Characterization of the livestock production systems and potential to enhance dairy productivity through improved feeding in sub-humid western Kenya

Muyekho F.N., B. Lukuyu[2] and A.J. Duncan[2].

[1]Masinde Muliro University of Science and Technology
[2]International Livestock Research Institute

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Acronyms

AI	Artificial Insemination
CP	Crude Protein
DM	Dry Matter
EAPP	East African Productivity Project
ECF	East Coast Fever
FEAST	Feed assessment tool
FGD	Focused Group Discussion
GDP	Gross Domestic Product
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency syndrome
ICIPE	International Centre for Insect Physiology and Ecology
KARI	Kenya Agricultural Research Institute
ME	Metabolisable Energy
PRA	Participatory Rural Appraisal

Introduction and background

Livestock farming contributes significantly to the economies of the Western Kenya (Ojowi et.al 2001 and KARI Kakamega 2006) through generation of tangible and intangible products (World, 2005). Within the region, most of the milk produced is marketed informally and is thus an important source of employment and income in rural areas from production at household level to informal transporters and retailers in the urban centres (EAPP Final Document). In addition, a regular supply of milk provides nutritional security for many rural poor families, affordable nutrients to improve the well-being of those suffering from HIV/AIDS and generates more regular household income and jobs than many other farming enterprises in Eastern Africa (Nicholson et al., 2003).

Western region is considered a high dairying region because of the favorable climatic conditions and soils (Jaetzold et. al. 2009), but productivity of its herd is much lower compared to similar regions like Central Kenya and the North Rift Valley because poor dairy genetic resources kept by farmers. According to estimates by Waithaka et al. (2002) only 13% of the households kept improved dairy cattle. This implies that, there is a lot that need to be done to attain the standards of other regions with similar climatic conditions. Another major challenge to increasing dairy productivity in the highly populated regions of Western Kenya is inadequate quality livestock feeds (KARI Kakamega 2006 and Ojowi et.al. 2001). This is particularly critical during the dry season, when dairy herds are forced to rely on low quality feed resources, which are nutritionally deficient in energy, nitrogen, minerals and vitamins with minimal supplementation. Most dairy farming in this region is practiced by smallholder farmers which are densely populated. These conditions forces farmers to allocate most of the available land to food crops and leaving very little for planted pasture/fodders and natural grazing. With increased crop productivity dairy cattle are therefore fed on crop residues and Napier grass (*Pennisetum purpureum* Schumach) which is planted on average in less than 0.5 of an acre. However, Napier stunt disease caused by phytoplasma, have since mid-1990's caused forage yield reduction of up to 90% (Lusweti et al., 2004; Mulaa et al., 2004), and is currently the biggest threats to forage production and hence dairy sector in the region. According Mr. Sagala of Heifer international Western Region (Personal Communication) there has been milk yield reduction of 20 -40% due to under feeding and destocking due to inadequate feeds as a result of the stunt disease.

This constraint calls for a combination of solutions besides improved breeds. There is need for improving animal productivity through more intensification and utilization of crop livestock interactions; .and promotion and adoption of genetically diverse, high yielding, and climatically adapted grasses that are tolerant to diseases. Therefore, in order to design site specific strategies for sustainable feed supply and utilization, the current survey was conducted with the following objectives:

1. To assess feed resource availability and utilization using FEAST within the context of the overall dairy value chain at four specific sites in Western Kenya
2. To determine the potential of site-specific feed interventions in selected areas

Methodology

Study sites

Four sub-Counties, namely Matayos (Busia County), Sabatiab (Vihiga County), Kisumu West (Kisumu County) and Marani (Kisii County) falling within the subhumid zone of Western Kenya were used in the study. Specific sites (wards) representing a typical rural setup and peri-urban communities were then selected for the PRA.

Participant selection

Participants were selected by the research team comprising of local/field agricultural/livestock production extension officers, research scientist from Masinde Muliro university of Science and Technology and Local administrators. At each site, 18 to 25 farmers were involved in group PRA discussion. Land holding, age, education status and gender were then the basis for selecting the nine farmers for individual interviews.

Data collection

Participatory Rural Appraisal (PRA) group discussions and key informant interviews were used to collect data. All selected individuals were used for the PRA group discussions. After completion of the PRA group discussion, nine individuals underwent individual interviews. The PRA group discussions focused on description of the general farming and livestock production systems and feed resource availability and utilization while the individual interviews focused on overall feed availability, quality and seasonality

Data analysis

The quantitative data collected during individual interviews was analyzed using the FEAST excel template (www.ilri.org/feast), a feed assessment tool that has been developed to help to design site specific strategies for feed supply and utilization. The qualitative data collected using the PRA group discussions was synthesized and summarized.

Chapter 1: Characterizing the livestock production system and potential to enhance productivity through improved feeding in Matayos in Busia county, Kenya

By Francis N. Muyekho[1], Donald Siamba[1], Humphrey Agevi[1] and Sebastian Okotsi[2]
[1] Masinde Muliro University of Science and Technology
[2] District Livestock Production Officer, Matayos sub-county

The Feed Assessment Tool (FEAST) was used to characterize the feed-related aspects of the livestock production system in Matayos, sub County, Busia County of Kenya. The assessment was carried out through focused group discussions (FGDs) and completion of short questionnaires at 3 sites representing peri-urban and near tarmac road and typical rural setup. At each site nine key farmers were interviewed, 3 each owning small, medium and large scale farms on the 22nd of November and 3rd December 2013.

The farming system is a mixed crop livestock production system. Cattle (predominantly local) are the most important livestock species In Matayos Sub-county. Improved dairy production is constrained by inadequate feeds and high cost of disease control in all the wards. Lack of improved breeds in Nasewa and Lwang'a and milk marketing are also constraints that require attention to activate commercial dairy productivity in the sub-county. To mitigate these constraints farmers suggested an integrated approach to improve livestock production through (i) expanding area under fodder crops with those tolerant to Napier grass stunt disease and those tolerant to drought, (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings especially in Nasewa and Lwang'a, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Background

Matayos is one of the seven sub-counties in Busia County lying between latitude 0 o N and 0010' N longitude 34 O E. and 34 6'0 E. It borders the Republic of Uganda on the West, Teso sub-county on the North, Nambale sub-county on the North East, Butula sub-county on the South East and Samia sub-county on the South West. Matayos sub-county is made up of seven wards namely; Burumba, Mayenje, Bukhayo West, Matayos North and Matayos South covering a total area of 196.1 km2. Table 1.1 shows the current administrative wards and its population structure.

Rable 1.1. Matayos sub-county administrative wards and its population structure

Administrative wards	Area (ha)	Households	Population		Total
			Male	Female	
Bukhayo West	7280	6700	16384	17096	33480
Bisibwabo	3250	2253	5359	5969	11328
Nang'oma	2840	2504	5847	6411	12258
Lwanya	1830	1832	4093	4660	8753
Nasewa	2180	1979	4611	5252	9863
Township (Burumba)	2230	8558	17283	18380	35663
Total	19,610	23,826	53,577	57,768	111,345

Matayos sub-county has a population of 111,345 (males 53,577 and females-57,768). There are 23,826 households and a density of 567.8 people per km2 according to the 2009 National population and household census. The community is cosmopolitan with a cross section of ethnic groups as inhabitants. The residents include members of the Luhya (mainly Khayo sub tribe), Luo, Teso, Kikuyus and Somali ethnic groups. Average family size is 6 members and average farm holding is 1 (one) hactre. The major economic activities of the residents include; retail and wholesale businesses, small scale farming, transport business, real estate, hotel industry and buying and selling of cereals. Despite the aforementioned economic activities, the sub-county is faced with high poverty levels of 60%.

