeds for grasses and lucerne						
Boma Rhodes Grass		3	kg/acre	Ksh	1,000.00	per kg
Columbus Grass		5	kg/acre	Ksh	120.00	per kg
Sudan Grass		5	kg/acre	Ksh	150.00	per kg
Lucerne (aurolla, trificca)		10	kg/acre	Ksh	1,500.00	per kg
Seeds for maize						
Kenya Seed Company		10	kg/acre	Ksh	150.00	per kg
Pioneer		10	kg/acre	Ksh	165.00	per kg
Pannar		10	kg/acre	Ksh	148.00	per kg
Fertilizers						
Can/Urea	subsidized	75-100	kg/acre (maize)	Ksh	1,500.00	per 50kg
Can/Urea	commercial			Ksh	2,600.00	per 50kg
DAP	subsidized	75-100	kg/acre (maize)	Ksh	2,000.00	per 50kg
DAP	Commercial			Ksh	3,100.00	per 50kg
23/23	Subsidized			Ksh	2,000.00	per 50kg
23/23	commercial			Ksh	3,100.00	per 50kg
17/17	subsidized			Ksh	2,000.00	per 50kg
17/17	commercial			Ksh	3,100.00	per 50kg
Herbicides	**pre/post seeding**					
Lumax	pre + post	1.5	ltr/acre	Ksh	8,500.00	per 5 ltr
Primagram	pre + post	1	ltr/acre	Ksh	7,500.00	per 5 ltr
Buctril	post (grass fodder)	1	ltr/acre	Ksh	1,000.00	per ltr
2.4D	pre	1	ltr/acre	Ksh	1,000.00	per ltr
Guardian Max/Senior	pre	1	ltr/acre	Ksh	7,800.00	per 5 ltr
Sigma Combi	post	1.25	ltr/acre	Ksh	5,000.00	per 5 ltr
Auxo	post			Ksh	5,500.00	per 5 ltr

Figure 4.7 Inputs for fodder crops

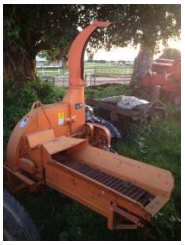
4.5 Uganda

Cultivation of fodder crops for dairy cattle in Uganda is in its very infancy stage. Business-oriented dairy farmers grow and harvest - often manually – Napier grass and legumes like desmodium and lablab. Some large scale farmers make hay and are partially mechanised, but generally silage or hay making is just at an early non-mechanised development stage in Uganda.

An exception to this general state of affairs is Jesa Dairy Farm. At this farm maize silaging is being done with a tractor pulled forage harvester. Jesa Farm also intends to start practising grass silage (Boma Rhodes grass).

In typical milk sheds like the south-western Mbarara-region mechanisation of fodder crop production is very limited. All preserved fodders like legumes, Napier grass, maize and hay are ensiled and/or baled and stored manually. Since land is mainly used for grazing, trees and bushes are obstacles for mechanised fodder crop production. Specifically for the production of a high potential crop like maize, mechanized planting and harvesting is required for acceptable yields.

Consequently the use of inputs like seeds and fertilizers (high priced in Uganda) is very limited. The ISSD seed programme, in which Wageningen-UR participates and cooperates with local seed authorities like NASECCO, focuses – amongst other seeds - also on multiplication of high yielding pasture and fodder grasses. Contrary to Kenya manure is used as organic fertilizer as much as possible. A large number of medium/large scale dairy farmers have installed biogas installations for the production of biogas and electricity by fermenting manure. Cow manure (dried) in Uganda has a market price of around Ush 75,000/Mton.


Maize chopper


Manual planting -> low yields


Manual silage making


Silage pit

4.6 General observations

For Kenya (KE) the following observations are made:

KE.1 Feeding is often based on what is available rather than on what the cow needs.

KE.2 No registration of fodder intake, total DM intake and feeding rations per cow/per day.

KE.3 No registration and calculation of feeding costs per cow or per kg of milk.

KE.4 The crude protein content of fodders is low (except for lucerne).

KE.5 Probably > 70% of dairy cows are kept in free-grazing or in semi-zero grazing systems.

KE.6 Fodder production/preservation skills (planning/management) on most dairy farms are poor.

KE.7 The production potential of Boma Rhodes and Kikuyu grass (CP-content per cut, DM/acre) is underutilised. This is due to the prevailing lack of fertilization and the mowing and baling regime (maximum 2 cuts per year).

KE.8 Pasture management is poor and grass silage is not known and practised.

KE.9 The increased use of maize for silage may interfere with the fact that maize is the national staple food. Yellow maize seed varieties are not likely to be released in Kenya.

KE.10 Yields of maize per acre are low (poor seedbed preparation, planting and low cost inputs).

KE.11 Losses in maize silage (quantity and quality) are high, due to low harvest capacity per day, early harvesting (milky stage), inadequate conservation techniques/skills, low feeding speed and often sub-standard design of the silage pit.

KE.12 Drainage of maize fields is poor which adversely affects timing and planning of harvesting.

KE.13 There are no or few data available on soil fertility; the use of blended or customized fertilizers is not practised much, and the same applies to compost and manure to enhance soil health and organic matter content.

KE.14 No systematic and periodical crop rotation practised by most farmers.

KE.15 No infrastructure of professional agricultural farm machinery contracting services and -in addition to that – for operation and maintenance of farm machinery.

