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Feed plans for producer organizations in Nyanza region, Kenya: Implementation of feed plans through producer organizations to improve productivity

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Feed the Future Accelerated Value Chain Development (AVCD) Program

Feed plans for producer organizations in Nyanza region, Kenya: Implementation of feed plans through producer organizations to improve productivity

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The Feed the Future Kenya Accelerated Value Chain Development (AVCD) program seeks to widely apply technologies and innovations for livestock, dairy and staple crop (root crops and drought-tolerant crops) value chains in order to competitively and sustainably increase productivity, contributing to inclusive agricultural growth, nutrition and food security in 23 counties in the country. Supported by the United States Agency for International Development as part of the US government's Feed the Future initiative, its main goals is to sustainably reduce poverty and hunger in the Feed the Future zones of influence in Kenya.

In partnership with the International Crops for Research Institute for Semi-Arid Arid Tropics (ICRISAT) and the International Potato Center (CIP), International Livestock Research Institute (ILRI) will lead the implementation of AVCD. The three CGIAR centres will work closely with partners—county governments, NGOs, CBOs, private sector actors and other USAID-funded projects/programs, as well as leverage knowledge and best practices from academic institutions and foundations.

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Introduction

Feeds account for the single largest cost of production in Kenya's smallholder livestock systems (Kibiego 2015). The smallholder farming systems are characterized by feed shortages during the dry seasons and feed wastages during the wet season, which lead to fluctuations in production occasioned by seasonality. Feed planning is the practice of planning the livestock feed supply to meet the nutritional requirements of the herds and production targets of the farms. Feed planning is a multilevel process which can be done at farm level, producer organization level, administrative units' level and overall at the country level. In recognition of the vital role of feed planning, the Accelerated Value Chain Development (AVCD) program is working with producer organizations in Kenya to develop feed plans.

Importance of a feed plans to farmers

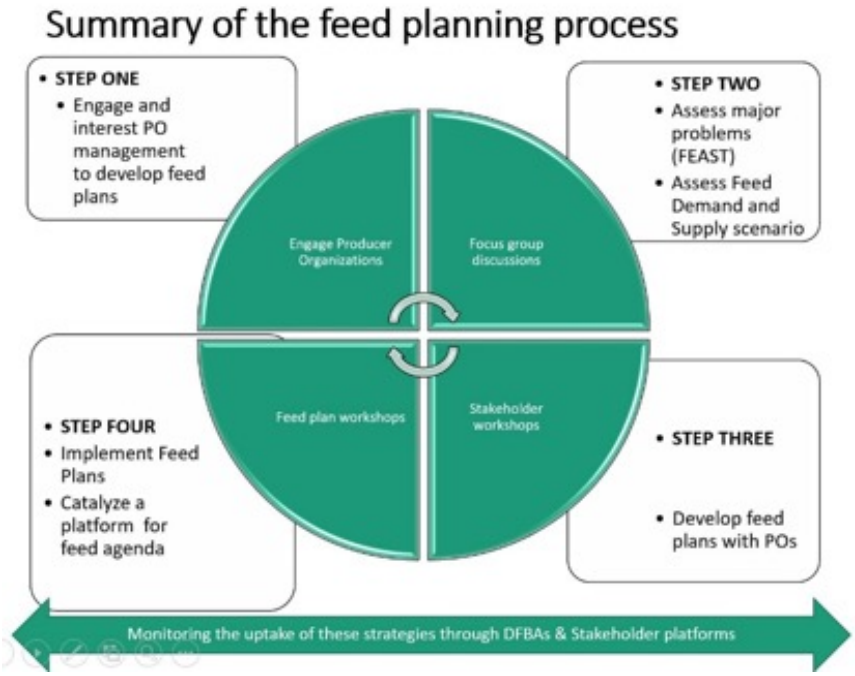
There are various benefits to feed planning, which relate to both the nutrition requirements of the herd and the cost of production. They include the following:

- Feeding the animals sufficiently so they can meet set production targets
- Minimizing feed wastage on farms
- Predicting surpluses and shortages, and the appropriate action to take
- Foreseeing supplements requirements in advance and their purchase in bulk at the lowest price
- Contemplating the best- and worst-case scenarios to reduce the impact of low growth periods

Methodology and approach

Feed planning is context specific and successful feed interventions must consider the context. The feed planning process is broken down into four stages (Figure 1).

Figure 1: Feed planning process summary (source: Ben Lukuyu).



Step one: Engage producer organizations

Feed planning starts by sensitizing the representatives of the producer organizations (POs) on feed plans, the feed planning process and the advantages of a having a feed plan as a producer organization. It is at this stage that PO boards will buy into the planning process and take ownership of the final product. It is critical to get the buy-in of PO boards as they are not only the custodians of the plan but also the lead implementors of the plan.

Step two: Feed assessment

The second step involves working with the farmers' cooperatives to systematically assess local feed resource availability and use, and constraints and opportunities using the Feed Assessment Tool (FEAST). FEAST comprises two main elements (Duncan 2012):

- A focused group exercise with groups of farmers provides an overview of the farming system with emphasis on livestock feed aspects as well as identifying potential interventions.
- Individual interviews are held with a subset of FGD participants using a quantitative questionnaire. Findings from this exercise generate quantitative feed information that is input into a FEAST application to produce charts and tables. The information is then compiled and analysed into a report with quantitative information on overall feed availability, quality and seasonality, and ideas for key problems and solutions. This helps to design the intervention plans.

Why the FEAST process is important:

- It quickly diagnoses key livestock feeding issues through focused group discussions and helps collect very light data.
- It helps to structure thinking and allows dialogue with stakeholders on what the key feeding issues are and how they fit into the broader context.
- It help get more specific and more analytical information on which feed technologies might work in a particular context.
- The entire process also creates better links and understanding between farmers, researchers and development agents.

AVCD trained sub-county livestock production officers to lead the FEAST exercise in the respective sub-counties in Nyanza and generated reports that were used to guide the POs during the feed planning process.

Step three: Stakeholder workshops

This stage commences following completion of the FEAST reports that are required to guide the deliberations. Key stakeholders are invited to feed planning workshops including the following:

- PO board members
- Farmer representatives
- Extension officers linked to the PO
- Input and service providers who stock animal feed stores within the PO catchment
- Local leaders

It is important that these groups of stakeholders attend the workshop as they are key in providing the required data and the opinion voiced in the groups can be validated amongst themselves. The stakeholder workshop has two stages:

The first stage involves assessment of the feed demand and supply scenario, which is done using a participatory approach and guided by a feed plan data collection tool (Figure 2). Example of data[1] collected through this process include:

- Milk production in the PO catchment area (in l/day)
- Total number of dairy farmers in the PO catchment area
- Number of lactating cows in the PO catchment area
- Number of dairy cattle in the PO catchment area
- Average number of dairy cattle per dairy farmer in the PO catchment area
- Average volume of milk produced per dairy farmer in the PO catchment (l/day)
- Average volume of milk produced per cow in the PO catchment area (l/day)

1. Feed Demand –Supply Template analysis template on Annex 1

Figure 2: Sample Feed Demand –Supply Template analysis template.

Indicators	Current Scenario	Projected in 5 Years	Diffrence	Notes/Assumptions
Total Number of Dairy Farmers	720	963	243	The PO to plan for 963 farmers enrolled by DFAs
Average Herdsize Improved	2	4	2	
Average Herdsize Locals	5	2	-3	local cows mainly kept for cultural reasons
Number of dairy Cattle Improved	1440	3852	2412	
Number of dairy Cattle Locals	3600	1926	-1674	
Total Number of Cattle	**5040**	**5778**	738	
Number of lactating Cows	3780	4333.5	553.5	
Average volume of milk produced per dairy cow Improved	7	10	3	
Average volume of milk produced per dairy cow Local	1.5	3	1.5	
Average volume of milk produced per dairy farmer	19.625	44.5	24.875	
Average supply per farmer to the cooperative	4	27		
Fodder Production				
Average weight of Improved **A**	280	320	40	
Average weight of Locals **B**	240	250	10	The genes are locked even if you feed better
Average cow weight in the area (A+B)/2	260	285	25	
Dry Matter Requirement per cow *@3% body weight*	7.8	8.55	0.75	
Fresh Matter Requirement In Kgs *assumption of napier at 30% DM,*	26	28.5	2.50	Most feed is lush
Total Dry Matter Requirement Improved Cows per day	11232	32934.6	21702.60	
Total Dry Matter Requirement Locals Cows Per day	28080	16467.3	-11612.70	Reducing as the number of local cows decrease
Total Dry matter requirement per annum *Kgs*	14,348,880	18,031,694	3682813.50	
Bales hay required per annum *assumption of 15 Kgs per bale*	956,592	1,202,113	245520.90	
Dry Matter Sources Breakdown *based on FEAST*				
Total Dry matter Sources per annum *Kgs* Grown on Own Farms *insert FEAST proportions C25*	6,313,507	7,933,945	1620437.94	0.44
Total Dry matter Sources per annum *Kgs* Commercial Fodder Production *insert FEAST proportions C26*	2,295,821	2,885,071	589250.16	0.16
Total Dry matter Sources per annum *Kgs* Crop Residue *insert FEAST proportions C27*	4,448,153	5,589,825	1141672.19	0.31
Total Dry matter Sources per annum *Kgs* Concentrates Feeds *insert FEAST proportions C28*	1,291,399	1,622,852	331453.22	0.09
Yield of hay per acre /annum ***i.e (200*15)*** **in Kgs** *@ 2500 per hectare*	6,178	6,178	0.00	
Acres under fodder production (Boma Rhodes, Brachiaria) Grown own Farm @ 75%	**1,022**	**1,284**	262.31	
Acres under fodder production (Boma Rhodes, Brachiaria) Commercial Fodder 15%	**372**	**467**	95.39	
Bags of % 50 Kgs of Concentrate feeds required per annum	25,828	32,457	6629.06	
Machinery				
Number of hay baling machines	2	3	0.56	

Stage two involves review of FEAST reports

- To characterize existing farming systems and how they impact on the current dairy feeding (helps guide decisions on fodder production strategies).
- To identify existing production problems/gaps and existing opportunities (What are the potential interventions for improving feed production?).
- To extract major feed types, feeding practices (helps calculate dry matter requirements of dairy herds in the locality).

The stakeholders then go through a process of developing the feed plans (see Table 1) bearing in mind:

- What are the feed constraints?
- What are the potential solutions?
- What needs to be done to solve the problems (A list of activities)
- What resources are needed for each activity and who provides them
- Who does it? Who is in charge (at all levels, PO/actors level) and by when?
- How will progress be monitored?
- What will be monitored and by whom?

Table 1: Sample constraint/opportunity analysis matrix

Constraint	Potential solutions	Activities to solve the problem	Resources needed	Who provides?	Who does the task?	When?	What to monitor?
Constraint 1							
Constraint 2							
Constraint 3							

Step four: Implementation of feed plans through producer organizations

This is the final step in the planning process, it involves implementation of the solutions identified by the feed plans. Producer organizations work with diverse group of partners and it is important to have a concerted approach towards feed plan implementation, as such, the groups are encouraged to form a platform for the feed agenda. The feed agenda platform will continuously monitor progress, provide feedback and allow for continuous improvement of the intervention. The platform will also catalyse the formation of a broad coalition of actors (stakeholder platforms/ fora) to share and discuss feed plans with an emphasis on how to implement various activities

To operationalize the feed plans, it is critical that identified points of actions are included in the PO strategic plans and annual operation plans and budget. It is important to note that feed plans are dynamic and require constant revision based on the ever-changing farming, dairying and PO operational circumstances. In this regard, there is need to build the capacity of the producer organizations management and extension to be able to develop, revise and continuously implement feed plans.