The sub-county receives a bimodal rainfall pattern which ranges from 1200 to 1500 mm per year with average annual rainfall of 1690 mm. The long rains are received between March and July while the short rains are received from September to November. The months of January to February are relatively dry. The maximum temperatures range is 26°C while the annual mean temperature is 20°C. The sub-county is dominated by the Low Midland 1 (LM1) and lies at an altitude of 1000 to 1231 m.a.s.l. The soils are well drained moderately dark reddish brown clay loam (Orthic acrisols). The sub-county is traversed by river Sio which divides it halfway.

Materials and methods

To characterize the livestock production system, with emphasis on dairy cattle, and its potential to enhance productivity through improved feed and feeding interventions in Matayos sub-county, a three-step approach was performed. First, synthesis/analysis of available secondary data to establish the status of the general farming system in the sub-county was carried out as a preamble to a Participative Rural Appraisal (PRA). Second and third stages were PRA and individual farmer interviews, respectively, using the Feed Assessment Tool (FEAST, version, Duncan et al., 2012) to characterize the livestock production system and, in particular, feed-related aspects. The FEAST tool is a rapid and systematic method that combines a PRA (Participative Rural Appraisal) with individual farmer interviews.

The PRA provides an overview of the farming system, in particular, the livestock production system. It also helps identify major problems, issues and opportunities within the livestock production system. The individual farmer interview gathers both quantitative and qualitative information according to major wealth groups based on relative land size owned. The assessment was carried out through two structured group discussions and completion of short questionnaires by key farmer representatives in Nasewa and Lwanya locations/wards on 22nd November 2013; and Burumba administrative Locations on 3rd December. Nasewa is a typical rural set up accessed only by an earth road from Matayos town, Lwanya boarders the Busia – Kisumu tarmac road and represents a transition zone between the more rural Lwanya to more urbanised Burumba ward in the Busia Township.

The PRA at Lwanya and Nasewa wards was preceded by a PRA training on 21st November 2013. The composition of the groups is shown in Table 1.2. Participating farmers were chosen by the sub-county Livestock Production Officers, Busia County Ministry of Agriculture and Livestock. Overall 25 persons participated in the group discussion in Lwanya and Nasewa wards and 18 in Township ward (Table 1.2). From each PRA group, 3 representatives for different wealth classes (Table 1.2) were chosen for the individual interviews. The following are findings of the assessment and conclusions for further action.

Table 1.2. Group composition of farmer representatives for feed assessment applying FEAST in Matayos sub-county, Busia County Kenya

Site	Men	Women	Total
Burumba (Township location)[1]	9 (5)	9 (4)	18 (9)
Lwanya location (Blanda)[1]	10 (5)	15 (4)	25 (9)
Nasewa location (Agori) [1]	16 (6)	9 (3)	25 (9)

[1]Sub-county administrative locations (what in brackets is the venue of PRA)
Number of individual interviews in parentheses

Results and discussion

The results presented and discussed below are an integrated analysis of the secondary information and the primary data using the FEAST.

Land holdings

The average land holding in the study sites is presented in Figure 1.1. Although Nasewa is typically a rural farming area, the results from the PRA indicate that the majority of the farming households are categorised as smallholders with land sizes < 1 hecter. The bigger portion of the land available in this rural setup is held by few households classified as medium and large farmers. In township ward, majority of the farmers fall under small farmer category while in Lwanya, the land holdings among the farmer categories can be described as normal distribution.

Food crop production

The high and reliable rainfall coupled with moderate temperatures and good soils is suitable for growing crops. About 80% of the county is arable. Therefore, Agriculture is an important part of the livelihoods of the people of Matayos sub County.

Lwanya has the greatest diversity of crops grown (14 crops) while Nasewa and Burumba had 10 crops, despite the small landholdings (Figure 1.2). Maize is the dominant crop in all the locations and is in most cases intercropped with beans (Figure 1.3). In Nasewa, maize was closely followed by sugarcane and cassava. The next important crops for farmers in Burumba (Township) was bananas and beans, while in Lwanya it was cassava and beans. Thus, maize is a basic food crop mainly supplemented by cassava and beans while sugarcane is the chief cash crop in the rural Nasewa ward most likely on few medium and large farms as shown in Figure 1.1. Households in surveyed areas are composed of approximately 6-8 people per household at all the sites.

Farmers described two distinct cropping seasons based on the rainfall patterns and the time of crop harvest. The long rainfall season 'Irotso' extends from March to June, while the short rainfall season '**Sirumbi**' is from September to November. It is in the main dry season '**Simiyu**' from January to February, when almost no precipitation takes place. Finally, '**Likesa**' refers to the harvesting season from July to August and December and these months are characterized by very low rainfall (Table 1.3).

The reduced rains during this period facilitates harvesting of the crops and provides opportunities for utilization of the crop residues as animal feed. Due to well distributed and adequate amount of rains, agricultural activities are mainly rain-fed except for 20% of the farmers live along the course of the rivers who practice bucket irrigation on vegetables during the dry season. Labour is generally available and is mostly required in the rain season for land preparation, planting and harvesting. It costs KShs 100 – 150 plus food (tea and lunch) in Nasewa and Lwanya while in township labour costs KShs 500 per day without meals. Many of the youth 70 to 80% prefer moving to towns in search of alternative jobs instead of providing labour in the farms.

Crop production is almost entirely rainfed. Although there exists potential for irrigation, adoption of the technology is still low. Bucket irrigation is commonly practiced along river valley bottoms. There is however an upcoming lower Sio Basin Irrigation project by the National Irrigation Board. Valuation for compensation of farmers whose farms would be used for setting up the canals and other structures is in progress and the project is expected to cost Kshs 3 billion.

From the results presented above, land is a limiting factor although the prevailing condition favour maize production in two seasons per year. This provides opportunities for use of crop residues as livestock feed. Intercropping with leguminous crops such as beans and growing of sugarcane further enhances the quantity of the residues available and he potential for specific interventions to improve the nutritional status of livestock especially dairy animals..