KE.16 Limited access to - and availability of – quality commercial fodders, yet this sub-sector is fast growing especially in regard to supply of hay and lucerne.

KE.17 Commercial fodders are high priced in relation to quality/nutritive value.

KE.18 Sub-standard quality and high variability of manufactured feeds and feed ingredients/raw materials.

KE.19 Lack of traceability of feed ingredients (no GMP systems in place).

KE.20 No systems in place for analysing manufactured feeds and forages like hay and maize silage; no acceptable laboratory facilities present in the country.

For **Uganda** (UG) most of the above mentioned observations also apply, except for the maize crops. Other observations specifically for Uganda are:

UG.1 Mainly pastoral use of (grass-)land in the dairy sector and not suitable for mechanised cultivation of (fodder) crops without uprooting trees and bushes.

UG.2 No or very limited use of (expensive) chemical fertilizers.

UG.3 Very low level of mechanisation.

UG.4 High focus on the low cost input - low output (grazing) system.

UG.5 No trading structure for commercial fodders.

UG.6 Limited use of concentrates, like brans, cakes and brewers' grains.

4.7 Recommendations

R.1 Define Total Mix Rations for optimal management and control of daily DM-intake per cow.

R.2 Increase the availability of high protein fodders like grasses (silage) and lucerne.

R.3 Introduce new fodder crop seed varieties with higher production per acre, protein content and resistance.

R.4 Improve the cultivation and silaging of maize: more plants per ha, minimize harvesting time and losses by professional seedbed preparation, planting and high capacity harvesting including crushers. Reduce loss of feeding value and palatability by improving storage and preservation.

R.5 Improve pasture management. With proper fertilization and timely mowing (4x per year instead of 2x) dry matter production of grassland can be easily increased from 8 tons DM/year to 12 tons DM/year. Fertilisation and timely harvesting will dramatically increase crude protein content of grass per kg/DM.

R.6 Reduce emphasis on maize as feedstock by introducing alternative energy rich silage crops (for example fodder sorghums) to stay away from any potential food-feed discussion.

R.7 Through best practice management: improve the quality and the productivity per acre of forages. This will reduce the cost price of forages and consequently also the sales price.

R.8 Introduce fodder production & feed purchase plans based on yearly fodder/feed consumption (per farm or per group of farmers/region).

R.9 Improve traceability and quality awareness in use of feed ingredients and production of fodder. For example through record keeping, tracking & tracing and SOPs for frequent laboratory analysis of feed and fodder samples.

R.10 Analyse soils and improve soil fertility through crop rotation, enhanced practices for land preparation (stop disc ploughing, introduce mulching), and optimal use of manure, organic matter and fertilizer. With a fertile and healthy soil, crops will be less sensitive to diseases and mycotoxins and productivity per acre will increase.

R.11 Improve the drainage and water discharge of land.

R.12 Stimulate mechanised service providers to offer a range of high quality machine and consulting services targeting fodder crops and silaging.

R.13 Introduce a ready-to-use and TMR package specifically for smallholders and medium sized dairy farmers.

To address the observations and recommendations referred to above, there is need for the development of a strong commercially driven “service infrastructure” for the dairy value chain. In particular this should be directed towards supporting the establishment and management of best practice mechanised fodder production, preservation, and – in case of commercial fodder supply chains – marketing, logistics and distribution.

For efficient, cost effective and high quality fodder production several factors have to be in place and need to work together. This involves healthy soils, certified seeds, farm inputs, farm machinery, storage and - most of all – know-how and management skills.

In a maturing dairy sector, the professional production, supply and use of fodder (and feed) is provided by specialized knowledge and service providers with adequate machinery and management skills. For example in the Netherlands a dense infrastructure of agricultural contracting companies exists, in addition to feed and fodder companies, machinery suppliers and mechanisation repair services, soil and feed labs, and so on and so forth.

In developing dairy environments like in Kenya and Uganda, this network of specialised and well-equipped service providers is lacking. To fill this gap a number of these services could be combined in a Fodder Supply and Service Centre. This concept will be explained and explored in the next chapter.

5. The Fodder Production and Service Centre

5.1 The concept

The concept of a Fodder Production and Service Centre (FPSC) is based on the assumption that a specialised large-scale fully mechanised fodder production and supply centre, which is managed professionally with the right skills/know-how and with proper farm machinery, can yield important economies of scale in fodder supply.
By outsourcing fodder production dairy farmers can focus on farm management and milk production. The scope of services provided by such a centre will vary according to the availability of land, the level of professional mechanised services offered and the market to be served, both in size (number of farmers) and composition (smallholders or medium/large scale farmers).

The main objective of the FPSC is to improve the regional availability of more and better feed and forage for dairy farmers. This is done through professional and controlled cultivation, harvesting, handling and storage of forages - in central and/or farm-based silage storages - and the supply of ready-to-use quality fodder (mixed, in bulk or packaged) to dairy farmers, when needed, in the required volumes and at a reasonable price. In addition to that the FPSC can provide agricultural contracting services at commercial rates to farmers who have sufficient land and want to establish and preserve their own fodder on-farm. The concept is explained in more detail below.