Producer organizations have the potential and capacity to implement some of the proposed interventions, however, some solutions will require engagement with the private sector. These types of engagements should be guided by the feed plan. Profit as an incentive has the potential of creating sustainability and hence cooperatives are encouraged to commercialize interventions for sustainability. From the identified interventions, the cooperatives can develop business models for few selected interventions. Such models need to consider inclusivity and geographical spread of the members. In developing the business models, the cooperatives may engage the services of business development providers (BDS) to provide technical assistance to the dairy cooperatives, facilitate signing forward feed supply contracts and facilitate farmer linkages to check-off services for farm inputs.

Results and discussions

Rongo Dairy Cooperative

Background

Established in 1988, the Rongo Dairy Cooperative is one of the oldest societies in the Nyanza region. The dairy cooperative is located in Rongo Sub-county, Migori County. The cooperative has a registered membership of 1,300 farmers, drawn mainly from Rongo and Awendo sub-counties. The business model projects to grow membership by an additional 900 farmers in the next five years bringing total membership to 2,200 farmers. The average milk production is estimated to be about 5 litres for the improved cows and 2 litres per day for the local cows. The cooperative receives a daily average of 4 litres per farmer per day. The smallholder farmers keep on average four locals cows and two improved cows. The county has witnessed significant investment in artificial insemination (AI) by both development partners, such AVCD, and county AI programs. With these investments, the average herd size is projected to constitute of four improved cows and two local cows in five years. Based on the average herd size, the current membership has an approximate 2,600 improved cows and 5,200 local cows and total herd size of 7,800 cattle. Service providers were asked to provide the estimated body weight of local and improved cows based on heart girth measurement, which is easy to undertake in smallholder dairy systems in Kenya (Lukuyu 2016). The average weight was estimated at 250 kg and 300 kg for local and improved cows, respectively.

Assessing feed constraints and opportunities in Rongo Dairy Cooperative

At the onset of the workshop, a participatory exercise to validate feed constraints collected earlier using the Feed Assessment Tool (FEAST) was held. The process identified constraints to feeds and feeding, potential solutions, and corresponding activities needed to achieve the potential solution as shown in Table 2. The interventions were identified participatorily and systematically. For each source of dry matter intake, the participants developed a list of constraints, potential solutions and opportunity and activities needed towards solving the problem. The identified solutions had to be realistic, actionable and time-bound indicating the person responsible to deliver the solutions.

Table 2: Rongo Dairy Cooperative feed constraints and potential solutions

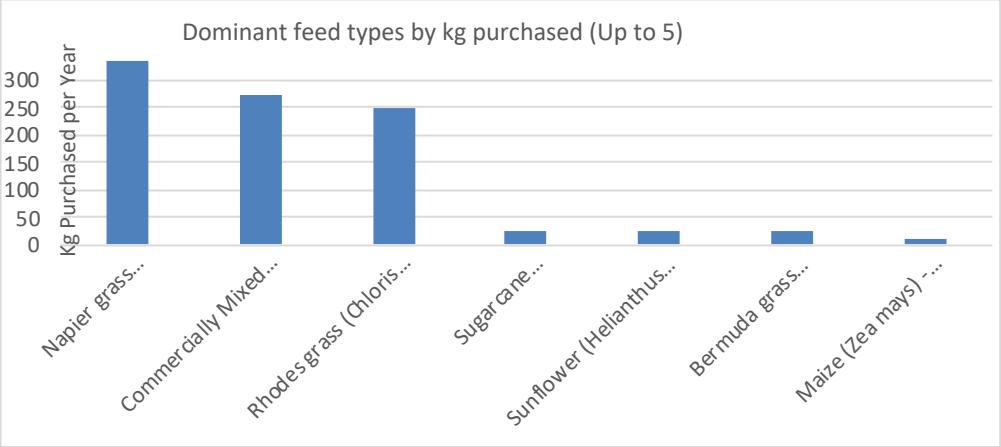
Feed constraints	Potential solutions or opportunities	Activities needed towards solving the problem
Low access to concentrates due high cost and lack of Knowledge on use	Educate farmers on the importance of concentrates on dairy animals through the dairy farmer associations (DFAs)	Cooperative to engage the services of additional extension officers to educate and sensitize farmers on use of concentrates to improve production Monitor concentrate quality to ensure consistency through sampling
	Business model through outsourcing (Memorandum of Understanding[MoU] with feed store within Rongo with payment options)	Identifying (scoping) the agrovet to partner with, based on agreed criteria and viable number of farmers for return on investment (ROI) Drawing and signing an MoU with the agrovet, monitoring and resolving emerging issues Linking cooperative members with the agrovet
Low quality of crop residues (sugar cane tops, maize stover)	Business models through private entrepreneur who won mechanized chopping/shredding of crop residues and offer services to formers for a fee. There is potential to organize for payment through check-off system with the dairy cooperative	Identifying 50 potential entrepreneurs Financing model for entrepreneurs to purchase feed choppers Training them on feed processing and ration mixing/formulation Drawing MoU with dairy cooperatives to firm up linkages with and protect farmers

Feed constraints	Potential solutions or opportunities	Activities needed towards solving the problem
Inadequate forages (cut and carry) due to insufficient land, forage disease, insufficient capital, and over reliance on Napier grass	500 farmers establish at least 2 acres of improved fodder through leasing of land	Identify type of fodder variety that suits the area Recruit 800 farmers for establishment of additional 2 acres per farmer Link farmers/PO to source of forage seeds Diversify on different fodder varieties (Rhodes grass, grazing species,) through commercial fodder production

Assessing feed supply in Rongo Dairy Cooperative

To understand the current dairy production levels and feeding practices, AVCD in collaboration with the County Government of Migori carried out an evaluation of farming systems within Rongo Sub-county with an aim of identifying potential interventions for improved livestock productivity (Odidi 2016). Figure 3 shows the dominant feeds purchased by smallholder farmers in Migori County. Napier grass and Rhodes grass feature dominantly as the main sources of forages for livestock.

Figure 3: Dominant feed types by kg purchased



Current dry matter requirement for herds in Rongo Dairy

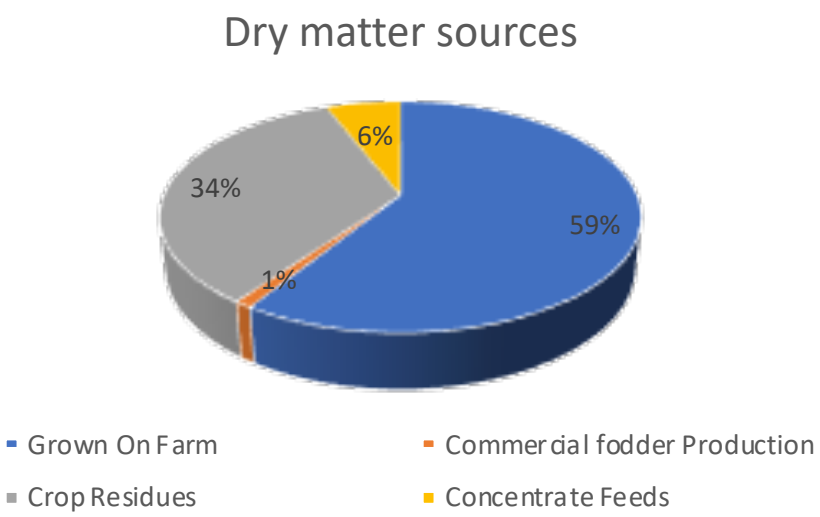
In our calculation, we computed the average weight of a cow (local and improved) to be 275[2] kg (see the respective weights by breed). With an average cow consuming 3% of its body weight of dry matter (DM) ration per day, this translate to 8.25 kg of dry matter requirement per cow per day. Based on the current herd size of 7,800 animals, the cooperative requires 64,350 kg of dry matter to feed the dairy cows per day. DM requirement for Rongo Dairy Cooperative when broken down by breed type, the dairy requires 21,450 kg and 42,900 kg of DM per day to feed the improved and local cows, respectively. This means that the cooperative would require 23,487 tons of DM to feed the current herd size of 7,800 cattle per annum. Assuming the cows were fed solely on hay and a bale weighs 15 kg, the dairy would require approximately 1.5 million bales of hay per year.

2. The average weight of a local cow weighing 250Kg and an improved cow weighing 300Kg

Current dry matter sources for herds in Rongo Sub-county

The FEAST report for Rongo Sub-county (Odidi 2016) provides a detailed breakdown of dry matter intake by source. According to the report, grazing contributes the highest percentage at 49%, followed by crop residue at 30%, then cultivated fodder at 6%, then collected feed at 5% and finally purchased feed at 1%. Sources of dry matter in Migori County are detailed in Figure 4.

Figure 4: Sources of dry matter intake in Migori County



Based on the above proportions, the dry matter intake per annum (current and projected) from the various sources for Rongo Dairy is apportioned as shown in Table 3.

Table 3: Quantity of dry matter intake for Rongo Dairy cooperative from the various sources

Dry matter intake source	Current		Projected (2025)	
	Proportion	Kg	Proportion	Kg
Grown on farm	0.59	13,857,773	0.59	25,583,580
Crop Residue	0.34	7,985,835	0.34	14,743,080
Concentrate feed	0.06	1,409,265	0.06	2,601,720
Commercial fodder production	0.01	234,878	0.01	433,620
Total	1	23,487,750	1	43,362,000

To meet the projected acreage under fodder, provide high-quality crop residues and the required quantities of concentrates, the dairy extension officers, farmers representatives and the board with the guidance of AVCD feed specialist developed strategies to bridge the gap (see **Table 2**). The Rongo Dairy Cooperative is in an area with a good climate that supports availability of various livestock feeds for improved animal diets and nutrition (Odidi 2016). The good climatic condition coupled with relatively large land holding and a reliable milk market through the dairy cooperative provides a favourable pull factors for dairy farming. Most farmers are small-scale dairy farmers and lack scale in farming operations limiting benefits they would derive through bulk purchase or supply. In recognition of this challenge, the AVCD program is promoting business models around the various feed technologies to cut on the cost of production and create sustained business linkages by leveraging on the number of registered farmers at the dairy cooperative.

Assessing feed demand for Rongo Dairy by 2025

Rongo Dairy projects to grow its membership by 900 farmers over the next five years, this growth will bring the total registered members to 2,200 up from the current 1,300 farmers. Growth in membership and the current investment by development partners and county government in breeding is expected to grow the number of cattle from the current 7,800 to 13,200 over the next five, representing an increment of approximately 1,000 cows per year. With better breeds coupled with proper feeding, the average weight of an improved cow is expected to increase from the current 300 kg to 350 kg. In the next five years the dry matter requirement for an improved cow will be 9 kg per day up from the current 8.25 kg a day. Consequently, per annum DM requirement is expected to be 43,362 tons, which is an increment of 19,000 tons from the current DM requirement Table 3

Table 4: Projected animal and dry matter requirements at Rongo Dairy Cooperative Society

Indicators	Current scenario	Projected in five years	Change	Notes/assumptions
Total number of dairy farmers	1,300	2,200	900	PO business improves through milk marketing, and timely payment of milk delivered to farmers
Average herd size improved	2	4	2.00	Breeding efforts by multi stakeholders continue
Average herd size (locals)	4	2	-2.00	Decrease as farmers embrace AI
Number of dairy cattle (improved)	2,600	8,800	6,200.00	Increase in exotic cattle as farmers adopt AI
Number of dairy cattle (locals)	5,200	4,400	-800.00	Decline in local cows as farmers adopt improved ones
Total number of cattle	7,800	13,200	5,400.00	In five years, the population of cattle is expected to grow by 5,400 animals, see above proportional changes by breed
Number of lactating cows	5,850	9,900	4,050.00	Lactating cows at 75% of the cows in the herd
Average volume of milk produced per dairy cow (improved)	5	10	5.00	Milk volumes expected to double as a result of better breeds, better herd management and feeding
Average volume of milk produced per dairy cow (local)	2	3	1.00	marginal increment in the milk produced by local cows, most of the potential is locked up
Average volume of milk produced per dairy farmer (l)	15.28	44.5	29.22	As productivity increases, we expect the total milk production rise from the current 15 to 44 litres per day
Average supply per farmer to the cooperative (l)	4.1	27		Increased production will lead to an increment in the milk share sold to the cooperative.
DM requirement				
Average weight of Improved A (kg)	300	350	50.00	Improved cows record an increase in weight due to better feeding
Average weight of locals B (kg)	250	250	0.00	Local cows' genetics locked and would not change in weight.
Average cow weight in the area (A+B)/2 (kg)	275	300	25.00	
DM requirement per cow @ 3% body weight (kg)	8.25	9	0.75	DM requirement of a cow at 3% of its body weight
Total DM requirement improved cows per day (kg)	21,450	79,200	57,750.00	Improved cows DM requirement increase in five years as farmers adopt more improved cattle
Total DM requirement local cows per day (kg)	42,900	39,600	-3,300.00	Local cows DM requirement decline in five years as farmers decrease the number of local cows in the herds
Total DM requirement per annum (kg)	23,487,750	43,362,000	19,874,250.00	Overall, the DM requirement is nearly doubling in five years.