Average land per household in Nasewa

Average land per household in Burumba (Township)
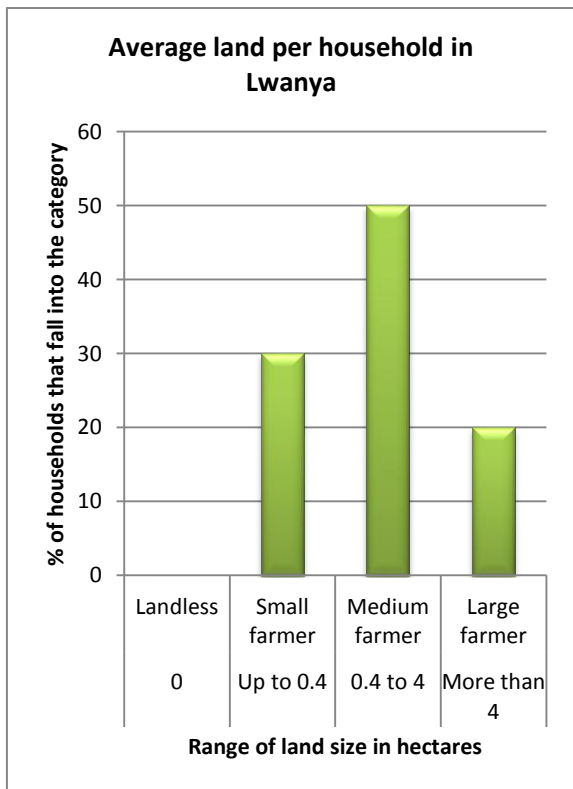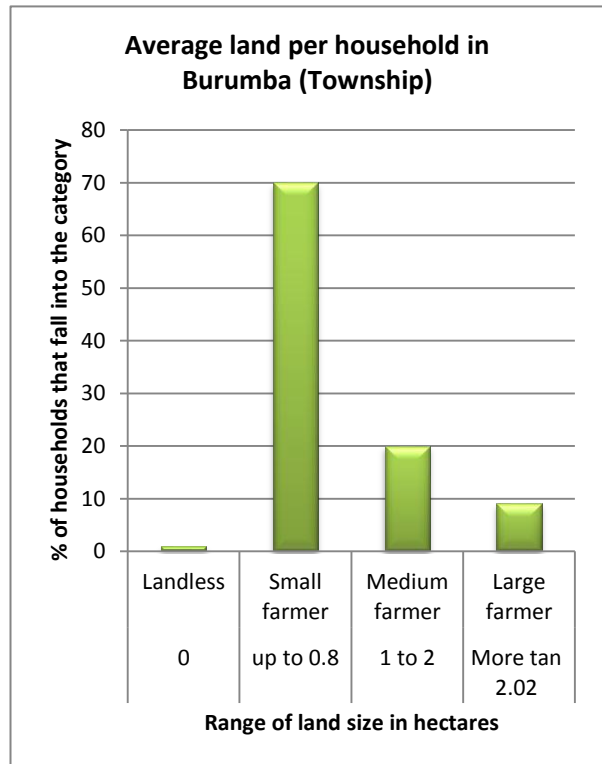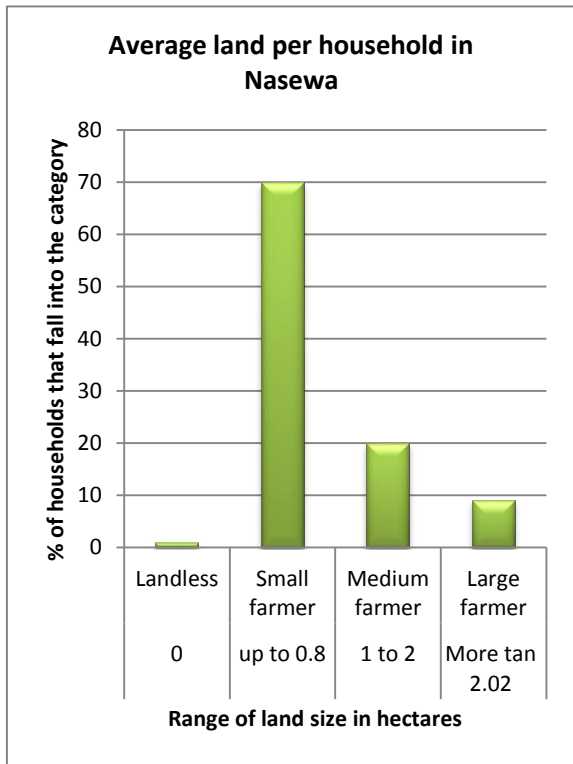
Average land per household in Lwanya

Figure 1.1. Average landholdings in Nasewa ward, Burumba township, and Lwanya ward, Matayos sub-county
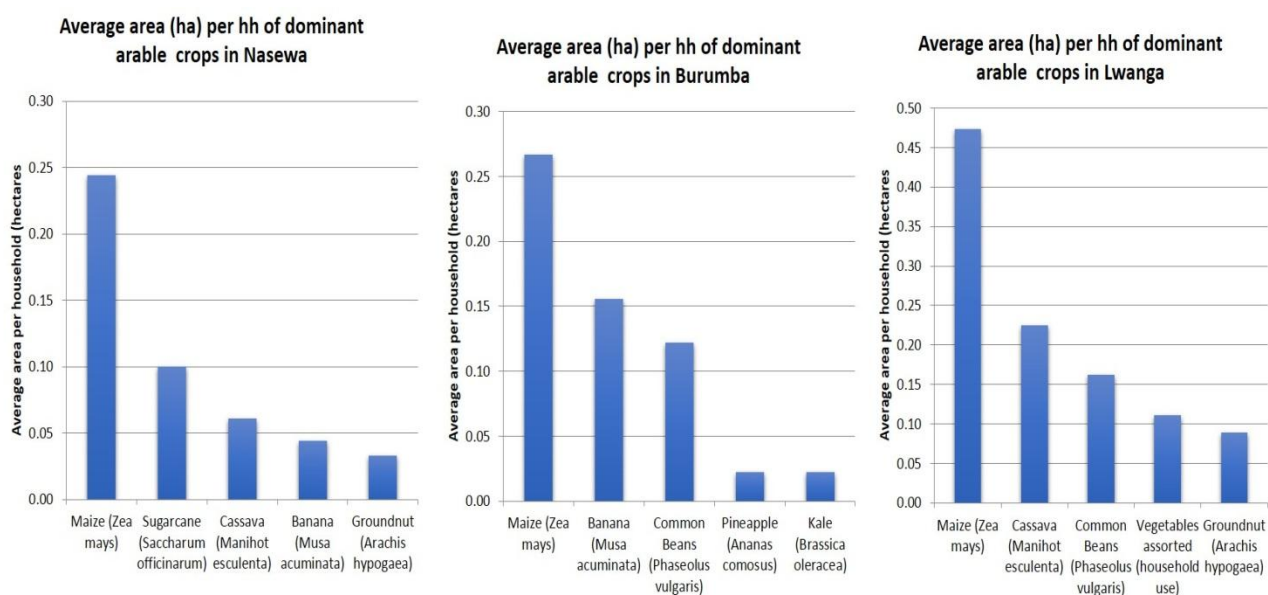
Figure 1.2. Average area (ha) per household of dominant arable crops Nasewa ward (left), Burumba township (middle) and Lwanya ward (right), Matayos sub-county

Table 1.3. Cropping seasons occurring in Matayos

Name of season	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Long Rain (Irotso)			██	██	██	██						
Short Rains (Sirumbi)									██	██	██	
Dry (Simiyu)	██	██										
Likesa							██	██				██

Livestock production

Livestock Production forms an integral part of Agriculture and almost every farming household keeps ruminants and all of them keep indigenous chicken (sub-county Annual Report 2012). Improved dairy cattle form only 15% of the cattle population in the sub-county and dairy goats are less than 200 (Table 1.4). Common dairy cows are zebu crosses with Friesian, Jersey and Aryshire and between the exotic breeds. Since 2010, the sub-county has recorded a steady increase in milk production with 5.5 million litres produced in 2013, representing a 15% increase compared to 4.7 million litres in 2010 (Figure 1.3). The sub-county however is still a milk deficit and relies on milk from the North Rift counties in Kenya and Uganda.