5.2 The services and the business model

As suggested in the previous chapter, in a fragmented emerging dairy sector like in Kenya or Uganda, knowledge and capital for optimum on-farm forage production is often lacking, whilst most service providers needed for optimum production are still in their infancy stage or even absent (e.g. agricultural contractors, feed and soil testing labs).
A professionally managed FPSC could combine production, distribution, training and service provision in one company to assure optimal yields, product quality and (quality) assurance of forages. The following services can be offered by the company:

a. Production and harvesting of high energy/high protein crops
b. Storage/conservation of own and/or purchased crops in silos at a central location
c. Supply of ready-to-use fodder in bulk or baled/packed (i.e. maize silage, grass silage, lucerne, hay) to dairy farms
d. Sourcing, purchasing, storage of quality assured feed-ingredients
e. Preparation, packaging and distribution of (Total) Mixed Rations
f. Agricultural machinery contracting services to dairy farmers, for:
    i. Soil improvement and seedbed preparation
    ii. Crop protection
    iii. Harvesting
    iv. Storage and transport
g. Advisory and analytical services for soil and feed/fodder management

(a) to (e) are business activities that are related to quality-controlled fodder production, packaging and distribution by the centre itself, possibly complemented by nearby farmers growing maize/grass for the FPSC on contract. The sustainability of the packaged product is hinged on dairy farmers who cannot produce enough feed/roughage at their own farms due to shortage of land for fodder production, and larger farmers who lack the machinery or skills to produce quality preserved fodders or wish to purchase fodders for other reasons (e.g. seasonal shortages).

Business activities (f and g) target those larger scale farms that have the potential to produce adequate and quality feeds in their farms if they can access the appropriate technical know-how and machinery. Activity (g) will be accessible both for own fodder production and can be accessed at commercial rates by client farmers.

By combining these services in one business entity effective and efficient use of labour, know-how, skills and machinery can be achieved and economies of scale can be maximized.

The fodder - mainly maize and grass - being produced by the FPSC (a-e) is meant to cushion and boost the business of dairy farmers in case of low supply respectively low quality of fodders.
The focus shall be to develop a maize/grass silage-based (T)MR product of high nutritive value and of GMP-quality (traceability) on a (initially) 500 acres leased farm.
If the initially targeted 500 acres own production of the FPSC shall not be sufficient to meet the demand, farmers can be contracted to produce maize (and/or grass) whilst the FPSC shall undertake the harvesting, ensiling, packaging and marketing. In such a contract farming scheme the FPSC will also provide advice for best practice production practices and access to inputs (seeds, fertilizers, pesticides, etc.) and farm machinery or mechanisation services.
Next to enhanced quality and traceability of feeds/forages, this shall be one way of mitigating risks of crop failure due to issues of poor weather, disease, pests, theft etc.

Growing maize on contract for the FPSC can compete with maize production for the millers. At the moment farmers make a gross income of about KSH 60,000 per acre from cereal maize. The same maize can translate to 20 Mt of silage and sold at KSH 4 per kg this translates in KSH 80,000 gross income. The farmers to be contracted in a region like Eldoret could be sourced from for example EDFA. The FPSC's role in this case shall be to facilitate knowledge transfer to the farmers, enter into contractual obligation with the farmers, and where necessary facilitate access to farm in-puts including machinery.




5.3 The location and region

The company should be located in one of the main milk producing areas of Kenya (or Uganda), like for example Eldoret or Nakuru. Main requirements to be met in this respect are:

a) Availability of fertile land suitable for mechanised cultivation and harvesting
b) Possibility to lease land for medium/long term
c) Conducive agro ecological/climatic conditions for main fodder crops (sufficient rainfall and good access to surface or ground water for irrigation)
d) Regional presence of smallholder, medium and large scale dairy farmers (market)
e) Proximity of dealers/importers of agricultural machinery for service/spare part backup
f) Commercial management but cooperative culture/atmosphere
g) Reasonable road infrastructure
h) Skilled and knowledgeable management (managerial, technical, financial)

5.4 The configuration

The company should be characterized as a "pilot project" for proof-of-concept purposes. Based on the situational analysis by the Mission Team, for this pilot the following investments are considered:

5.4.1 Land

Approximately 500 acres of fertile land is needed. Land can be leased on a renewable lease starting with a period of 3-5 years for Ksh 8,000 – 10,000/ acre per year and is available in regions like Eldoret, Kitale, Nakuru and Naivasha. This land has to be prepared for mechanised operations (drainage, accessibility, etc.). Soil analysis is needed to decide on use of fertilizers and soil improvers (manure, lime etc.). The arable land will initially be used for the production of maize crops and for different grasses, but in future also for other fodder varieties if suitable and commercially interesting (i.e. fodder sorghum, lucern, lupines).

Access to water is expected to be a key determinant in decision making regarding the exact location of the farm. For crops like lucerne irrigation is indispensable. But also for maize and grass simple hose irrigation would be essential in case of prolonged dry periods. Apart from proximity to surface water (river/stream), water harvesting by means of boreholes or water collection points has to be considered. In the proposed budget only one hose irrigation system has been included. Investments in water harvesting and collection should be specified, if necessary, after decision making on farm land location and fodder crops.

5.4.2 Fodder crops

Maize and grass will be the main energy and protein fodder crops to start with, and in the quantities as indicated below. Maize and grass are also good crops to grow in rotation for responsible soil management.