Fodder demand in Rongo Dairy by 2025

To estimate demand of fodder for the PO, the dry matter intake was converted to respective fresh matter. Based on the below assumptions, we then estimated the acreage required to produce the fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre
- Fodder crops anticipated to be planted are *Brachiaria* or Rhodes grass

Planted forages (both own-farm and commercially produced) account for 14 million kg DM intake annually representing 60% of dry matter requirement. To be able to meet this demand, the Rongo Dairy needs to establish 2,281 acres of planted fodder as shown in Table 5.

Table 5: Acreage of planted forages required to feed cattle in Rongo Dairy at current and projected demand

Dry matter intake source	Current			Projected		
	Proportion	Kg	Acres	Proportion	Kg	Acres
Grown on farm	0.59	13,857,773	2,243	0.59	25,583,580	4,141
Commercial fodder production	0.01	234,878	38	0.01	433,620	70
Total	0.6	14,092,651	2,281	0.6	26,017,200	4212

Concentrate demand in Rongo Dairy by 2025

Concentrates constitute 6% of the dry matter requirement for cattle in Rongo Sub-county. This translates to 1,500 tons of concentrate per annum. In other words, the dairy cooperative would require 28,185 bags 50 bags of concentrate every year to meet this demand. The demand for concentrate is expected to grow to 2,600 tons per annum, equivalent to 52,034 bags of 50 kg.

Rangwe Dairy Cooperative

Background

Rangwe Dairy Cooperative is in Homa Bay County, Rangwe Sub-county. The society was registered in 1998 as a dairy cooperative society. It has a membership of 220 registered dairy farmers drawn mainly from Rangwe Sub-county. Though at a limited scale, the dairy cooperative is bulking and selling milk to individual customers and institutions in Rangwe town. Membership of the dairy cooperative is projected to grow in the next five years by an additional 400 members, which could bring the total members to 600. On average, a smallholder farmer member keeps three improved and four local cows. Bearing in mind the total membership of 220 farmers, this implies that the members have a total herd size of 660 improved and 880 local cattle. There are ongoing efforts led by development partners and the county government to accelerate breeding of cows.

Through these efforts, farmers are expected to improve their breeds genetically and their herd composition will change to four improved and two local cows in the next five years. Changes in breed composition of the herd and increased membership (600 farmers) at the cooperative in the next five years is projected to increase the herd size to 2,400 improved cows and 1,200 local cows. The average milk production is estimated at six and two litres for improved and local cows, respectively. As livestock productivity increases, milk production is also expected to rise as a result of concerted efforts of improving animal breeding, animal health, feeding and animal husbandry. During the next five years, milk production is expected to increase to 10 litres and three litres from improved and local cows, respectively. In estimating the body weight of the cows within Rangwe Sub-county, service providers relied on heart girth measurement which is easy to undertake in smallholder dairy systems in Kenya (Lukuyu 2016). The average weight was estimated at 250 kg and 300 kg for local and improved cows, respectively.

Assessing feed constraints and opportunities in Rangwe Dairy Cooperative

At the onset of the workshop, a participatory exercise to validate feed constraints based on FEAST findings was conducted. This process identified constraints to feeds and feeding, potential solutions, and potential activities needed to solve identified problems as shown in Table 6. The interventions were identified participatorily and systematically. The identified solutions had to be realistic, actionable and time-bound; indicating the person responsible to deliver the solutions.

Table 6: Rangwe Dairy feed constraints and potential solutions

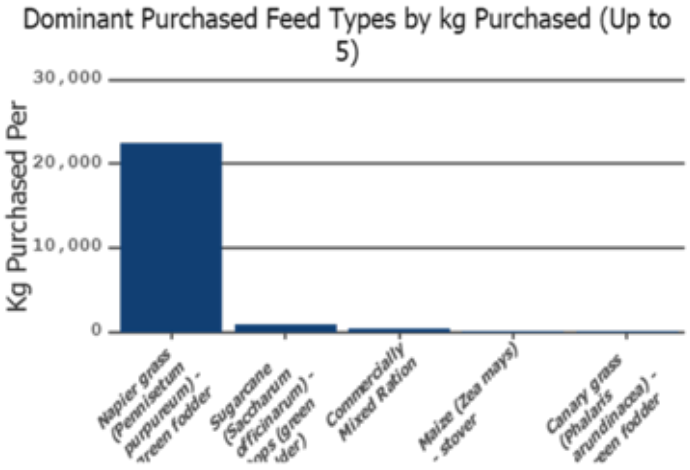
Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Lack of agronomic practices of fodder establishment and low access to forage seeds	Increase acreage under fodder	Training dairy farmers on agronomic practices on fodder/legumes establishments/field days Fodder/seed linkages with suppliers Suitability mapping of desired varieties
Crop residues–lack of skills and knowledge on crop residue conservation of the small-scale dairy farmer during harvesting season	Increased proper utilization of crop residues	Training on modern technologies of fodder conservation Creating awareness on how to conserve/store excess crop residue

Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
High cost of concentrates	Increase demand for concentrate	Linkages and partnerships with agro dealers with clear MoU
		Breaking bulk sizes for easier affordability
		Good husbandry practices to increase demand through DFAs
		Training on alternative homemade rations through DFAs
Inadequate portable water for animals during dry season	Availability of safe water during dry spell	Water harvesting technologies
		Linkages with microfinance institutions
		Formation of community innovation groups (CIGs) and advise by DFAs on table banking and creating linkages with other stakeholders

Assessing feed supply in Rangwe Dairy Cooperative

To understand the current dairy production levels and feeding practices, AVCD in collaboration with the county government of Homa Bay carried out an evaluation of farming systems within Rangwe Sub-county with an aim of identifying potential interventions for improved livestock productivity (Ndege 2016). Figure 5 shows the dominant feeds purchased by smallholder farmers in Homa Bay county. Napier grass features dominantly as the main sources of forages for the farmers.

Figure 5: Dominant purchased feed types by kg purchased



Current dry matter requirement for herds in Rangwe Dairy

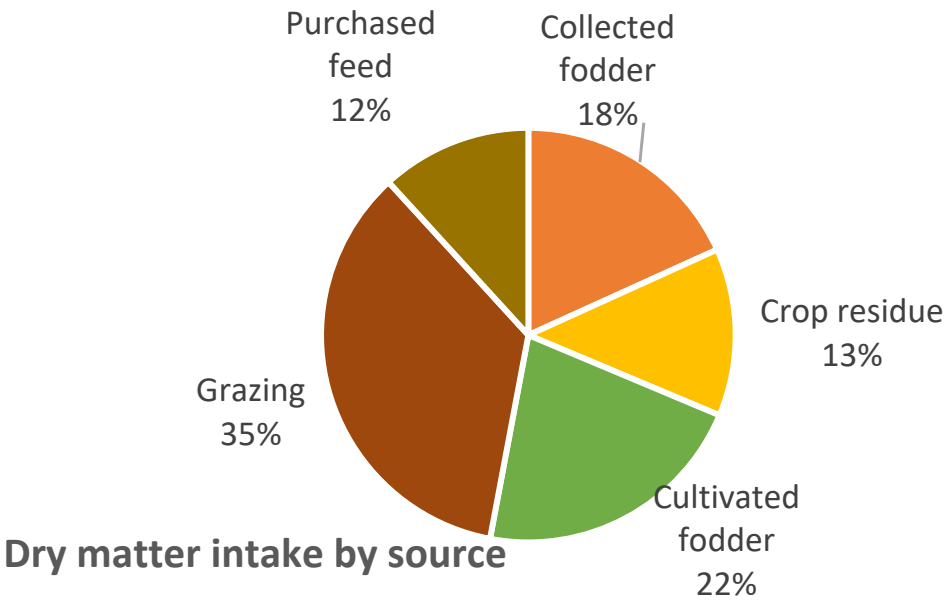
In our calculation, we computed the average weight of a cow (local and improved) to be 275[3] kg (see the respective weights by breed in Table 8). With an average cow consuming 3% of its body weight in dry matter ration per day, this translate to 8.25 kg of dry matter requirement per cow per day. Based on the current herd size of 1,540 animals, Rangwe Dairy Cooperative requires 12,705 kg of dry matter per day to feed all dairy cows. If the cooperative's DM requirement is broken down by breed type, then it requires 5,445 kg and 7,260 kg of DM per day to feed all improved and local cows, respectively. To put this into perspective, Rangwe Dairy Cooperative would require 4,637 tons of dry matter per annum to feed the current herd size of 1,540 cattle. Assuming the cows were fed solely on hay, the dairy would require approximately 309,155 bales per annum (assuming a bale of hay weighs 15 kg).

3. The average weight of a local cow weighing 250 kg and an improved cow weighing 300 kg.

Current dry matter sources for herds in Rangwe Sub-county

The FEAST findings for Rangwe Sub-county (Ndege 2016) provide a detailed breakdown of dry matter intake by source. According to the report, grazing contributes the highest percentage at 35%, followed by cultivated fodder at 22%. Crop residue and collected fodder contributes 13% and 18%, respectively, while purchase feeds account for 12% of the total dry matter intake by cattle in the system.

Figure 6: Sources of total dry matter intake in Homa Bay County



Based on the above proportions, the dry matter intake per annum (current and projected) from the various sources for Rangwe Dairy is apportioned as shown in Table 7.

Table 7: Quantity of dry matter intake for Rangwe Dairy from the various sources

Dry matter intake source	Current		Projected	
	Proportion	Kg	Proportion	Kg
Grazing	0.35	1623063.75	0.35	4,828,950
Own-farm grown (cultivated)	0.22	1,020,211.5	0.22	3,035,340
Crop residues	0.13	602852.25	0.13	1,793,610
Collected fodder (purchased fodder)	0.18	834,718.5	0.18	2,483,460
Concentrate	0.12	556479	0.12	1,655,640
Total	1	4,637,325	1	43,362,000

To meet the projected acreage under fodder, provide high-quality crop residues and the required quantities of concentrates, the dairy extension officers, farmers representatives and the board with the guidance of an AVCD feed specialist developed strategies to bridge the gap see Table 6. Rangwe Dairy is in one on the sub-counties of Homa Bay County that border Kisii County to the south. East and West Gem wards have high dairy potential because they are in agro-ecological zone 2. Rangwe Sub-county receives rainfall twice a year; short and long rain (Ndege 2016). The good climatic conditions coupled with relatively large land holdings and a reliable milk market provided by the dairy cooperative provides favourable pull factors for dairy farming. Most producers are small-scale dairy farmers who lack scale in farming operations, which limits the benefits they would derive through bulk purchase or supply. In recognition of this challenge, the AVCD program is promoting business models around the various feed technologies to cut on the cost of production and create sustained business linkages by leveraging on the number of registered farmers at the cooperative.