Table 1.4. Livestock population trends

| Species/crops		2013	2012	2011
Cattle	Grade/Crosses	3,590	3,570	3,515
	zebu	20,900	20,704	20,499
Goats	Local (meat)	7,665	6,660	6,500
	Dairy (Grade)	180	122	108
Sheep	Hair	-	6,150	5,890
Poultry	Indigenous	131,500	128,689	125,689
	Layers	1,000	600	2,000
	Broiler	1,200	1150	800
	Ducks	3,500	4,290	1,276
	Turkey	1,800	1,575	587
	Geese	375	252	143
	Cockerels		Nil	900
Pigs	-	-	10,368	10,432
Bee Hives	KTBH	300	349	346
	Langstroth	450	450	355
	Long hives	110	110	89
Donkey		21	0	0
Emerging Livestock	Guinea fowl	600	692	765
	Quails	1,000	400	200
	Pigeons	1,600	1,590	1,650
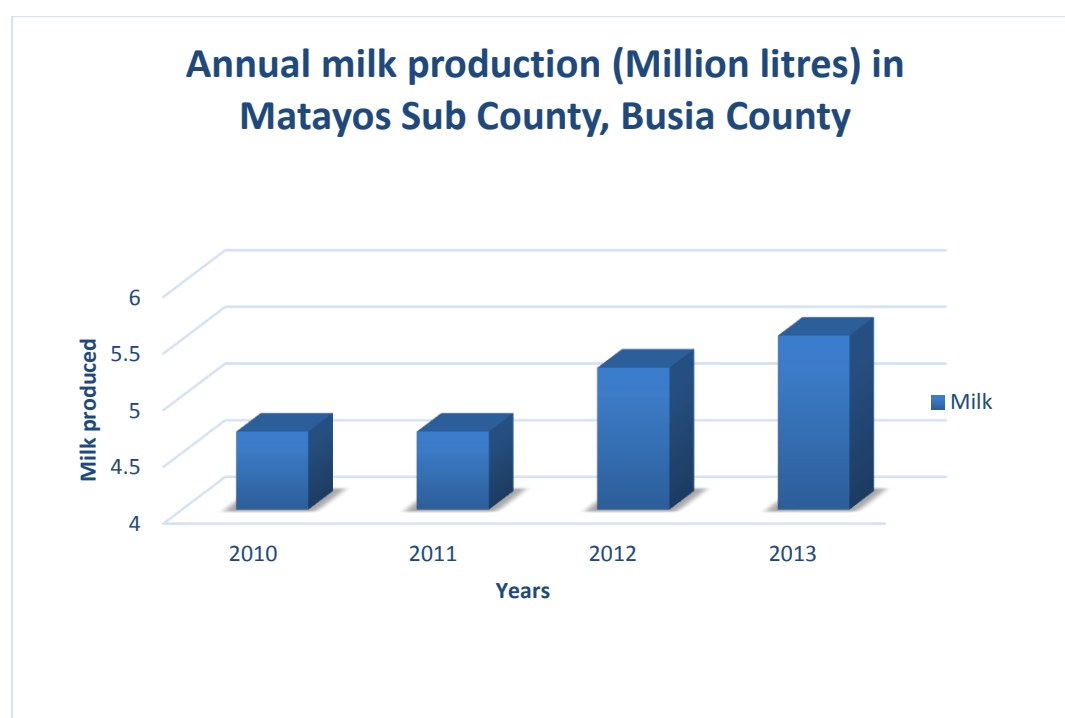
Figure 1.3. Milk production in Matayos sub-county

In terms of livestock improvement, most of the farmers use locally available bulls which are of low quality for breeding purposes. Only a few farmers use artificial insemination (AI) due to the high cost which ranges from US$ 12.5 to 18.75 (KSh 1200 to 1500). A.I. service providers are majorly in Busia town. Poultry is also a flourishing enterprise in the sub-county with an encouraging increase in population of emerging birds like Guinea fowls, Pigeon and Quails (Table 1.4).

Livestock production systems

The most common livestock production systems in Matayos were:

- The **zero-grazing system** with well-designed units, practiced by farmers who have improved livestock and this is mostly in Busia Township (Burumba). Farmers in this category practice cut and carry feeding systems. Fodder is often chopped before feeding and often supplemented with concentrate feeds.
- The **semi-zero-grazing** mainly used for keeping crossbreed cattle. Cattle are kept in fabricated zero-grazing unit (not build to standard) or tethered in the homestead during the day but provided with feed from the farm or collected from outside. This system is more common in Nasewa and Lwanya.
- **Tethering and free grazing** – mainly practiced for local cattle and predominant in Lwanya and Nasewa where majority of the households have higher numbers of local cattle.

In Burumba Township majority of the famers (70%) keep on average two improved dairy cattle per household (Table 1.5), while those of Nasewa and Lwanya kept on average 1.4 to 1.6 improved TLU per household (Figure 1.4,). Majority of the farmers selected for individual interviews were those in common interest groups and many of them had received support from Heifer International give a cow programme hence the low numbers of local dairy cows compared to the statistics from secondary data (data not shown). Both improved and local dairy cattle provide milk, manure and are sold as meat to supply substantial income when the need arises, and to meet other social obligations such dowries. The improved dairy cattle are in addition sold as breeding stock. Dairy goat production is still at infancy stages with only 10% of households in Burumba Townships having an average of one goat (Table 1.7). Majority of the farmers (90-100%) keep poultry for Eggs, meat, manure and sale for income; and local goats (60%) for sale for income, meat and manure.
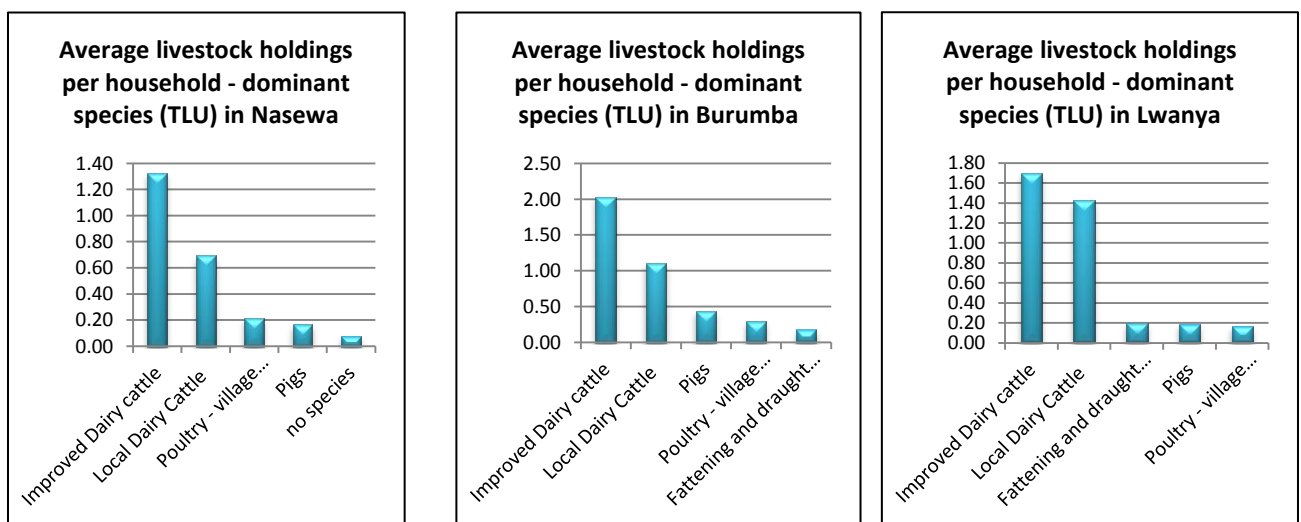

Figure 1.4. Average livestock holdings per household - dominant species (TLU) Nasewa ward (left), Burumba township (Middle) and Lwanya ward (right), Matayos sub-county

Table 1.5. Proportion of farmers owning different species of livestock, average herds per household (HH) and use in Matayos sub-county

Livestock species	Use	Nasewa		Burumba Township		Lwany'a	
		HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)
Improved dairy cows	Milk, manure and breeding stock sale (income)	5	2	70	3	10	1
Local dairy cows	Milk, manure, meat and breeding stock sale (income), dowry	40	3	50	5	80	8
Draught cattle	Ploughing, crashing machine, transport and hiring/sale for income	5	2-4	-	-	10	1
Sheep	Meat, cultural activites and sale for income	10	2	-	-	40	4
Local Goats	Meat and sale for income	20	4	20	1	40	3
Dairy goats	Sale for income, milk, meat, manure	<1	1	10	1	-	-
Pigs	Pork, manure and sale for income	20	2	10	3	50	2
Indigenous poultry	Eggs, meat, manure and sale for income	90	30	100	25	100	> 10
Commercial poultry	Eggs, meat, manure and sale for income	30	<50	5	100	-	-
Quails	Meat, cultural and sale for income	<0.5	25	-	-	-	-
Guinea fowls	Meat, pet and sale for income	-	-	20	3	-	-
Donkey	Sale for income, draught power	-	-			2	2
Rabbits	meat, manure	-	-	20	3	-	-

Generally, livestock input services such as feeds and veterinary drugs are available but were reported to be costly. Government veterinarians are mainly involved in vaccinations but are unavailable for animal health services. Private veterinary services are generally costly for most farmers. For example, treating East Coast Fever (ECF) costs farmers KShs 4,000 per treatment and between KShs 2500 to 3000 for other tick-borne diseases. Some of the private service providers are reported to be quacks and hence farmers incur losses through deaths of their animals. The most common diseases are ECF, mastitis and internal worm.