Production Planning of Fodders						
crop	**seed variety**	**acres**	**yield/year**		**DM%**	**Mton/year**
Maize	KSC	150	20	Mton/acre	30	3,000
	Pannar/Seedco	125	20	Mton/acre	30	2,500
	Pioneer	25	20	Mton/acre	30	500
Grass	Boma Rhodes, silaged	50	25	Mton/acre	40	1250
	Italian Rye, silaged	25	25	Mton/acre	40	625
	Kikuyu grass, silaged	25	25	Mton/acre	40	625
	Boma Rhodes, as hay	100	9	Mton/acre	80	900
Total		**500**				**9,400**

Figure 5.1 Fodder production planning

5.4.3 Assets

a. Storage

Storage infrastructure has to be constructed for silaging the harvested maize and grass. Also storage should be created for feed ingredients like maize/wheat bran, sunflower and/or cotton seed cake, brewer's grain, etc. for mixing into a (Total) Mixed Ration. In the start-up phase storages would be configured as follows:

- 1 silo storage for maize silage with a storage capacity of 5,000m3: H=3m1, W=20m1, L=50m1
- 2 silo storages for grass silage with a storage capacity of 2,000m3: H=2m1, W=12.5m1, L=50m1
- 1 silo storage for feed ingredients with a storage capacity of 250m3: H=1m1, W=25m1, L=10m1

b. Civil works

On a plot of approximately 3 acres next to the silage storages a building is needed for packaging, handling and storage of TMR-packs and office and workshop facilities. A generator will be necessary for secured electrical power supply.

c. Agricultural machinery

For professional planting, harvesting and handling proper agricultural machinery is needed. The investment plan for agricultural mechanisation should include 3 tractors, a (self-propelled) forage harvester, tippers, a plough, disc harrows, a planter, a boomsprayer, a disc-mower, a round baling machine (300-400 kg bales), a baling and packaging machine for 25kg square bales, a TMR-mixer and a shovel or telescopic loader. Machinery costs in figure 5.2 below are all based on prices for new machinery.

d. Weigh bridge

To have an accurate registration of yields per acre and of incoming and sold product a weigh bridge is indispensable. Since fodders will be partly delivered ex-works and loaded on clients' own transport vehicles invoicing is only possible with accurate weighing equipment on site.

e. Packaging/baling machines

Several alternative packaging systems can be considered. The cheapest would be a stationary (round-) baling machine (Agronic, Orkel or Lowell). These balers deliver round bales of 300 – 500 kgs, which have to be handled with forklift trucks or tractors/lifters. Small pack (25 kg) square baling and wrapping machines are much more expensive, but generate blocks which can be handled manually and could find an outlet/market to progressive smallholders.

5.5 Capital expenditures

The capital expenditures obviously depend on the scale of activities or operations. In the specification below machinery for ploughing, seedbed preparation, maize planting and harvesting, grass mowing, raking, baling and harvesting (with a forage harvester), storage, TMR-mixing and packaging are included. With this machinery the FPSC's own fodder production of 500 acres can be handled. The same machinery can be used for the FPSC's agricultural machine contracting services for on-farm production of fodders to nearby dairy farmers for approximately 500-750 acres.

CAPEX	Fodder Production and Service Center		(in US $)		
Machines	selfpropelled	1	tractor 125 hP	$72,500.00	$72,500.00
		2	tractor 100 hP	$60,000.00	$120,000.00
			forage harvester (used)	$75,000.00	$75,000.00
			shovel	$65,000.00	$65,000.00
	implements		disc plough	$15,000.00	$15,000.00
			disc harrow	$16,000.00	$16,000.00
			Boomsprayer	$10,500.00	$10,500.00
			fertilizer spreader	$5,000.00	$5,000.00
			tippers	$30,000.00	$30,000.00
			planter	$17,500.00	$17,500.00
			disc mower	$10,500.00	$10,500.00
			rake	$3,500.00	$3,500.00
			baler (square)	$25,000.00	$25,000.00
			TMR-mixer	$52,500.00	$52,500.00
Storages and civil works				$145,000.00	$145,000.00
Weigh bridge				$35,000.00	$35,000.00
Packaging			25 kg baler/300 kg round baler	$350,000.00	$350,000.00
Office				$15,000.00	$15,000.00
Miscellaneous (e.g. irrigation)				$50,000.00	$50,000.00
Total					**$1,113,000.00**

Figure 5.2 Capital expenditures to start-up a commercial fodder production and supply centre

5.6 Fodder products (services and revenues)

The main objective of this pilot project is to show best practices in soil management (i.e. fertilization, drainage), cultivation, handling, preservation and packaging. However for viability and sustainability the pilot company should operate commercially and maximize revenues during this first "proof-of-concept phase".

With the facilities and assets in place several fodder products and (T)MR's will be marketed and sold to farmers and – in addition to that – agricultural machinery contracting services will be offered.

In the most basic set up the following products and services will be offered at commercial rates.

5.6.1 Maize silage in bulk (loose and round bales)

Maize silage is becoming a commercial crop. It is locally traded and in some instances even distributed over large distances as seen at Kruger's farm. The demand for commercial maize silage, being the most important silage fodder in Kenya, is expected to grow both under commercial smallholders and medium and large scale dairy farmers. Certain EDFA-farmers for example have indicated during interviews that they were eager to outsource the production and storage of maize silage to a professional partner.