Assessing feed demand for Rangwe Dairy by 2025

Rangwe Dairy projects to grow membership threefold over the next five years, which will raise the total membership to 600 from the current 220. The growth in membership coupled with current investment in breeding by development partners and the county government is expected to increase the number of cattle from 1,540 to 4,200 over the next five years. Improved breeds coupled with improved feeding is expected to increase the average weight of a cow from the current weight of 275 kg to 300 kg. This increase in weight will mean that in the next five years, an average cow will feed on 9 kg of dry matter up from the current 8.25 kg, per day. Consequently, DM requirement per annum is expected to rise to 13,797 tons, which is an increment of 9,160 tons from the current 4,637 tons (Table 8).

Table 8: Projected dry matter requirement Rangwe Dairy Cooperative

Indicators	Current scenario	Projected in five years	Change	Notes/assumptions
Total number of dairy Farmers	220	600	380	PO business improves through milk marketing and extension service to farmers
Average herd size improved	3	4	1	Breeding efforts by multi-stakeholders continue
Average herd size locals	4	3	-1	Decrease as farmers embrace AI
Number of dairy cattle (improved)	660	2,400	1,740	Increase in exotic cattle as farmers adopt AI
Number of dairy cattle (locals)	880	1800	920	Increase in local cows as PO recruits more farmers
Total number of cattle	1,540	4,200	2,660	In five years, the population of cattle is expected to grow by 2,600 animals, see above proportional changes by breed
Number of lactating cows	1,155	3,150	1,995	Lactating cows at 75% of the cows in the herd
Average volume of milk produced per dairy cow improved (l)	6	10	4	Milk volumes expected to increase as a result of better breeds, better herd management and feeding
Average volume of milk produced per dairy cow local (l)	2	3	1	Marginal increment in the milk produced by local cows, most of the potential is locked up
Average volume of milk produced per dairy farmer (l)	24	46	22.7	As productivity increase, we expect the total milk production rise from the current 24 to 46 litres per day
Average supply per farmer to the cooperative (l)	3	27	24	Increased production will lead to an increment in the milk share sold to the cooperative.
DM requirement				
Average weight of improved A (kg)	300	350	50	Improved cows record an increase in weight due to better feeding
Average weight of locals B (kg)	250	250	0	Local cows' genetics locked and would not change in weight.
Average cow weight in the area (A+B)/2 (kg)	275	300	25	
DM requirement per cow @3% body weight (kg)	8.25	9	0.75	Dry matter requirement of a cow at 3% of its body weight
Total DM requirement Improved cows per day	5,445	21,600	16,155	Improved cows DM requirement increase in five years as farmers adopt more improved cattle
Total DM requirement locals cows per day (kg)	7,260	16,200	8,940	Local cows DM requirement increases as the cooperative recruits additional farmers with local cows
Total DM requirement per annum (kg)	4,637,325	13,797,000	9,159,675	Overall the DM requirement tripling in five years.

Fodder demand in Rangwe Dairy by 2025

To estimate demand for fodder for the PO, the dry matter intake was converted to respective fresh matter. Based on the assumptions below, we estimated the acreage required to produce the required fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre
- Fodder crops varieties to be planted are *Brachiaria* spp or Rhodes grass

Currently, planted forages (both own-farm and commercially produced) account for 1.8 million kg DM intake annually representing 40% of dry matter requirement. To be able to meet this demand, the dairy cooperative needs to establish 300 acres of planted fodder as shown in Table 9.

Table 9: Acreage of planted forages required to feed cattle in Rangwe Dairy at current and projected rates

Dry matter intake source	Current			Projected		
	Proportion	Kg	Acres	Proportion	Kg	Acres
Grown on farm	0.22	1,020,211.5	165	0.22	3,035,340	491
Commercial fodder production	0.18	834,718.5	135	0.18	2,483,460	402
Total	0.4	1,854,930	300	0.4	5,518,800	893

Concentrate demand in Rangwe Dairy by 2025

Concentrates constitute 12% of the dry matter requirement for cattle in Rangwe Sub-county. This translates to 556 tons of concentrate per annum. In other words, the dairy would require 11,129 bags of 50 kg concentrate feed every year to meet this demand. Over the next five years, the concentrate requirement is projected to grow to 1,655 tons per year, translating to approximately 33,133 bags of 50 kg.

Kasbondo AIM Dairy Farmers Cooperative Society Limited

Background

Kasbondo AIM Dairy Farmers Cooperative Society Limited is a member-owned institution established in 2014 under the Co-operatives Society Act. The society draws its members from Rachuonyo East and Rachuonyo South sub-counties of Homa Bay County, with the main offices located in Oyugis town. The core business is milk aggregation, value addition and sales of milk products to the local market amongst other activities. Milk is supplied by an active supplier base of approximately 114 farmers out of a registered membership of 720. Current milk intake is 470 litres per day and 50% of this volume is processed into cultured milk and yoghurt. The rest is sold as raw pasteurized or fresh milk at the Oyugis market outlet.

Membership of the dairy cooperative is projected to grow in the next five years by an additional 240 members, which would raise its membership to 960. An average member farmer keeps 2 improved and 5 local cows, which implies the members have a total herd of 1,440 improved and 3,600 local cows. There are ongoing efforts to accelerate breeding led by development partners and the county government. Through these efforts, farmers expect to improve their breeds and hence the herd composition is expected to change to four improved and two local cows in the next five years. As farmers improve their cows and membership of the PO grows, the number of improved cows is expected to grow to 3,852 cattle. The local cows will decline to 1,926. The current average milk production is estimated to be 7 and 1.5 litres for improved and local cows, respectively. As livestock productivity increases, milk production is expected to rise as a result of concerted efforts to improve animal breeding, animal health, feeding and animal husbandry. During the next five years, milk production is expected to increase to 10 litres and 3 litres from improved and local cows, respectively. In estimating the body weight of the cows within Kasbondo, service providers relied on heart girth measurement, which is easy to undertake in smallholder dairy systems in Kenya (Lukuyu 2016). The average weight was estimated at 280 kg and 240 kg for local and improved cows, respectively.

Assessing feed constraints and opportunities in Kasbondo Dairy Cooperative

At the onset of the workshop, a participatory exercise to validate feed constraints based on the Feed Assessment Tool (FEAST) was conducted. This process identified constraints to feeds and feeding, potential solutions, and corresponding activities needed to enhance feed production as shown in Table 10. The interventions were identified participatorily and systematically. For each source of dry matter intake, the participants developed a list of constraints, potential solutions and opportunity and activities needed to solve the problems. The identified solutions had to be realistic, actionable and time-bound indicating the person responsible to deliver the solutions.

Table 10: Kasbondo Dairy feed constraints and potential solutions

Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Scarcity of clean and enough water during dry seasons	Digging wells	Sensitize farmers to have their own wells through the DFAs
		Educate farmers to be in loan groups or saccos to be able to have their own wells, linkage with village savings and loan associations (VSLAs) and microfinance institutions through extension
	Roof catchment	Establish linkages with storage tanks suppliers on check-off arrangement with the cooperative

Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Fodder: inadequate fodder due to low conservation level	Increase acreage and diversity of fodder varieties.	Identify suitable varieties for each agro-ecological zones. Linkage to suppliers of the seeds
	Increased extension services	Grouping farmers from different wards and training on different fodder varieties and how to use them during feeding
	Proper conservation methods	Mechanized, commercialized fodder harvesting and bailing using machines through youths and entrepreneurs
Concentrates: Affordability of the products and their varied quality	Homemade rations	Train extension staff on feed formulation
	Bulk breaking	MOU with the agrovets to sell small quantities and group purchase

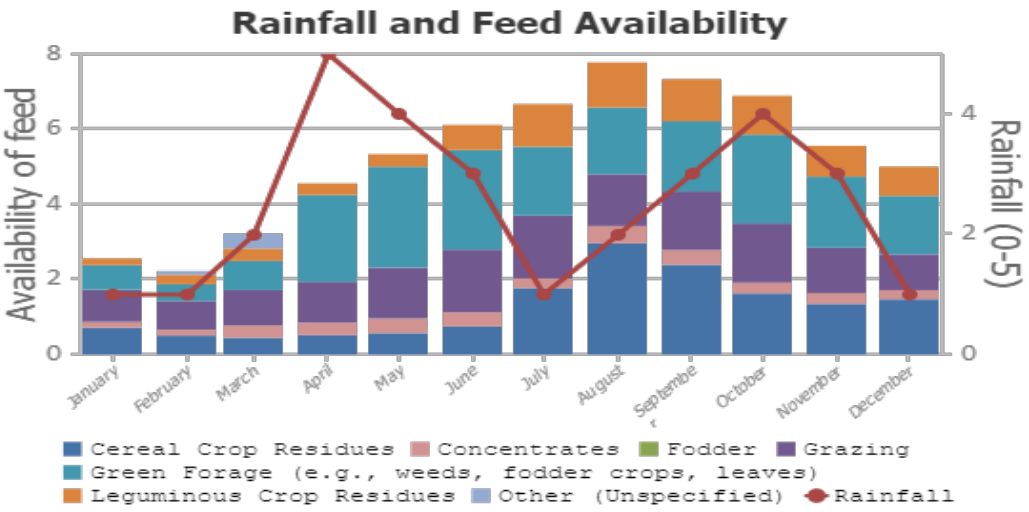
Assessing feed supply and rainfall patterns in Kasbondo Dairy

To understand the current dairy production levels and feeding practices, AVCD in collaboration with the County Government of Homa Bay carried out an evaluation of farming systems in Kabondo/Kasipul Sub-county with an aim of identifying constraints and opportunities for enhancing feed production and potential interventions for improved livestock productivity (Omolo 2016). Rainfall pattern in the area is bimodal with long rains received in the months of April to June commonly referred to as 'chwiri' in the local language. The short rains run from September to November and are commonly referred to as 'opon'. Rainfall is well distributed throughout the seasons with April have the highest amount of rainfall, and January and February the lowest amount of rainfall. The dry season falls between December and March. (Figure 7).

During the long rains, farmers often intercrop maize, beans, millet, sorghum and groundnut while Napier grass is planted along the paddocks and boundaries. Some farmers, however, have pure stands of forage or an interplant of Napier and Desmodium grasses.

In the short rains the main crops planted by farmers are maize, sorghum, millet, beans, sweet potatoes, groundnuts, watermelons and vegetables

Figure 7: Rainfall and feed availability in Kabondo/Kasipul



There is seasonal variation in the style of feeding livestock in Rachuonyo East. During rainy seasons, farmers normally graze on pasture reserved within homesteads and along the roadside reserves while during dry seasons farmers collect grass, Napier grass, crop residues and other fodder off-farm and transport to feed animals.

In this sub-county, it was noted that only 0.5% of the farmers process their feeds. Few mix home-made rations from processed feed such as seed cakes and crushed crop residues

Current dry matter requirement for herds in Kasbondo Dairy

In our calculation, we computed the average weight of a cow (local and improved) to be 260[4] kg (see the respective weights by breed in Table 11). With an average cow consuming 3% of its body weight in dry matter ration per day, this translate to 7.8 kg of dry matter requirement per cow per day. Based on the current herd size of 5,040 animals, Kasbondo Dairy requires 39,312 kg of dry matter per day to feed the dairy cows. When broken down by breed type, the DM requirement for Kasbondo Dairy's dairy cattle is 11,232 kg and 28,080 kg of DM per day to feed the improved and local cows, respectively. To put this into perspective, Kasbondo Dairy would require 14,348 tons of dry matter per annum to feed the current herd size of 5040 cattle. Assuming the cows were fed solely on hay and a bale weighing 15kg, the dairy would require approximately 956,592 bales of hay per annum.