Artificial Insemination (AI) services are readily available for Burumba Township from private service providers. In Nasewa and Lwanya, the services can also be accessed from Busia Township but because of the distance they are expensive and there are delays leading to 2-3 repeats. The cost for a single insemination is KShs 1,000-3,000 depending on the breed and is inclusive of semen and transport. Majority of the service providers will charge for repeats at 50 to 100% depending on the distance. Improved bulls are mostly used for breeding at Nasewa and Lwanya at a cost of KShs 500 per service, while local bulls are offered at KShs 100. Farmers with high yielders fear using bulls because of disease. Therefore the high rates of repeats coupled by high cost of AI in Nasewa and Lwanya contributes to the low numbers of improved cattle hence farmers need assistance.

Agricultural and livestock inputs (farm implements, crop seeds, fertilizers, herbicides, pumps, acaricides, feed supplements) are readily available from agro-vets within the sub-county. Credit facilities for crop or livestock production are available from commercial and micro-finance institutions in Busia town but majority of famers lack collateral due lack of title deeds and/or fear of losing land in the event of defaulting. Farmers also complained of high interest rates and the short grace period for bank loans. Merry-go-round and Table banking are available within the communities but the capital available is low and cannot support most of the farming activities. Income generated within the sub-county is mainly food crops, livestock and small businesses within and across the Uganda border. There are no major cash crops in the County since the collapse of the cotton industry. From the aforementioned, the farming system can be classified as an integrated mixed crop-livestock production system.

Feed types and sources throughout the year and feeding systems
About 80% in Burumba Township and 10% in Nasewa of the farmers who keep improved cattle stall-feed their animals with cut and carry grasses that are manually chopped with a 'panga' (local machete) and a few with motorized chopper before feeding. Feed for the improved animals are often supplemented with commercial concentrates, such dairy meal, maize bran and minerals though not in adequate amount because of the high cost. Local cattle are open grazed except in Township some are tethered due to limited grazing area. For improve dairy cattle men participate more in feed collection while women participate in the feeding.

Napier grass is the only roughage feed fodder crop grown in Nasewa, Burumba (Township) and Lwanya. The acreage planted ranges from 0.2 in Nasewa and Burumba to 0.25 in Lwanya which is inadequate to feed a dairy cow throughout the year (Figure 1.5). Farmers in Nasewa and Lwanya also grow calliandra, leuceana, desmodium and sweet potato on very small acreages ranging from 0.01 to 0.05 again which is insignificant to meet the dietary needs of even one dairy cow. A range of commercial and roughage feeds are purchased to supplement those grown on the farm. The feeds that were dominantly purchased at all the locations were commercial mixed rations (dairy meal), cracked maize and Napier grass (Figure 1.6). In Burumba farmers interviewed did not mention Napier grass but on followup through telephone all of them confirmed between 25 to 50% of the roughage consist of purchased Napier grass. Crop residues mainly from maize and sweet potato vines form the bulk of the feed especially during the dry season.

Dietary composition

In Matayos sub-county, grazing contributes 54% of DM to the diet in both Nasewa and Lwanya wards but contributes only 13% of total DM in Burumba (Figure 1.7) . A significant contribution of total DM in Burumba comes from cultivated fodder especially Napier grass. This is due to the larger land sizes in Nasewa and Lwanya wards compared to Burumba. Cultivated fodder, and naturally occurring and collected feeds/grazing make the biggest contribution of ME (approximately 75%) with grazing contributing less as one moves from the more rural Lwanya to the urban ward of Burumba. This pattern can be attributed to diminishing land sizes and the need for improved nutrition to sustain the improved dairy breeds. Driven by better access to the urban market, there is a tendency to shift towards planted fodder to meet the demands of the improved dairy cattle. This partially explains why in Nasewa, the largest (61%) contribution comes from planted fodder (Figure 1.8). The pattern is similar in Burumba but is overtaken by grazing in Lwanya. (Figure 1.8). Trends in the contribution of CP% were similar to those ME for all the three sites (Figure 1.9). Purchased feeds contributed significant proportion of the ME at Burumba an indication that farmers in the township ward rely on concentrates as a source of protein for their dairy cattle. These results indicate that improvement in dairy production in Matayos sub-county in respect to nutrient supply should be targeted at grazing and planted fodder with supplementation from concentrates especially in stalled animals in Burumba. Despite abundant crop residues in the area, the contribution of crop residues to the diets on the basis of DM, ME and CP is minimal. The proportion of crop residue contribution to DM, ME and CP is only 2% in Burumba contrary to the expectations especially in the rural areas.

Seasonality of feeds

Seasonality of feeds is shown in Figure 1.10. Natural pasture serves in varying proportions at different sites almost year round. However, its availability is lower in December, January, February and March. During the drier months, crop residues and green forage (from roadsides and along rivers) assume highest importance. Residues of maize, sugarcane tops, bean haulms and banana pseudostems are important feed sources in the dry season. Based on the harvesting index procedure, about 6.7, 4.2 and 7.1.6 tons of crop residues/household can be produced in Nasewa, Burumba and Lwanya, respectively. It was reported that supplementation with commercial concetrates is done especially in Burumba for better milk production. Weeds from cropping areas, along the river banks and roadsides are provided in the dry season. Some farmers offer crop residues (in the rainy season) before they let their animals graze to avoid risk of bloating. According to respondents, no incidence of bloating happens if animals are offered some dry feed like maize straw before they are let out to graze in the initial part of the wet season.
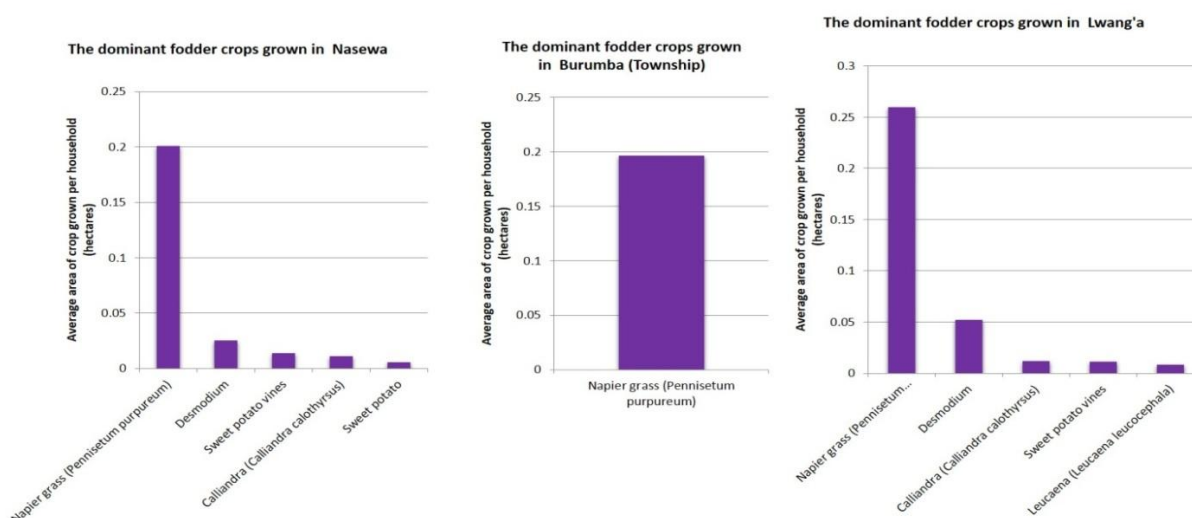