The maize silage in bulk can be collected in loose form by nearby farmers in pick-ups (on daily basis) and it will be compressed and packed in round bales of 300-400 kgs by the FPSC. The shelf life of properly compressed and packed silage is minimum 6 months.

For forecasting purposes we estimate that yearly 1,925 tons will be sold in bulk, priced Ksh 6,000/ton for loose maize (50%) and Ksh 9,000 for packed maize (50%) delivered ex-works in round wrapped bales of 300-400 kg.

5.6.2 Maize silage in square bales

Specifically for smallholders and medium sized dairy farmers maize silage will be packaged in square and sealed 25 kg bags, ready to use and suitable for distribution at greater distance. Pricing of this product is forecasted at Ksh 9.00/kg delivered ex works. Expected yearly sales are estimated at 123,000 blocks of 25 kg in the first year. This means that the packaging line has to process 65 packs per hour during 5 days a week, 48 weeks per year. The maximum capacity of this line will be much higher, i.e. up to 240 packs per hour. The size of the baled and sealed packages is L60cmxW30cmxH20cm, containing 23-25 kg silage maize. These packs can easily be handled manually and piled up for efficient storage and transport. Because of the controlled packing and sealing lasting quality can be guaranteed.

Figure 5.3 Baling and wrapping machine for 20-25 kg packs

5.6.3 (Total) Mixed Rations in bulk (loose and round bales)

An important innovative element of the company is the mixing of fodders and potentially feed ingredients into a Mixed Ration. The composition of the Mixed Ration can be varied as per specifications of the farmer and can be tailored to the needs of young stock, milking cows, dry cows and so on.

The fodder components of the Mixed Ration will be mainly maize and grass silage. These are removed from the silage storages as required and loaded into a trailed feed or forage mixer. This machine mixes and cuts possible long fibred components into one homogeneous product. Forecast calculations are based on a 50-50% share of maize and grass in the ration. Optional hay and other products like lucern, concentrates and minerals can be added to arrive at a Total Mixed Ration.

The main advantage of a Mixed Ration is product consistency and to avoid that cows select and eat only the preferred tastier more palatable components of the feed ration, like maize silage.

By feeding well-prepared and balanced MR-rations, dairy farmers can increase milk production per cow dramatically. Investing in the required equipment to make a Mixed Ration would be generally

too expensive for an individual dairy farmer. Medium and large scale farmers can collect the MR in bulk from the fodder centre in own or hired trucks or pickups.
Expected annual sales of bulk MR is 1,000 tons at Ksh 7,000/Mton for loose product (50%) and Ksh 10,000/Mton for round bales (50%), delivered ex-works.

5.6.4 (Total) Mixed Rations in square bales

Packaging a (T)MR product in ready-to-use easy-to-handle 25 kg blocks will allow the forage centre to also tap into the market of medium scaled and smallholder without any investments by these farmers in farm machinery, logistics for handling the bales and storage. Estimated sale of this product is 40,000 packs of 25 kgs in the first year. Packaging, sealing and package sizes are identical as with maize silage (see 5.6.2.) Market price of these TMR-blocks is set at Ksh 10.00/kg delivered ex-works.

5.6.5 Grass silage in bulk (loose and round bales)

A new fodder product, based on existing forage, would be grass silage instead of hay. Silaging of grass has a number of advantages as compared to hay:

- Higher crude protein content because of earlier cutting
- Higher growth yield per year because of more frequent cutting just before flowering stage
- Very short drying period after mowing because of required higher moisture content (55-60%)

Because of earlier cutting non-digestible fibres and lignin content are lower in comparison to grass hay. This makes it easier for a ruminant to extract valuable components like proteins from the grass. By supplying grass silage in loose bulk form dairy farmers can pick up their required portion of ready-to-use grass silage on a daily base or 2-3 times per week. If supplied in round bales the shelf life is at minimum 6 months.
The grass silage is to be fed in combination with for example the farmer's own maize silage. The expected sales price of loose grass silage (50%) would be Ksh 5,000/Mton. Estimated annual sales are 700 Mtons. If packed in round bales (50%) the price would be Ksh 8,000/Mton.

5.6.6 Grass silage in square bales

Grass silage will also be offered in 25 kg packs for smallholders. Forecasted sales are 32,000 packages at a sales price of Ksh 8.25/kg (ex works).

5.6.7 Hay in bales

The existing fodder demand is mainly for hay. In order to fulfil also this existing fodder demand the company will produce and sell approximately 45,000 square bales of 20 kg Rhodes hay. Prices will be in accordance with actual market prices, for calculations set at Ksh 220.00/bale (20kg). Bales will be sold direct from the land to dairy farmers and from storage(s). If the (T)MR-menu requires so, hay bales will be mixed with the other components in the TMR.

5.6.8 Machine contracting services

The Forage Production and Service Centre will also offer agricultural machinery contracting services of which the following is foreseen:

Soil improvement, seedbed preparation, planting and crop protection

High yields per acre start with good soil and seedbed preparation. Accurate ploughing, harrowing and planting form the foundation for optimum germination of maize seeds and further plant development. At least 5-10% increase of yield per acre can be reached by just improving these operations. Forecasted acreage to be ploughed, harrowed and planted for farmers is put at 500 acre per year, at a price of Ksh 9,300/acre. Crop protection and weeding will be done with a tractor and boomsprayer priced at Ksh 1,000/acre. The forecasted acreage to be invoiced is 650 acres per year.