Current dry matter sources for herds in Kabondo Sub-county

According to (Omolo 2016), the dominant style of feeding livestock in the area is tethering for local breeds and some crosses. Animals under zero-grazing are, however, stall fed. Those which normally graze have paddocks reserved for grazing within homesteads and along roadsides. These paddocks are often overgrazed. In the wet seasons, farmers mainly rely on natural pastures and crop residues to feed their animals. During the dry season farmers will collect the natural grasses to feed their animals. There are few farmers who feed animals on planted fodder. What this implies is that most of the dry matter intake by Kasbondo Dairy farmers comes mainly from natural pastures, collected feeds or grazing.

Assessing feed demand in Kasbondo Dairy by 2025

Kasbondo Dairy projects to grow membership by 243 farmers over the next five years, this growth will bring the total registered members 963 up from the current 720 farmers. Growth in membership and the current investment by development partners and county government in breeding is expected to grow the number of cattle from the 5,040 to 5,778 over the next five, representing an increment of 738 cows. Better breeds coupled with proper feeding will mean the average weight of an improved cow is expected to increase from the current 280 kg to 320 kg. In the next five years, the dry matter requirement for an improved cow will be 8.6 kg per day up from the current 7.8 kg a day. Consequently, per annum DM requirement is expected to be 18,031 tons which is an increment of 3,682 tons from the current DM requirement (Table 11).

Table 11: Projected dry matter requirement Kasbondo Dairy

Indicators	Current Scenario	Projected in 5 Years	Change	Notes/Assumptions
Total number of dairy farmers	720	963	243	The PO to plan for 963 farmers enrolled by DFAs
Average herd size (improved)	2	4	2	Breeding efforts by multi stakeholders continue
Average herd size (locals)	5	2	-3	Decrease as farmers embrace AI, local cows mainly kept for cultural reasons

4. The average weight of a local cow weighing 240 kg and an improved cow weighing 280 kg.

Indicators	Current Scenario	Projected in 5 Years	Change	Notes/Assumptions
Number of dairy cattle (improved)	1,440	3,852	2412	Increase in exotic cattle as farmers adopt AI
Number of dairy cattle (locals)	3,600	1,926	-1674	
Total number of cattle	5,040	5,778	738	In five years, the population of cattle is expected to grow by 2,600 animals, see above proportional changes by breed
Number of lactating (cows)	3,780	4,333	553	Lactating cows at 75% of the cows in the herd
Average volume of milk produced per dairy cow (improved) (l)	7	10	3	Milk volumes expected to increase as a result of better breeds, better herd management and feeding
Average volume of milk produced per dairy cow (local) (l)	1.5	3	1.5	Marginal increment in the milk produced by local cows, most of the potential is locked up
Average volume of milk produced per dairy farmer (l)	19	44	24	As productivity increase, we expect the total milk production rise from the current 19 to 44 litres per day
Average supply per farmer to the cooperative (l)	4	27	23	Increased production will lead to an increment in the milk share sold to the cooperative.
DM requirement				
Average weight of Improved A (kg)	280	320	40	Improved cows record an increase in weight due to better feeding
Average weight of Locals B (kg)	240	250	10	Local cows' genetics locked, minimal weight increment.
Average cow weight in the area (A+B)/2 (kg)	260	285	25	
Dry matter requirement per cow @3% body weight (kg)	7.8	8.6	0.75	Dry matter requirement of a cow at 3% of its body weight
Total DM requirement improved cows per day (kg)	11,232	32,935	21,702	Improved cows DM requirement increase in five years as farmers adopt more improved cattle
Total DM requirement locals cows per day) (kg)	28,080	16,467	-11612	local cows DM requirement decrease as the cooperative members improves their cows
Total DM requirement per annum (kg)	14,348,880	18,031,694	3,682,813	

Fodder demand in Kasbondo Dairy by 2025

To estimate demand for fodder for the PO, the dry matter intake was converted to respective fresh matter (as feed basis). Based on the assumptions below, we then estimated the acreage required to produce the fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre.
- Fodder crops planted are *Brachiaria* or Rhodes grasses.

Currently, planted forages (both own-farm and commercially produced) account for 8.6 million kg DM intake annually representing 60% of dry matter requirement. To be able to meet this demand, the dairy cooperative needs to establish 1,394 acres of planted fodder as shown in Table 12.

Table 12: Acreage of planted forages required to feed cattle in Kasbondo current and projected

Dry matter intake source	Present			Projected		
	Proportion	Kg	Acres	Proportion	Kg	Acres
Grown on farm	0.44	6,313,507	1022	0.44	7,933,945	1,284
Commercial fodder production	0.16	2,295,821	372	0.16	2,885,071	467
Total	0.6	8,609,328	1394	0.6	10,819,016	1,751

Concentrate demand in Kasbondo Dairy by 2025

Concentrates constitute 9% of the dry matter requirement for cattle in Kasbondo, this translates to 1,291 tons of concentrate per annum. In other words, the dairy cooperative would require 25,828 bags of 50 kg of concentrate every year to meet this demand. Over the next five years, the demand for concentrates is expected to increase to 1,622 tons per annum, equaling 32,457 bags of 50 Kg.

Osiepe Practical Action

Background

Osiepe Practical Action is a community-based organization (CBO) formed in 2012. The CBO has a registered membership of 150 farmers mainly drawn from Muhoroni, Kisumu County. The CBO's business interests includes milk aggregation and sale, improved fodder promotion, agro dealer shop. On average the dairy cooperative collects 700 litres of milk per day from a pool of 38 active milk suppliers. Milk is mainly sold in the peri-urban town of Muhoroni as pasteurized milk, while baled *Brachiaria* grass is mainly sold to the neighbouring counties of Nandi, Kericho, Kisii, Homa Bay and Siaya. Osiepe Practical Action Dairy is located in Muhoroni Sub-county, one of the sub counties making up Kisumu County covering an area of 699.9 sq km (Atieno, 2016). The sub-county borders Kericho County to the South, Nandi County to the North, and Nyando and Kisumu central sub-counties to the west. Muhoroni receives rainfall twice a year; short and long rains (Atieno 2016). The good climatic conditions coupled with relatively large land holdings and a reliable milk market through the dairy cooperative provide favourable pull factors for dairy farming. Most farmers are small-scale dairy farmers who lack scale in farming operations, which limits the benefits they would derive from bulk purchase or supply. In recognition of this challenge, the AVCD program is promoting business models around the various feed technologies to cut on the cost of production and create sustained business linkages by leveraging on the number of registered farmers at the cooperative.

Osiepe Practical Action is implementing a shared manager extension model, through which the dairy cooperative is reaching approximately 600 farmers. It is this number of farmers that the dairy sought to make feed plans for. An average farmer keeps three improved cows and four local cows. In consideration of its total membership of 600 farmers, it implies the members of the dairy have a herd size of 4,200 cows composed of 1,800 improved cows and 2,400 local cows. Average milk production is estimated at six and two litres for the improved and local cows, respectively. In estimating the body weight of the cows within Muhoroni, service providers relied on heart girth measurement, which is easy to undertake in smallholder dairy systems in Kenya (Lukuyu 2016). The average weight was estimated at 300 kg and 200 kg for improved and local cows, respectively.

Assessing feed constraints and opportunities in Osiepe Practical Action Dairy

At the onset of the workshop, a participatory exercise was conducted to validate feed constraints and opportunities collected using the Feed Assessment Tool (FEAST). FEAST identified constraints to feeds and feeding, potential solutions, corresponding activities needed to achieve the potential solution as shown in Table 13. The interventions were identified participatorily and systematically. For each constraint, the participants developed a list of potential solutions, opportunities and activities needed towards solving the problem. The identified solutions had to be realistic, actionable and time-bound indicating the person responsible to deliver the solutions.

Table 13: Osiepe Practical Action Dairy feed constraints and potential solutions

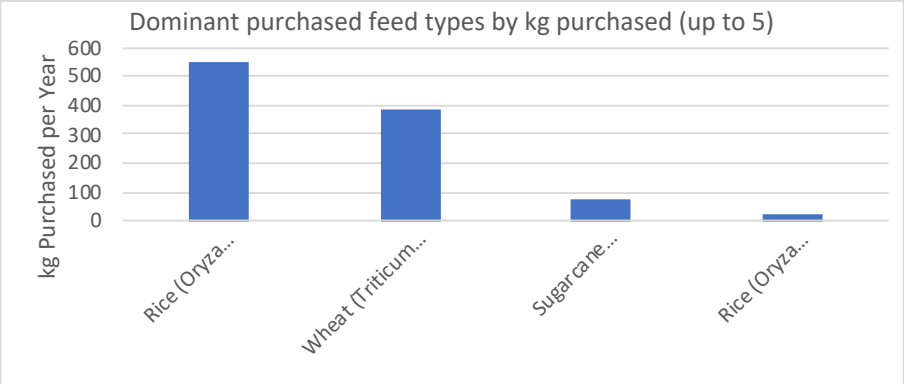
Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Lack of storage facilities and market (fodder)	Commercial hay production storage and sale	Establish 279 acres through leasing of land at cost 30K annually for 6 years
		Improved harvesting, storage and linking commercial farmers to the fodder PO market (recruit farmers through DFAs, train on fodder business models) fodder linkage apps, hay grading app
	Mechanized harvesting through centralized PO shared equipment	Procurement of various machines to be hired at a cost (long-term plan is to buy and own machinery, initial plan is hire from members and redistribute at a cost)
	Set up an aggregation and bulking centre for the cooperative.	Construct a hay barn at a central location (Awasi) with a capacity of 20,000 bales. Support farmers to construct own feed stores. Schematic of farmer owned hay storage
	Feed and fodder processing (Value addition)	Train DFAs/EOs/Board representative on total mixed rations (TMR) and provide technical materials for training farmers. Explore possibilities of acquiring feed pelleting machines. Business model for TMR
	Linking PO to forage seed company	Promoting forage seeds to the farmers (follow up with ACL), information fact sheets for forage seeds distributed. Share suitability maps
Water shortage	Excavation of 7 dams (1 per route) targeted capacity at 200,000 litres to accommodate 20 households per dam	Create awareness to the local community, formation of project implementation committee, identify land and survey for the said purpose, acquire legal documents (Ministry of Water, land board, NEMA, county government) from respective authorities, Hiring machinery for excavation, testing and certifying for viability, payment, election and training of the management committee, establishment of management committee policies
	Roof catchment (140 targeted households) 20 households per route	PO to create awareness, select volunteers and identify their needs, formation of the committee, train the willing participants, provision of soft loans through the cooperative, supervision and monitoring of ongoing work, actual collection of water
Concentrates: high costs and accessibility	Add the number of outlets retailing concentrates (owned by the PO)	Establish two additional outlets for concentrates
		Establishing checkoff system so that farmers can access concentrates on credit
		PO having contracts for direct supply by feed manufacturers to reduce costs of feed (Unga Feeds, link POs to feed manufacturers
	Franchising other feed retailers to supply the PO members (4 in number)	Distribution networks survey for potential retailers to be franchised
		Linking the PO members to the identified retailers
		Drawing formal contracts with the retailers
		Launching the actual feed distribution

Assessing feed supply and rainfall patterns in Osiepe Practical Action Dairy

To understand the current dairy production levels and feeding practices, AVCD in collaboration with the County Government of Kisumu carried out a livestock feed assessment in Muhoroni Sub-county with an aim of identifying potential interventions for improved livestock productivity (Atieno, 2016). There are two cropping seasons in the year: chiri is the long rain season and opon the short rain season. The long rain season sets in at the end of March and slows down some time in August to give way for crop harvesting before chiri sets in in September for the short season crops.

According to (Atieno, 2016), there is enormous pressure on land for food production, cash crop production and fodder crop production. The availability of free fodder from the sugar cane plots, crop residues in form of sugar cane tops and some free grazing land has made the farmers reluctantly allocate land for fodder production. Other important crop residues in the area include maize stover, sweetpotato vines and residue from harvested beans. The dominant purchased feed is rice bran which is mainly fed to poultry and some dairy animals during lactation (Figure 8).