Figure 1.5. Dominant fodder crops grown in Nasewa ward (left), Burumba Township (middle) and Lwanya ward (right), Matayos sub-county
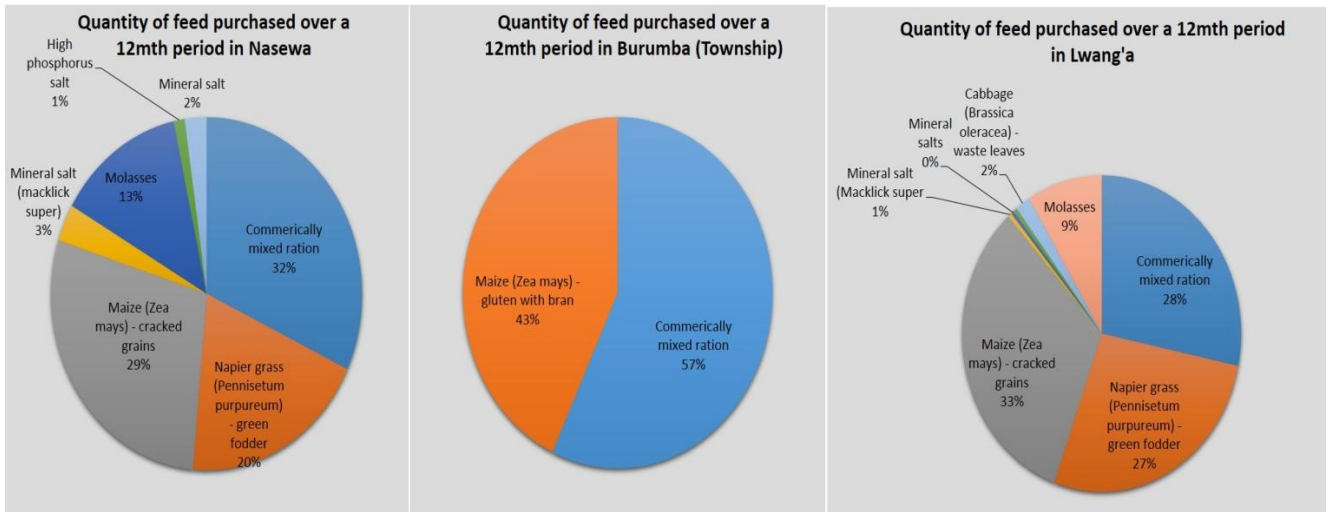
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Figure 1.6. Quantity of feed purchased over a 12mth period grown in Nasewa ward (left), Burumba Township (middle) and Lwanya ward (right), Matayos sub-county
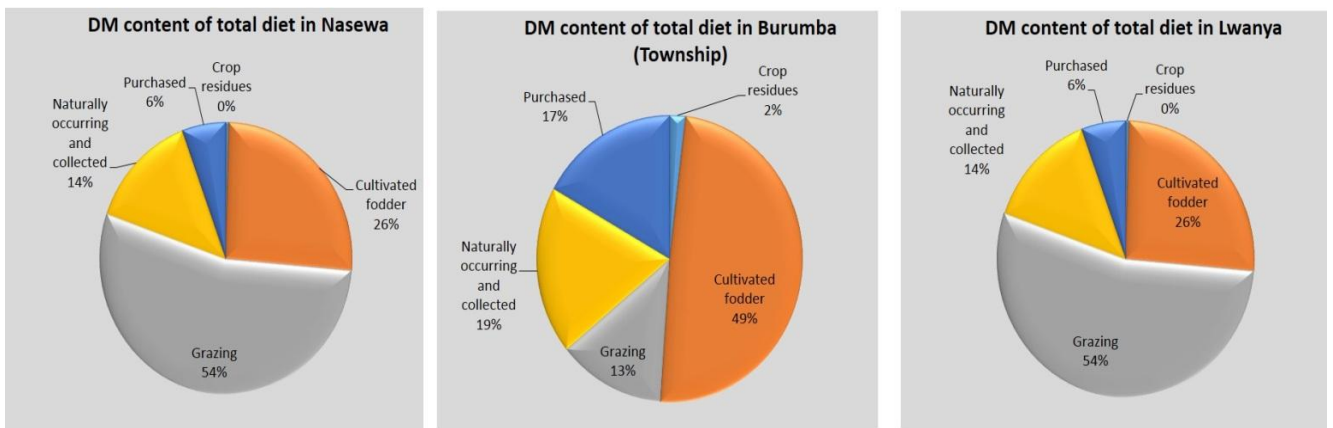

Figure 1.7. The contribution of various feedstuffs to DM to livestock diets in Matayos sub-county
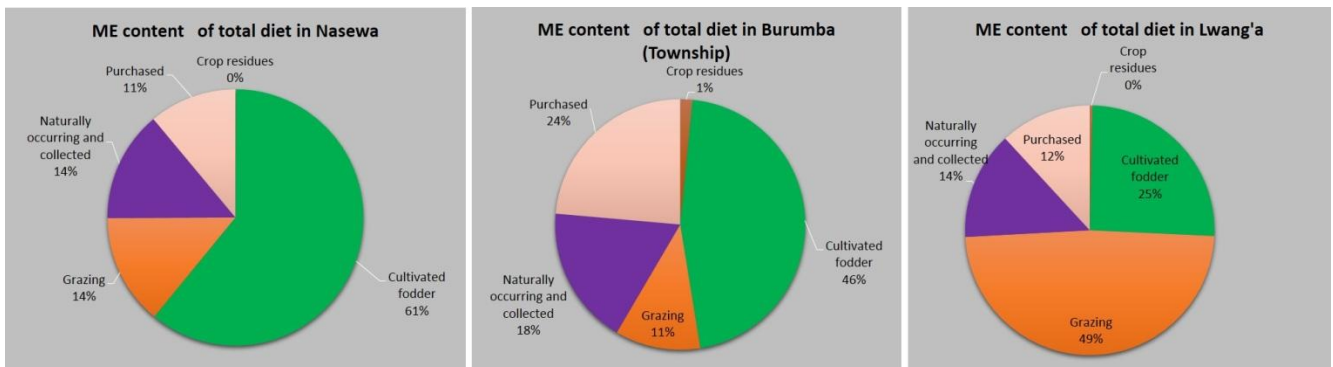
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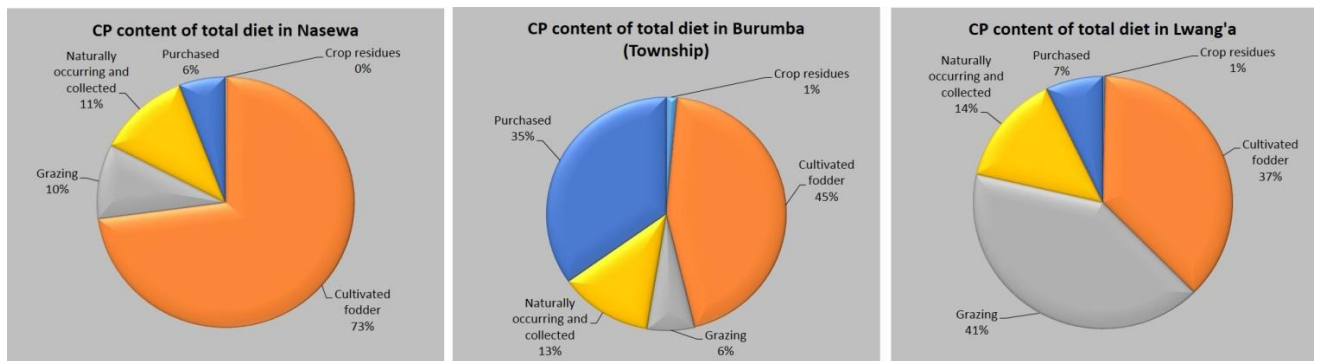**Figure 1.8. The contribution of various feedstuffs to ME to livestock diets in Matayos sub-county**