Harvesting and silaging

For contract harvesting of maize and grass a self-propelled forage harvester will be used. This machine has a capacity of 2-3 acres per hour for maize harvesting and 7-10 per hour for grass silage harvesting. Because of this high capacity at least two tractors + tippers are needed for transport to the silage storage at the client's farm. A shovel or tractor has to be and stay on site to compress the silage immediately and without interruptions for immediate closure of the pit and maximum silage quality. Offering these harvesting services will increase the quality of silage maize and grass because of the minimized processing time. Estimated acreage for harvesting and ensiling is 250 acre per year, invoiced at Ksh 12,500/acre.

5.6.9 Advisory and analytical services

To optimize the profitability of farm operations, in mature farming communities farmers resort to soil and feed analysis for enhanced decision making on farm management. The FPSC will be able to link farmers/clients to professional laboratories like SoilCares BLGG and Crop Nutrition at discoun-ted rates. Samples can be taken by certified sampler takers employed by the company and sent on behalf of the clients to the labs. In addition to that the company can assist in sourcing and making available testing devices and programs to measure mycotoxins in crops and silages of its clientele. Estimated revenues are moderate for the first year, i.e. Ksh 250,000.

5.6.10 Total revenues per year

Above mentioned forecasted sales per product or service are summarized in figure 5.3.

Revenues per year						
		quantity	**unit**	**Ksh/unit**	**unit**	**total Ksh**
Mais silage	Bulk	1,925	MT	7,500	per ton	14,437,500
	Baled	3,075	MT	9,000	per ton	27,675,000
Grass silage	Bulk	700	MT	6,500	per ton	4,550,000
	Baled	800	MT	8,250	per ton	6,600,000
(T)MR	Bulk	1,000	MT	8,500	per ton	8,500,000
	Baled	1,000	MT	10,000	per ton	10,000,000
Rhodes hay	baled	45,000	Bale	220	per bale	9,900,000
Soil preparation +planting		500	Acre	9,300	per acre	4,650,000
Weeding		650	Acre	1,000	per acre	650,000
Harvesting/silaging		250	Acre	12,500	per acre	3,125,000
Analyses						250,000
Total Ksh per year						**90,337,500**
Total US $ (1 US $ = 88 Ksh)						**1,026,560**

Figure 5.3 Total forecasted revenue per year

5.7 Operating costs

Yearly costs of operations are specified in figure 5.4.

Operating expenses (in US $)		
External costs		$ 100,000
Land lease		$ 45,000
Labour costs		$ 135,000
Machine costs	depreciation	$ 150,000
	diesel/electricity/water	$ 165,000
	insurance	$ 15,000
	maintenance	$ 32,500
Administrative costs		$ 5,500
Sales costs		$ 10,000
General costs		$ 12,500
Financial costs		$ 94,000

Figure 5.4 Operating expenses per year

External costs are costs for purchased products and services like for example seeds, fertilizers, herbicides and packaging material.
The cost of lease of land is put at Ksh 8,000 per acre per year.
Labour costs are based on a crew with following positions:

- 1 general manager
- 1 controller/administrative employee
- 5 -10 operators (depending on season)
- 1 engineer

Machine costs are based on depreciation of the purchased machinery.
Diesel costs are mainly for crop cultivation operations on land leased by the company and not for customer operations. For external customers served through the company's agricultural machinery contracting services, diesel is charged separate from operations.
Other costs (administrative, sales and general costs) are based on a rough estimate and can vary.
Interest costs are based on the assumption that part of the capital investments costs is covered by grants from development partners (e.g. through KMDP's Innovation Fund).

5.8 Income statement

The estimated revenue and costs of the company are summarized in figure 5.6 below. Figure 5.6 shows the profit & loss account and a cash flow for a 5 year period starting from 2015. Based on the assumption that preparations and construction will not be finished before the beginning of 2015, field operations start beginning of 2015.

Consequently revenues can be generated only in the last part of 2015 when crops have been harvested, put under silage and sales can start. For this reason the table below shows a negative cash flow in the first year of operations. Revenues are expected to increase over the following years, due to improved yields per acre, better product quality and as a consequence higher sales prices for offered products and services. The size or acreage of leased land will also increase to an estimated 750-1,000 acres, whilst lease price per acre will be a little lower due to showing best soil management practices.