Figure 8: Dominant purchased feed types by kg



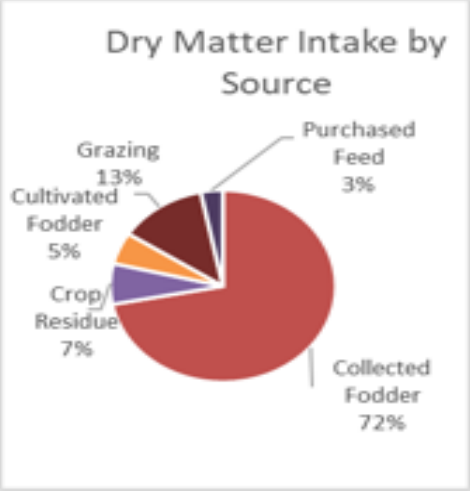
Current dry matter requirement for herds in Osiepe Practical Action Dairy

In our calculation, we computed the average weight of a cow (local and improved) to be 250[5] kg (see the respective weights by breed in Table 15). With an average cow consuming 3% of its body weight in dry matter ration per day, this translate to 7.5 kg of dry matter requirement per cow per day. Based on the current herd size of 3,150 animals, Osiepe Dairy requires 31,500 kg of dry matter per day to feed the dairy cows. When broken down by breed type, the DM requirement for Osiepe Dairy is 13,500 kg and 18,000 kg of DM per day to feed the improved and local cows, respectively. To put this into perspective, Osiepe Dairy would require 11,497 tons of dry matter per annum to feed the current herd size of 3,150 cattle. Assuming the cows were fed solely on hay and a bale weighing 15 kg, the dairy would require approximately 766,500 bales per annum.

Current dry matter sources for herds in Muhoroni Sub-county

The FEAST report for Muhoroni Sub-county (Atieno, 2016) provides a detailed breakdown of dry matter intake by source. According to the report, collected fodder contributes the highest percentage at 72%, followed by grazing at 13%. Crop residue and cultivated fodder contributes 7% and 5%, respectively, while purchase feeds account for 3% of the dry matter intake.

Figure 9: Dry matter intake by source



5. The average weight of a local cow weighing 250 kg and an improved cow weighing 300 kg

Based on the above proportions, dry matter intake per annum from the various sources for Osiepe Dairy is apportioned as shown in Table 14.

Table 14: Quantity of dry matter intake for Osiepe Dairy from the various sources

Dry matter intake source	Proportion	Kg
Grazing	0.13	1,494,675
Grown in own farm (cultivated)	0.05	574,875
Crop residues	0.07	804,825
Collected fodder (purchased fodder)	0.72	8,278,200
Concentrate	0.03	344,925
Total	1	11,497,500

To meet the projected acreage under fodder, provide high-quality crop residues and the required quantities of concentrates, the dairy extension officers, farmers representatives and the board with the guidance of the AVCD feed specialist developed strategies to bridge the gap (see Table 13).

Assessing current feed demand in Osiepe Practical Action Dairy

In assessing the current feed demand for the 600 farmers within Osiepe Dairy, the extension officers estimated the average herd size for a smallholder farmer in Muhoroni. An average farmer keeps at least three improved and four local cows weighing an average of 300 kg and 200 kg, respectively. From the above average herd size, it implies the catchment has a total of 1,800 improved and 2,400 local cows, whose feed demand the team sought to estimate. Based on the 3% dry matter requirement for cows, it implies that a cow averaging 250 kg in Muhoroni would require 7.5 kg of dry matter a day. To put it into perspective, if the dry matter requirement was to be obtained 100% from lush Napier grass with 40% dry matter, a cow would require approximately 19 kg of feed per day. The per annum demand for feeds stands at 11.4 million kg.

Table 15: Projected dry matter requirement for Osiepe Practical Action Dairy

Indicators	Current scenario
Total number of dairy farmers	600
Average herd size (improved)	3
Average herd size (locals)	4
Number of dairy cattle (improved)	1,800
Number of dairy cattle (locals)	2,400
Total number of cattle	4,200
Number of lactating cows	3,150
Average volume of milk produced per dairy cow (improved) (l)	6
Average volume of milk produced per dairy cow (locals) (l)	2
Average volume of milk produced per dairy farmer (l)	24
Average supply per farmer per day (l)	10
Fodder production	
Average weight of improved A	300
Average weight of locals B	200
Average cow weight (A+B)/2	250
Dry matter requirement per cow (kg)	7.5
Fresh matter assumption of Napier grass at 40% kg	18.75
Total dry matter requirement (improved per day) (kg)	13,500
Total dry matter requirement (locals per day) (kg)	18,000
Total dry matter requirement per annum (kg)	11,497,500

Indicators	Current scenario
Bales hay required per annum	766,500
Dry matter sources breakdown based on FEAST	
Total dry matter sources per annum (kg) Grazing 13%	1,494,675
Total dry matter sources per annum (kg) Grown in own farms 5%	574,875
Total dry matter Sources per annum (kg) collected (purchased) fodder 72%	8,278,200
Total dry matter Sources per annum (kg) crop residue 7%	804,825
Total dry matter Sources per annum (kg) concentrate feeds 3%	344,925
Yield of hay per acre /annum (i.e. 200*15 in kg)	6,178
Acres under fodder production (Boma Rhodes and Brachiaria grasses) grown in own farm @ 5%	93
Acres under fodder production (Boma Rhodes and Brachiaria grasses) commercial fodder 72%	1,340
Bags of % 50 kg of concentrate feeds required per annum	6,899

Fodder demand in Osiepe Practical Action Dairy

To estimate demand for fodder for the PO, the dry matter intake was converted to respective fresh matter. Based on the below assumptions, we then estimated the acreage required to produce the fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre
- Fodder crops planted are *Brachiaria* or Rhodes grasses

Currently, planted forages (both own-farm and commercially produced) account for 8.8 million kg DM intake annually equivalent to 77% of the total dry matter requirement. To be able to meet this demand, the dairy needs to establish 1,433 acres of planted fodder as shown in Table 16

Table 16: Acreage of planted forages required to feed cattle in Osiepe Dairy

Dry matter intake source	Current		
	Proportion	Kg	Acres
Grown on farm	0.05	574,875	93
Commercial fodder production	0.72	8,278,200	1,340
Total	0.77	8,853,075	1,433

Concentrate demand in Osiepe Dairy

Concentrates constitute 3% of the dry matter requirement for cattle in Osiepe Dairy, which translates to 345 tons of concentrate per annum. In other words, the dairy would require 6,899 bags of 50 kg of concentrate every year to meet this demand.

Seke Farmers Dairy Cooperative Society Limited

Background

Registered in October 2014, the Seke Dairy Cooperative Society is a peri-urban producer organization located in Kisumu West Sub-county of Kisumu County. The dairy has a registered membership of 75 farmers who actively supply approximately 300 litres of milk per day to the cooperative. Most of the milk is sold raw within Kisumu and the balance is value added to make yoghurt and fermented milk. In collaboration with development actors and the county government, the dairy has been supporting members in improving their cattle breeds through accelerated breeding, which is also known as fixed-time artificial insemination. Members also access extension services through a network of shared managers known as dairy farmer assistants (DFAs). These DFAs have been at the forefront of promoting improved fodder to the members and community at large.

Assessing feed constraints and opportunities in Seke Dairy Cooperative

At the onset of the workshop, a participatory exercise was held to validate feed constraints and opportunities collected earlier using the Feed Assessment Tool (FEAST). The process identified constraints to feeds and feeding, potential solutions, and corresponding activities needed to achieve the potential solution as shown in Table 17. The interventions were identified participatorily and systematically. The participants also developed a list of potential solutions, opportunities and activities towards solving the identified problems. The identified solutions had to be realistic, actionable and time-bound, and indicated the person responsible to deliver the solutions.

Table 17: Seke Dairy feed constraints and potential solutions

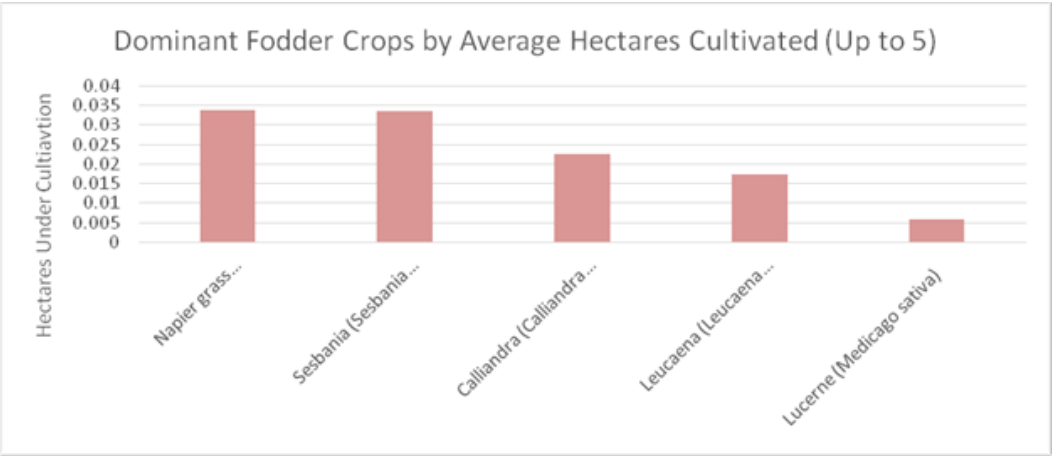
Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Poor quality of concentrates caused by dishonest suppliers	Bulk purchase of concentrate and improved distribution system to farmers	• Engage Lake Feeds to develop an MoU (aim to facilitate bulk supplier of feeds to cooperative, branded and quality-controlled feeds). Heifer International to work out models for farmers accessing concentrates, payment options, distribution mechanism (cooperative outlet, agrovet agents) • Creating linkage for feed analysis (e.g. a quarterly review of feeds being sold to the farmers) • Train DFAs on feed formulation application and feed mixing
Disorganized fodder marketing system (sales mainly at farm gate and small-scale markets at Dago, Kiboswa)	Establish fodder aggregation, marketing groups and centres	• Work with the cooperative to set up a hay aggregation and collection centres • Developing a viable business plan for the business line. Heifer International to assist with business model

Assessing feed supply in Seke Dairy Cooperative

To understand the current dairy production levels and feeding practices among members of Seke Dairy, AVCD in collaboration with County Government of Kisumu carried out an evaluation of farming systems in Kisumu West Sub-county with an aim of identifying potential interventions for improved livestock productivity (Ouma 2016). Figure 10 shows the dominant fodder crops cultivated by smallholder farmers in Kisumu County. Napier grass is the dominant

fodder in most farms, with each household planting an average of 0.03 ha of Napier. Other common fodder crops include *Sesbania*, *Calliandra*, *Leucaena* and lucerne.

Figure 10: Dominant fodder crops by hectares cultivated



Current dry matter requirement for herds in Seke Dairy Cooperative

In our calculation, we computed the average weight of a cow (local and improved) to be 250[6] kg (See the respective weights by breed in Table 19). With an average cow consuming 3% of its body weight in dry matter ration per day, this translate to 7.5 kg of dry matter requirement per cow per day. Based on the current herd size of 2,850 animals, Seke Dairy requires 21,375 kg of dry matter per day to feed the dairy cows. When broken down by breed type, the DM requirement for Seke Dairy is 7,125 kg and 14,250 kg of DM daily to feed the improved and local cows, respectively. This means that Seke Dairy would require 7,801 tons of dry matter per annum to feed the current herd size of 2,850 cattle. Assuming the cows were fed solely on hay and a bale weighing 15kg, the dairy would require approximately 520,125 bales.