Figure 1.9. The contribution of various feedstuffs to CP to livestock diets in Matayos sub-county
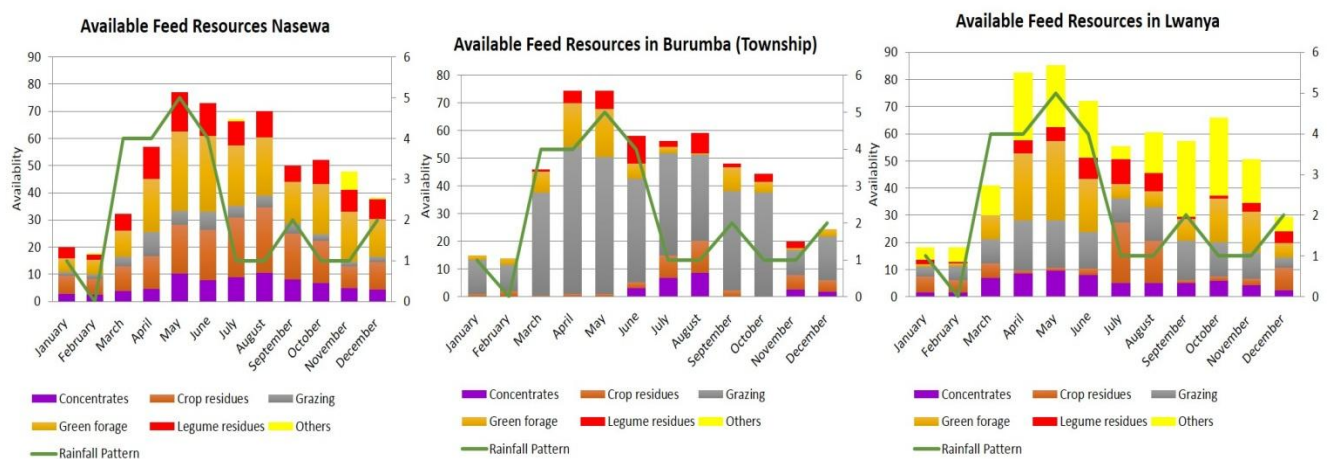

Figure 1.10. Availability of feed resources

Major income sources

As presented in Figure 1.11, the main contributors to household income vary with the specific sites with dairy, poultry for meat and employment contributing on average, 19%, 9% and 14%, to total income at Nasewa, Burumba and Lwanya, respectively. Participants indicated that residents for Nasewa and Burumba cultivated crops, mainly groundnuts for sale (cash crops) as 25% of their household income is derived from cash crops. However, food crops, at 23% is the second major contributor to household income in Lwanya. While off farm business contributes significantly to household income (24% at each site) in Nasewa and Burumba, it does not contribute to income in Lwanya. The results indicates the general importance of agriculture and livestock husbandry for the livelihoods of matayos sub-county with dairy and cash crops predominating especially in more accessible wards of Burumba and Nasewa.
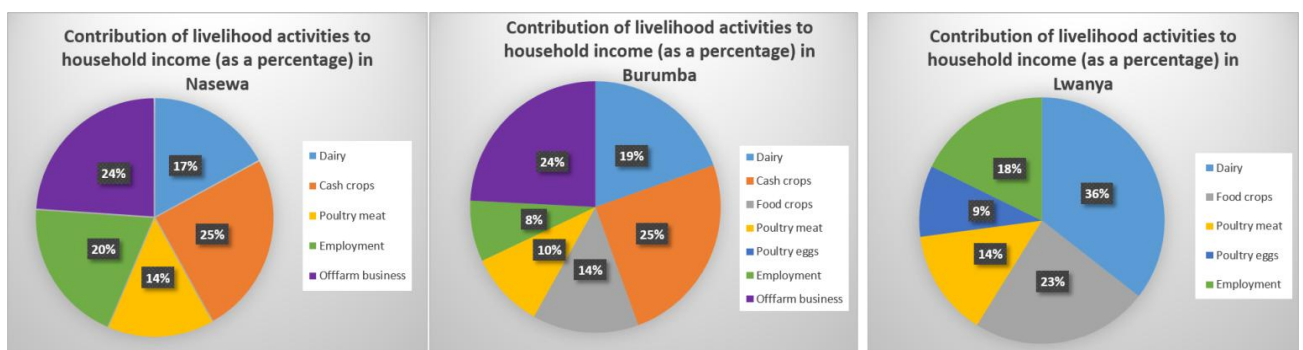

Figure 1.11. Contribution of livelihood activities to household income (as a percentage) in Nasewa ward (left), Burumba Township (middle) and Lwanya ward (right), Matayos sub-county

Challenges and opportunities

Overall, the main issues that farmers face in the farming systems are listed in Table 9. Inadequate animal feeds and costly animal health services were high priority problems in all the Locations. Inadequate animal feeds especially roughage was attributed to Napier stunt disease and prolonged drought in all the sites, while limited land was a major constraint to feed production in Nasewa and Burunda (Township). The major disease problems were tick-borne especially East Cost fever and trypanasomosis as this is a tsetse flies infested zone. Cost of treating these diseases is KShs 4000 and KShs 500 for ECF and trypanasomosis, respectively.

Improved breeds were priority in Nasewa and Lwang'a. Both diseases treatment were considered to be very costly in Nasewa and Lwang'a because service providers are all located in Busia town. The cost of AI services ranges from KShs 1500 for local semen to 8000 or sexed semen inclusive of transport in all the Location but farmers in Nasewa and Lwang'a experience high costs delayed services that lead to on average two to three repeats which are charged at between 50 to 100% per repeat service. Bulls are available at a cost of KShs 500 but quality and diseases are a major concern to farmers.

Farmers in Burumba on the other hand considered milk marketing to be their 3rd priority and was due to lack of organized marketing, coolers/processing plants and competition from milk coming from eastern Uganda and from the North and South Rift Valley counties of Kenya. Most female famers in Burumba cited labour under zero-grazing to be a concern that needs to be addressed. Lack of credit is a problem to rural farmers but was ranked low by farmers in Burumba (Township). The list of potential solutions in Table 1.6 suggests that farmers require initial assistance from outside for them to improve dairy productivity.