Cash Flow and Profit & Loss (in US $)						
		2015	**2016**	**2017**	**2018**	**2019**
Capital Injection/Loan		$ 669,000				
Grants		$ 446,000				
Revenues		$ 396,450	$1,026,560	$1,128,510	$1,272,220	$1,425,250
External costs		$ 100,000	$ 127,456	$ 132,250	$ 145,475	$ 160,023
Land Lease		$ 45,000	$ 51,750	$ 59,513	$ 65,464	$ 72,010
Farmer Contracting Costs		$ -	$ 35,000	$ 42,000	$ 49,000	$ 52,500
Gross margin		$ 251,450	$ 812,354	$ 894,747	$1,012,281	$1,140,717
Labour costs		$ 135,000	$ 145,000	$ 135,000	$ 145,000	$ 160,000
Machine costs	depreciation	$ 100,000	$ 170,000	$ 170,000	$ 170,000	$ 170,000
	diesel	$ 65,000	$ 75,000	$ 90,000	$ 100,000	$ 110,000
	insurance	$ 27,500	$ 28,500	$ 29,500	$ 30,500	$ 31,500
	maintenance	$ 42,500	$ 45,000	$ 50,000	$ 60,000	$ 75,000
Administrative costs		$ 7,500	$ 9,000	$ 10,000	$ 10,500	$ 11,000
Electricity and Water		$ 100,000	$ 110,000	$ 121,000	$ 133,100	$ 146,410
Sales costs		$ 10,000	$ 11,000	$ 12,100	$ 13,310	$ 14,641
General costs		$ 17,500	$ 20,000	$ 25,000	$ 32,500	$ 38,000
Financial costs		$ 94,000	$ 78,255	$ 65,147	$ 54,235	$ 45,151
Total costs		$ 599,000	$ 691,755	$ 707,747	$ 749,145	$ 801,702
Profit/loss		$ -347,550	$ 120,599	$ 187,000	$ 263,136	$ 339,015
Loan repayment		$ 75,000	$ 115,000	$ 135,000	$ 165,000	$ 180,000
Capital expenditures		$1,113,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Net cashflow		$ -320,550	$ 75,599	$ 122,000	$ 168,136	$ 229,015

Figure 5.5 Income statement 2015-2020

6. Demonstration Project Uganda

6.1 Introduction

As described in the previous chapters, in Uganda dairy production is less developed than in Kenya and is mainly pasture-based. It therefore needs a different focus and approach with regard to introducing commercial fodder production and supply. Although the sector shows high growth figures and is influential in (agricultural) policy development, the huge numbers of smallholders are mainly low-input low-output oriented.

Except for a limited number of large scale dairy farmers, the current practice in feeding dairy cattle needs a major transition, by moving away from "semi-pastoralism" to more intensified feeding and foraging systems. Therefore, before starting a pilot Fodder Production and Service Centre as suggested for Kenya, one or two regional farmgroup fodder pilot projects are suggested to show best practice in feeding.

6.2 Demonstration project definition

It is suggested to demonstrate 'on-the-spot' the effectiveness of a different farming and feeding system by piloting zero grazing. This can be done in cooperation with one or two large scale farmers with sufficient land resources. The demo or pilot could be defined as follows:

a. A group of dairy cows (say minimum 50) is separated from the others to be kept and fed in a zero grazing system. During the pilot milk production and feeding costs of this group are recorded and compared with a control group of similar cows under (free-) grazing.
b. For the test group of cows a TMR menu is defined.
c. Based on the defined TMR a fodder production plan is made (75 acres)
d. This fodder production plan is doubled to produce the same amount of fodder crops for nearby smallholders (total 150 acres)
e. Crops are harvested and ensiled on the nucleus or pilot farm
f. The test group of cows is fed during 3 till 6 months with the TMR
g. In the same period TMR-portions are packed with a simple manually-operated packaging machine, like for example the silo facil from Brasil.
h. These TMR-packs are 'sold' to smallholders, payment is in (extra) milk to be delivered to the chilling tank of the nucleus farm
i. Milk productivity and quality of these smallholders is recorded and analysed.

By setting up a feeding and fodder crop demonstration project in one or two regions - linked to an increasing (controlled) milk production - the concept of 'feeding costs-precede-milking benefits' can be demonstrated in practice.

For this pilot fertile land has to be prepared for mechanised operations which means that the land has to be cleared from trees, bushes and other obstacles. Also drainage should be prepared to be less vulnerable for excess rainfall.

Equipment for ploughing, seedbed preparation, planting, weeding and harvesting can be rented or used-equipment can be purchased to minimize costs. An important aspect of this project is to pilot alongside the effect of fertilizer in virgin Ugandan pastures. Therefore different plots have to be created with different fertilization and or manure applications (including non-fertilisation) to show differences in plant development.

Another crucial element of this project will be to demonstrate a more cost-effective and easy manner of making silage pits, and to change from underground pits to surface pits with proper earth walls and drainage. Making small compressed bales by a simple manual silage press (see appendix 8.3) as an alternative way of silaging should also be demonstrated.

6.3 Reline Dairy Farmers/Jesa Dairy Farming

Two organisations, both visited by the mission team, could be potential partners for this pilot:

a) The Reline Renaissance Livestock Farmers Network and in particular the farm of Emmanuel Tayebwa. This typical lead-farmer is based in Mbarara (South West of Uganda) and owns 1,500 acres of land at 2 locations with 5 herds of dairy cows (each around 100 cows). The farm produces approximately 2,000-2,500 liters of milk per day and collects milk from 150 smallholders (in total 100-150 litres average per day per farmer).Emmanuel is eager to participate in the above proposed demonstration pilot.

b) Jesa Dairy Farming, owned by Geoffrey Mulwana. This innovative and professional organized dairy farm and milk processing company, is eager to source more quality milk from other farmers. Jesa is already processing milk from milk traders from various parts of the country. The dairy farm is very suitable for demonstration purposes. It covers 2 square miles of productive land and is based just north of Kampala. Geoffrey is interested to participate in a pilot, but first wants more information on project objectives and partners. Jesa Dairy Farming is one of the few professionally managed dairy farms in Uganda and is far ahead in mechanised harvesting of maize and grass and in applying TMR feeding.

Both Emmanuel Tayebwa and Geoffrey Mulwana are lead-farmers with a strong network of milk suppliers (milk traders and smallholders).