Current dry matter sources for herds in Kisumu West Sub-county

The FEAST report for Kisumu West Sub-county (Ouma 2016) provides a detailed breakdown of dry matter intake by source. According to the report, grazing provides the highest amount of dry matter intake by animals (60%), cultivated fodder contributes 14% while crop residues account for 29% of dry matter intake. Only 1% of the dry matter intake is from purchased feeds.

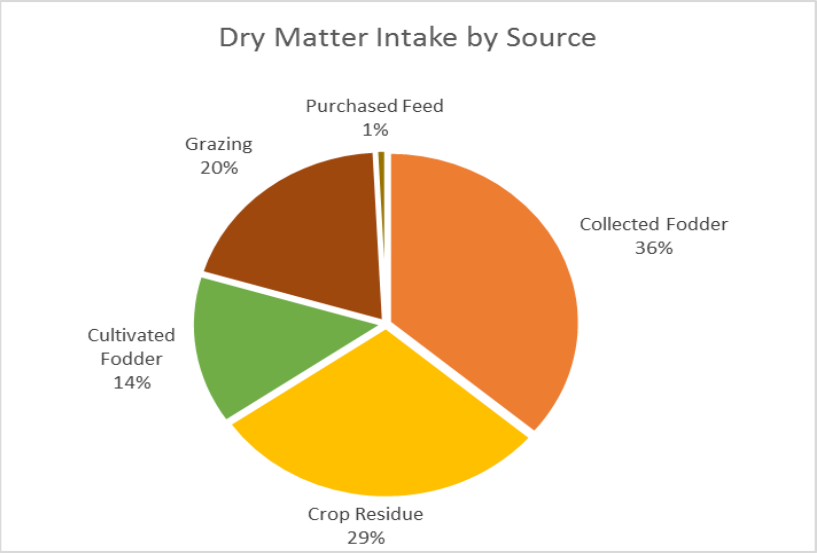
Based on the above proportions, the dry matter intake per annum (current and projected) from the various sources for Seke Dairy is apportioned as follows (Table 18):

Table 18: Quantity of dry matter intake for Seke Dairy from the various sources

Dry matter intake source	Current		Projected (2025)	
	Proportion	Kg	Proportion	Kg
Grazing/collected fodder	0.56	4,369,050	0.56	12,141,360
Crop residue	0.29	2,262,544	0.29	6,287,490
Cultivated fodder	0.14	1,092,263	0.14	3,035,340
Purchase feed	0.01	78,019	0.01	216,810
Total	1	7,801,875	1	21,681,000

6. The average weight of a local cow weighing 200 kg and an improved cow weighing 300 kg

Figure 11: Sources of dry matter intake in Kisumu West Sub-county



To meet the projected acreage under fodder, provide high-quality crop residues and the required quantities of concentrates, the dairy extension officers, farmers representatives and the board with the guidance of the AVCD feed specialist developed strategies to bridge the gap (see **Table 17** Seke Dairy is in an area with good climatic conditions, which supports availability of various livestock feeds that can contribute to improved animal diets and nutrition (Ouma 2016). The good climatic conditions conducive for dairy and the peri-urban locality of the dairy offers a ready market for the milk and provide a favourable pull factors for dairy farming. Most farmers are small-scale dairy farmers and lack scale in farming operations limiting benefits they would derive through bulk purchase or supply. In recognition of this challenge, the AVCD program is promoting business models around the various feed technologies to cut on the cost of production and create sustainable business linkages by leveraging on the number of registered farmers at the cooperative.

Assessing feed demand in Seke Dairy Cooperative by 2025

Seke Dairy projects to grow membership to 1,200 farmers over the next five years from the current membership of 475. Growth in membership and the current investment by development partners and county government in breeding is expected to grow the number of cattle from the 2,850 to 7,200 over the next five years, representing an increment of approximately 900 cows per year. Because of improved breeds coupled with proper feeding, the average weight of an improved cow is expected to increase from the current 300 kg to 350 kg. In the next five years the dry matter requirement for an improved cow will be 8.3 kg per day up from the current 7.5 kg a day. Consequently, per annum DM requirement is expected to grow from the current 7,800 tons to 21,681 tons (see Table 18)

Table 19: Projected dry matter requirement Seke Dairy

Indicators	Current scenario	Projected in five years	Notes/assumptions
Total number of dairy farmers	475	1,200	
Average herd size (improved)	2	4	Decrease in land size, hence intensive production through improved cows
Average herd size (locals)	4	2	
Number of dairy cattle (improved)	950	4,800	
Number of dairy cattle (locals)	1,900	2,400	
Total number of cattle	2,850	7,200	
Number of lactating cows	2137.5	5,400	
Average volume of milk produced per dairy cow (improved) (l)	5	10	Improved feeding, better herd management,

Indicators	Current scenario	Projected in five years	Notes/assumptions
Average volume of milk produced per dairy cow (local) (l)	3	3	
Average volume of milk produced per dairy farmer per day (l)	19	44.5	local, Improved and factor lactating
Average supply per farmer to the cooperative (l)	8	27	cooperative improve on marketing
Fodder production			
Average weight of improved A (kg)	300	350	With good feeding and breeding
Average weight of locals B (kg)	200	200	
Average cow weight in the area (A+B)/2 (kg)	250	275	
Dry matter requirement per cow @3% body weight (kg)	7.5	8.25	
Fresh matter requirement in kg assumption of Napier at 40% DM	18.75	20.625	
Total dry matter requirement improved cows per day (kg)	7,125	39,600	
Total dry matter requirement local cows per day (kg)	14,250	19,800	
Total dry matter requirement per annum (kg)	7,801,875	21,681,000	
Bales hay required per annum assumption of 15 kg per bale	520,125	1,445,400	
Dry matter sources breakdown based on FEAST			
Grazing/collected fodder	4,369,050	12,141,360	
Crop residue	2,262,544	6,287,490	
Cultivated fodder	1,092,263	3,035,340	
Purchase feed	78,019	216,810	
Yield of hay per acre /annum (i.e. 200*15 in kg @ 2,500 per hectare)	6,178	6,178	
Acres under fodder production (Boma Rhodes, Brachiaria) grown in own farm @ 75%	176	491	
Bags of % 50 kg of concentrate feeds required per annum	1,560	4,336	
Machinery			
Number of hay baling machines	2	3	400 bales an hour per machine, 7 hours in a day, one machine can bale for 22 days in a month for two months each season; hence a total of 88 days in a year

Fodder demand in Seke Dairy Cooperative

To estimate demand for fodder for the PO, the dry matter intake was converted to respective fresh matter. Based on the below assumptions, we then estimated the acreage required to produce the fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre
- Fodder crops planted are *Brachiaria* or Rhodes grasses

Currently, planted forages account for 4,369 tons of DM intake annually equivalent to 14% of the total dry matter requirement. To be able to meet this demand, the dairy requires to establish 176 acres of planted fodder as shown in Table 19

Concentrate demand in Seke Dairy Cooperative

Concentrates constitute 1% of the dry matter requirement for cattle in Seke Dairy, this translates to 78 tons of concentrate per annum. In other words, the dairy would require 1,560 bags of 50 kg of concentrate every year to meet this demand.

Sam Malanga Dairy Farmers Cooperative Society Limited

Background

Sam Malanga Dairy Farmers Cooperative Society was founded in 1987 in Alego Usonga Sub-county, Siaya County. Siaya County enjoys a moderate equatorial climate characterized by bimodal rainfall patterns influenced by local relief systems and the expansive Lake Victoria. The area is suitable for crop and livestock farming. The cooperative has a registered membership of 1,339, with only 200 active milk suppliers. The dairy plant has a cooler with a capacity of 8,000 litres and a batch pasteurizer of 500 litres. The dairy is aggregating an average of 250 litres per day and most of the milk is sold within Siaya town.

Management challenges have left the dairy cooperative with huge farmer debts, which have created low member loyalty to the dairy, resulting in insider selling of milk. The cooperative is currently focused on strengthening governance and operational structures with a view to becoming a market leader in the supply of high-quality milk products and livestock inputs in the county. Currently, with the support of the county government the dairy is focused on acquiring milk processing and packing equipment with an aim of adding value to milk thereby generating higher returns for its members. In collaboration with development actors and county government, the dairy has been supporting members in improving their cattle breeds through accelerated breeding, which is also known as fixed-time artificial insemination. Members also access extension service through a network of shared managers known as dairy farmer assistants (DFAs). These DFAs have been at the forefront in promoting improved fodder to the members and community at large.

Assessing feed constraints and opportunities in Sam Malanga Dairy Cooperative

At the onset of the workshop, a participatory exercise was held to validate feed constraints collected earlier using the Feed Assessment Tool (FEAST). The process identified constraints to feeds and feeding, potential solutions and corresponding activities needed to achieve the potential solution as shown in Table 20. The interventions were identified participatorily and systematically. For each problem, the participants developed a list of constraints, potential solutions and opportunities, and activities needed towards solving the problems. The identified solutions had to be realistic, actionable and time-bound, indicating the person responsible to deliver the solutions.

Table 20: Sam Malanga Dairy feed constraints and potential solutions

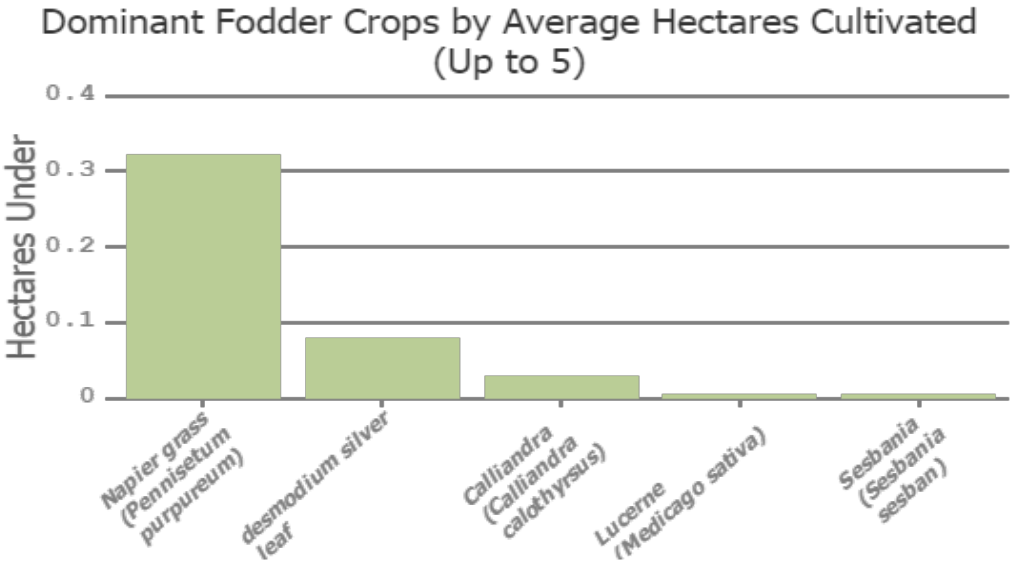
Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
Feed shortage during the dry season	Commercial fodder production and conservation	Target profiled farmers with potential to grow fodder; additional 1 acre per farmer targeting a total of 2,000 farmers Establish linkages with suppliers of fodder seeds Establish linkage to machinery (farmer owned, cooperative owned, establish balers available, tractors, balers and trailers) Establish storage at farm level and cooperative level (at the cooperative level work with POs to construct a hay barn with a capacity of 10,000 bales), simple schematic designs at farm level to be promoted by DFAs Develop an aggregation system of hay through hay collection centres to the cooperative. Hay production and selling system. HIT to support with business model Promote tube silage making through DFAs

Feed constraints	Potential solutions or opportunity	Activities needed towards solving the problem
High prices and poor quality of feed concentrates	Bulk purchase of concentrates and improved distribution system to farmers	Engage SOCCA feeds to develop an MoU (aim to facilitate bulk supplier of feeds to cooperative, branded and quality-controlled feeds). HIT to work out models for farmers accessing concentrates, payment options, distribution mechanism (cooperative outlet, agrovet agents) Creating linkage for feed analysis (e.g. a quarterly review of feeds being sold to farmers) Train DFAs on feed formulation application and train on feed mixing

Assessing feed supply in Sam Malanga Dairy Cooperative

To understand the current dairy production levels and feeding practices, AVCD in collaboration with County Government of Siaya carried out an evaluation of farming systems within Alego Usonga Sub-county with the aim of identifying potential interventions for improved livestock productivity (Mwazighe 2016) Figure 12 shows the dominant fodder crops cultivated by smallholder farmers in Alego Usonga Sub-county. Napier grass is the dominant fodder in most farms, with each household planting an average of 0.3 ha of the grass. Other common fodder crops include silverleaf desmodium, *Calliandra*, *Sesbania* and lucerne.

Figure 12: Dominant fodder crops by average hectares cultivated



Current dry matter requirement for herds in Sam Malanga Dairy Cooperative

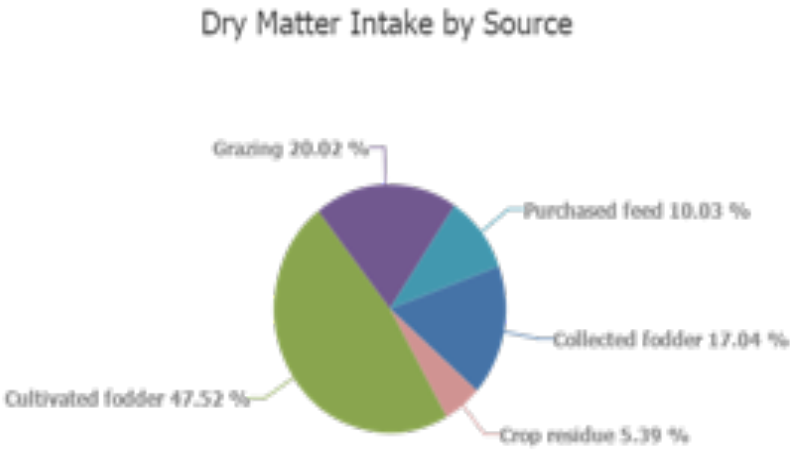
In our calculation, we computed the average weight of a cow (local and improved) to be 250[7] (see the respective weights by breed in Table 22). With an average cow consuming 3% of its body weight in dry matter ration per day, this translate to 7.5 kg of dry matter requirement per cow per day. Based on the current herd size of 5,600 animals, Sam Malanga Dairy requires 42,000 kg of dry matter per day to feed the dairy cows. DM requirement for Sam Malanga Dairy when broken down by breed type is 10,500 kg and 31,500 kg of DM daily to feed the improved and local cows, respectively. This means that the Sam Malanga Dairy would require 15,330 tons of dry matter per annum to feed the current herd size of 5,600 cattle. Assuming the cows were fed solely on hay and a bale weighing 15 kg, the dairy would require approximately 1,022,000 bales.

7. The average weight of a local cow weighing 200 kg and an improved cow weighing 300 kg

Current dry matter sources for herds in Sam Malanga Dairy Cooperative

The FEAST report for Alego Usonga Sub-county (Mwazighe 2016), provides a detailed breakdown of dry matter intake by source. According to the report, cultivated fodder accounts for the highest amount of dry matter intake by animals (47.5%), followed by grazing at 20% and collected fodder at 17%. Purchased feeds contribute 10% of the dry matter intake while crop residue contributes 5%.

Figure 13: Sources of dry matter intake in Alego Usonga Sub-county



Based on the above proportions, the dry matter intake per annum (current and projected) from the various sources for Sam Malanga Dairy Cooperative is apportioned as show in Table 21.

Table 21: Quantity of dry matter intake for Sam Malanga Dairy from the various sources

Dry matter intake source	Current		Projected	
	Proportion	Kg	Proportion	Kg
Cultivated fodder	0.475	7,281,750	0.475	28,086,750
Grazing	0.2002	3,069,066	0.2002	11,837,826
Collected fodder	0.1704	2,612,232	0.1704	10,075,752
Purchased feed	0.1003	1,537,599	0.1003	5,930,739
Crop residue	0.0539	826,287	0.0539	3,187,107
Total	1	15,326,934		59,118,174

To meet the projected acreage under fodder, provide high-quality crop residues and the required quantities of concentrates, the dairy extension officers, farmers representatives and the board with the guidance of the AVCD feed specialist developed strategies to bridge the gap (see Table 20). Most parts in Alego Usonga Sub-county are classified as the low-midland zones (LM2 and LM3). These are sub-humid and humid zones with reliable precipitation. The sub-county experiences bimodal rainfall, with long rains falling between March and June and short rains between September and November (Mwazighe 2016). Most farmers are small-scale dairy farmers and lack scale in farming operations limiting benefits they would derive from bulk purchase or supply. In recognition of this challenge, the AVCD program is promoting business models on various feed technologies to cut on the cost of production and create sustained business linkages by leveraging on the number of registered farmers at the cooperative.

Assessing feed demand in Sam Malanga Dairy Cooperative by 2025

Sam Malanga Dairy projects to grow membership to 2,000 farmers over the next five years from the current 700. Growth in membership and the current investment by development partners and county government in breeding is expected to grow the number of cattle from the current 5,600 to 18,000 over the next five years, representing an increment of approximately 2,480 cows per year. Improved breeds coupled with proper feeding are projected to increase the average weight of an improved cow from the current 300 kg to 350 kg. In the next five years, the dry matter requirement for an improved cow will be 9 kg per day up from the current 7.5 kg a day. Consequently, per annum DM requirement is expected to grow from the current 15,330 tons to 59,130 tons (see Table 22).

Table 22: Projected dry matter requirement Sam Malanga Dairy

Indicators	Current scenario	Projected in five years	Difference
Total number of dairy farmers	700	2,000	1,300
Average herd size (improved)	2	5	3
Average herd size (locals)	6	4	-2
Number of dairy cattle (improved)	1,400	10,000	8,600
Number of dairy cattle (locals)	4,200	8,000	3,800
Total number of cattle	5,600	18,000	12,400
Number of lactating cows	4,200	13,500	9,300
Average volume of milk produced per dairy cow (improved)	8	12	4
Average volume of milk produced per dairy cow (local)	1	1.5	0.5
Average volume of milk produced per dairy farmer	20.5	64.5	44
Average supply per farmer to the cooperative	6	30	
Fodder production			
Average weight of improved cattle A (kg)	300	350	50
Average weight of locals B (kg)	200	250	50
Average cow weight in the area (A+B)/2 (kg)	250	300	50
Dry matter requirement per cow @3% body weight (kg)	7.5	9	1.5
Fresh matter requirement in kg assumption of Napier at 40% DM	18.75	22.5	3.75
Total dry matter requirement improved cows per day (kg)	10,500	90,000	79,500
Total dry matter requirement locals cows per day (kg)	31,500	72,000	40,500
Total dry matter requirement per annum (kg)	15,330,000	59,130,000	43,800,000
Bales hay required per annum assumption of 15 kg per bale	1,022,000	3,942,000	2,920,000
Dry matter sources breakdown based on feast			
Total dry matter Sources per annum in kg cultivated fodder	7,281,750	28,086,750	20,805,000
Total dry matter Sources per annum in kg grazing	3,069,066	11,837,826	8,768,760
Total dry matter sources per annum in kg collected fodder	2,612,232	10,075,752	7,463,520
Total dry matter sources per annum in kg purchased feed	1,537,599	5,930,739	4,393,140
Total dry matter sources per annum in kg crop residue	55,086	3,187,107	0.1003
Yield of hay per acre /annum (i.e. 200*15 in kg @ 2,500 per hectare)	6,178	6,178	0
Acres under fodder production (Boma Rhodes and Brachiaria grasses) grown in own farm @ 48%	1,179	4,547	3,367.8
Bags of % 50 kg of concentrate feeds required per annum	30,752	118,615	87,862.8

Fodder demand in Sam Malanga Dairy Cooperative

To estimate demand for fodder for the PO, the dry matter intake was converted to respective fresh matter. Based on the below assumptions, we then estimated the acreage required to produce the fresh matter.

Assumptions in estimating acreage:

- Yield of 2,500 kg of dry matter per hectare equivalent to 6,178 kg per acre
- Fodder crops planted are *Brachiaria* or Rhodes grasses

Currently, planted forages account for 7,281 tons of DM intake annually equivalent to 48% of the total dry matter requirement. To be able to meet this demand, the dairy requires to establish 1,179 acres of planted fodder as shown in Table 22

Concentrate demand in Sam Malanga Dairy Cooperative

Concentrates constitute 10% of the dry matter requirement for cattle in Sam Malanga Dairy, this translates to 1,537 tons of concentrate per annum. In other words, the dairy would require 30,752 bags of 50 kg of concentrate every year to meet this demand.

Implementation of the feed plans

Building capacity

Livestock extension services play a critical role in in enhancing uptake of improved dairy technologies and practices leading to improved dairy productivity (Rao, 2019). The AVCD program supported dairy cooperatives to implement a private sector-led Dairy Farmer Assistant (DFA) extension model. The extension agents (DFAs) are at the forefront of rolling out technologies to the farmers and providing technical backstopping. DFAs were involved in the feed planning process and the program organized a workshop through which DFAs were trained (online) on feeds and feeding. Lack of skills in ration formulation was identified as a key challenge in value addition of crop residues (sugar cane tops, maize stover). There is need to invest in training DFAs on feed ration formulation and follow up on how farmers are trained on mixing of feeds. Lastly, the program has invested in an open source self-learning module where DFAs and extension service providers can go for a refresher course on dairy farming.

Business models

AVCD through Heifer International is providing technical capacity building on commercialization of various interventions with an aim of creating sustained business linkages beyond the project life cycle. On forage establishment, the program is working with farmer cluster leaders popularly known as common facilitators to establish bulking plots that will be a source of planting materials. Through these community bulking plots, farmers will access clean seedlings, Napier grass vines, *Desmodium* spp and *Brachiaria* grass at an affordable price within their locality. Harvesting of forages is tedious and time consuming and most farmers shy away from the ideal practice of bulk cutting and storage, which would allow them to weed and apply manure on their forages. AVCD through the cooperatives is promoting use of mechanized harvesting using brush cutters. The machines will not only alleviate the labour demand for harvesting but also create employment for the youths. The machine can be owned by one young person in the cooperative who will provide cutting services at fee to the other members of the cooperative. In making quality rations, one of the challenges has been access to pulverizers to shred fodder. The program is working with producer organizations on linking the dairies to suppliers of machines and capacity building some of their members not only to provide the chopping services but also assist with mixing of feed rations. On concentrates, farmers cite the high cost mainly occasioned by the low quantities they are purchasing. To mitigate the high cost of concentrates, the cooperatives agreed to identify an agrovet they can engage for preferential terms. Such terms will allow members to enjoy discounted prices, assure on quality of concentrates and enable flexible payment options through cooperative-facilitated check-off systems.

Conclusion

Feed plans are dynamic documents that constantly require updating as circumstances change. In this regard the dairy cooperatives are to set up subcommittees from the board that will champion the feeds agenda. The committees will oversee integrating feed planning into the strategic plan and developing a multi stakeholder platform to advocate and champion feeds agenda.

Adoption of productivity enhancing technologies (improved feeds, breeding and herd management) currently being promoted within the cooperative is pegged on the cooperative being able to market members surplus. Farmers will not adopt technologies to improve production if the market is uncertain. Corresponding efforts to improve market reliability and collective action at the cooperative need to accompany ongoing farm investments. Failure to address milk marketing challenges will lock farmers in a low-input low-output vicious cycle.

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Annexes 1. List of dairy farmer assistants consulted

Name	Contact	Position	Hub/PO	County
Jackline Awino Oluoch	711209184	DFA	Kasbondo	Homa Bay
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