7. Conclusions

This report reflects the business opportunities in Kenya for controlled commercial fodder production and distribution in the Kenyan dairy sector, by a dedicated pilot company called the Fodder Production and Service Center (FPSC), and – less elaborated - for a forage silaging pilot project with one or two lead farms in Uganda.

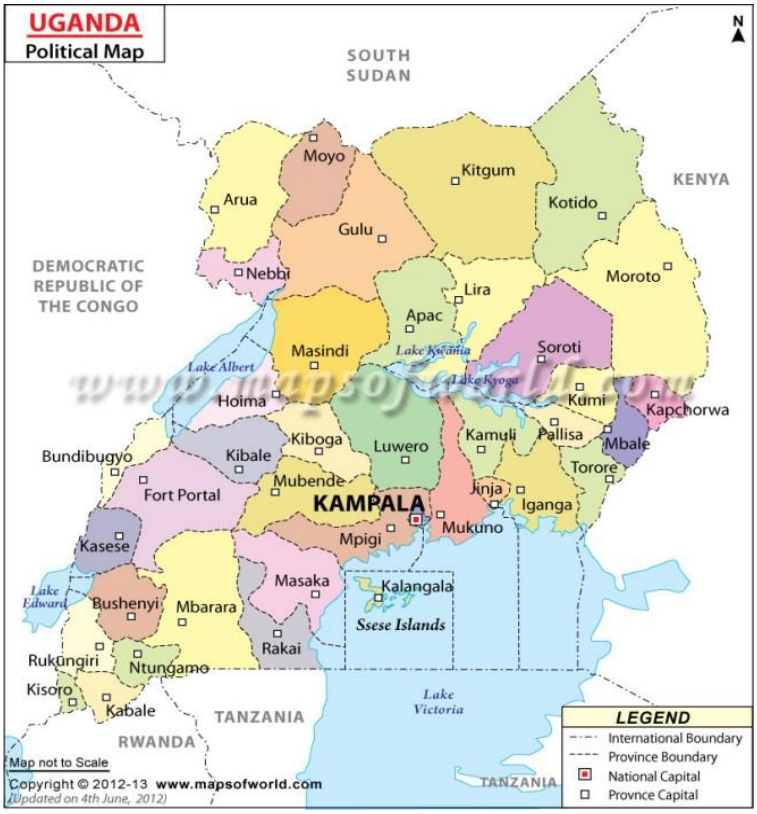
Based on a quick scan and the assumptions derived from this regarding product mix, market, required machinery, staffing, costs and prices, the concept is commercially viable. However, detailed elaboration of the proposed business model and corresponding investments, products and prices is needed when decisions have been made by the executing partners on for example the exact location of the FPSC and the farm land to be leased.
A crucial success factor of the described concept, based on a service-oriented approach of fodder management and supply, is the incremental and flexible growth of a demonstration or pilot company, showing best practices in production, silaging and feeding of high quality forages.

Both initiatives can only be successful if the further elaboration and execution of the suggested concepts and plans, is done by a limited number of committed and sustainable business partners and/or investors.
Potential partners should have a background or interest in milk production, such as a Farmers' Association (e.g. the EDFA group of farmers in Kenya or the Reline Group in Uganda) and/or a milk processor with high interest and ability to invest in his supply chain. Other parties that might be interested to invest/participate are commercial fodder producers, agricultural contractors, agro-dealers and – possibly feed manufacturers.
In any case, interested parties should have – or be able to mobilize - the managerial capacity and technological know-how and experience required for fodder production, packaging and marketing.

Furthermore, financial and technical support through subsidies or grants will be indispensable for a professional set up of this new fodder production and supply concept or pilot. This is related to the level of investments and the required (international) management support, in combination with the highly innovative character of the pilot project which requires and justifies (financial) risk mitigation. Considering the potential impact that this pilot project shall have on one of the major systemic bottlenecks that hamper growth and competitiveness of the dairy industry in Kenya and East Africa at large, the Mission Team considers this justifiable and important.

For the Ugandan situation, this report has proposed to set up a 2 or 3 year pilot project on forage silaging in close cooperation with 1 or 2 leading dairy and milk collecting farms (or firms). In a fast growing dairy sector like in Uganda, this proof-of-concept on the effect of feeding silage in a (semi-) zero grazing system instead of free-grazing, will possibly be a first step towards more milk and less seasonality of supply.

Appendix 1. Maps of Kenya and Uganda



Appendix 2. Silo Facil

- ✓ Confiable
- ✓ Resistente
- ✓ Ligera
- ✓ Sencilla
- ✓ Económica

Silo Facil from *Invento, Colombia*, takes all air by high hydraulic pressure (70 times more than by persons) and produces small quantities from 50 till 100 kg

- In plastic bags or plastic vessels.
- Is easy to handle after training
- Investment is relatively low, and is depending on the type of machine
- High capacity per hour, depending on type of Silo Facil, supply of forage and persons operating
- Is developed in a tropical region for tropical region
- Can easily be transported to areas with difficult transport conditions, especially when placed on a lorry, for behind a pick up
- Is robust, good constructed of high quality material
- Hydraulic system can operate manually, on electrical power, generator or with tractor
- Is available in different capacity (Silo Facil 1, or 2, or 3 or even 4, see link)
- Maintenance can be trained easily.

Appendix 3. Packaging and Handling of Fodder in Round Bales