Conclusions

Matayos sub-county is characterized predominately by mixed crop-livestock production systems. Dairy and food crops are the primary sources of household income. Cattle are the most important livestock species. Farmers in Nasewa and Lwang'a have predominantly local cattle while majority of the households in Burumba (Township) keep improved dairy cattle. Improved dairy production is constrained by inadequate feeds and high cost of disease control in all the Loctions. Lack of improved breeds in Nasewa and Lwang'a and milk marketing are also constraints that require attention to activate commercial dairy productivity in the sub-county. To mitigate these constraints farmers (and other stakeholders) will be required to take an integrated approach to improve livestock production through (i) expanding area under fodder crops with those tolerant to Napier grass stunt disease and those tolerant to drought, (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings especially in Nasewa and Lwang'a, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Table 1.6. Ranking of main problems in livestock production and proposed solutions Matayos sub-county

Challenges	Ranking in Nasewa	Ranking in Burumba	Ranking in Lwang'a	Possible solutions
Lack of/difficulty to reach milk markets	**4**	3	-	• Ensure milk quality • Set up a milk cooling plant • Organize milk transport together
Lack of improved breeds	**4**	-	3	• Train and provide initial capital for local A.I. services providers • Acquire improved breeds • Address issues of dairy cattle fertility
Inadequate technical knowledge on fodder, feeding management	-	-	4	• More technical knowledge in feeds production, processing and feeding through training and tours • Reduce costs of feeds by procuring them together (cooperative) • Training in record keeping
Costly animal health services	**2**	1	1	• Preventive strategies through effective tick control by revival of communal dips and routine hand spraying • Vaccination campaigns • More technical knowledge in animal health services including hygiene
Lack of credit facilities to invest in feed and commercial concentrates	**3**	-	3	• Merry-go-round • Provide affordable credit facilities • Institute farmer friendly collateral for loans • Form input access groups
Inadequate feed especially due limited land, Napier stunt disease and prolonged dry periods	**1**	2	1	• Promoted Napier stunt disease tolerant fodders • Practice zero grazing • Credit facilities to hire land and invest in feed production • Conserve when it is in plenty • Plant variety of crops and conserve • Plant drought resistant fodder and pastures
Costly labour especially for Zero grazing dairy system	-	3	-	• Provision of motorized Napier grass choppers • Access to credit

Chapter 2. Characterization of the livestock production system and potential to enhance productivity through improved feeding in Sabatia, Vihiga county, Kenya

By Francis N. Muyekho[1], Donald Siamba1, Humphrey Agevi[1] and Sebastian Alex Etiang[2]

[1]Masinde Muliro University of Science and Technology
[2]District Livestock Production Officer, Sabatia sub-county

The Feed Assessment Tool (FEAST) was used to characterize the feed-related aspects of the livestock production system in Sabatia, sub-county, Vihiga County of Kenya. The assessment was carried out through focused group discussions and completion of short questionnaires at 3 sites representing peri-urban and near tarmac road and typical rural setup. At each site 20 farmers attended group PRA followed by nine key farmers consisting of 3 each representative owning small, medium and large scale farms on the 4th December 2013. The following are the findings of the assessment and conclusions for further action. Sabatia sub-county is characterized predominately by smallholder mixed crop-livestock production systems on approximately less than a hectare (2.5 acres) of land. Dairy and food crops are the primary sources of household income. Farmers in Sabatia Ward have predominantly improved dairy cattle while those of Wodanga keep predominantly local cattle. Improved dairy production is constrained by inadequate feeds, high cost of disease control and poor breeds. Unorganized milk marketing is also a constraint. To mitigate these constraints farmers (and other stakeholders) will be required to (i) lease land and expanding area under fodder crops with those fodder crops that tolerant to Napier grass stunt disease, (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Background

Sabatia is one of the four sub-counties in Vihiga County. It is made up of six wards namely; Wodanga, Busali, Sabatia West, North Maragoli, Lyaduywa and Chavakali covering a total area of 110.9 km^2 with an arable land of 101.9 km^2 (Figure 2.1). There are eight locations and 31 sub-locations in the sub-county.

Climate and agro-ecological zones

The sub-county is dominated by the Upper Midland 1 (UM1) covering 80%, followed by Lower Midland 1 (15%) and Upper Midland 2 (UM2) which is only 5% of the land area. It receives a bimodal rainfall pattern which ranges from 1800 to 2000 mm per year. The long rains are received between March and July while the short rains are received from September to November. The months of January to February are relatively dry. Temperatures ranges from 18°C to 26°C and the soils dark reddish brown friable ferro-nitrisol sandy loam.

Methodology

The study was conducted in Sabatia sub-county of Vihiga County to characterize the livestock production system, with special focus on dairy cattle, and its potential for enhancing productivity through improved feed and feeding interventions. A two-step Feed Assessment Tool (FEAST, version from 15 June 2012 by Duncan et al.) was used to characterize the livestock production system and, in particular, feed-related aspects. The FEAST tool is a rapid and systematic method that combines a PRA (Participative Rural Appraisal) with individual farmer interviews. The first step, PRA provides an overview of the farming system, in particular, the livestock production system. It also helps identify major problems, issues and opportunities within the livestock production system. The individual farmer interview which is the second step, gathers both quantitative and qualitative information

from farmers stratified based on relative land size owned. The assessment was carried out through two structured group discussions and completion of short questionnaires by key farmer representatives in Chavakali administrative Ward and Wodanga administrative Ward (Figure 1.1) on 4th December 2013. Chavakali is traversed by Chavakali-Kapsapet tarmarc road and Kakamega Kisumu road, while Wodanga is a typical rural set up accessed only by an earth road. The composition of the groups is shown in Table 2.1. Participating farmers were chosen by the sub-county Livestock Production Officers (PDO) Sabatia sub-county Ministry of Agriculture and Livestock. Overall 27 persons participated in the group discussion in Chavakali Ward and 20 in Wodanga Ward (Table 2.1). From each PRA group 3 representatives of different wealth classes (Table 2.3) were chosen for the individual interviews. The following are findings of the assessment and conclusions for further action.

Figure 2. 1. Map of Vihiga County with Sabatia sub-county

Table 2. 1. . Group composition of farmer representatives in Sabatia sub-county, Vihiga County Kenya; number of individual interviews in parentheses

Site	Men	Women	Total
Chavakali Ward (Chavakali Location)[1]	15 (5)	12 (4)	27 (9)
Wodanga Ward (Vokoli Location)[1]	20 (4)	15 (5)	20 (9)

[1]Sub-County administrative Wards (what in brackets for the Wards is the venue of PRA, and farmers that participated in individual interviews)

Social – economic indicators

Sabatia sub-county has a population of 129,678 (males 61,439 and female 68,239). There are 28,700 households and a density of 1,250 people per km^2 according to the 2009 National population and household census. Average family size is 8 members and average farm holding is 0.34 hectare and there are farm families. The major economic activities of the residents include; retail and subsistence small scale mixed farming and buying and selling agricultural produce. The sub-county is faced with high poverty levels of 64.5% and a literacy level of 54%.

Agriculture and Livestock production

The high and reliable rainfall coupled with moderate temperatures and good soils is suitable for growing crops. About 92% of the sub-county is arable. The food crop enterprises of importance are maize and beans which form stable food for the people of Sabatia. Other food crops grown on small units of land include sweet potatoes and cassava, Bananas and sorghum (Table 2.2). Tea is the only cash crop grown in the sub-county. The sub-county is food insecure with deficit (Table 2.2) being met by importation of dry maize and beans from neighbouring sub-Counties of Nandi, Kakamega and Trans Nzoia. Local farmers also lease land in Lugari and Nandi to grow maize and beans.

Table 2.2. Crop production statistics in Sabatia sub-county for 2013

| Year	Achieved area (Ha)	Achieved yields (90 kg bags)	Annual consumption (90 kg bags)	Deficit (90 kg bags)
Maize	1,220	36,000	151,018	115,018
Beans	1,220	7,280	41,607	34,327
Sorghum	-	-	280	-
Sweet potatoes	-	-	7,670	-
Cassava	-	-	16,000	-
Bananas[2]	-	-	80,500	-
Tea	-	-	280	-

[2]Bananas are in kg and not in 90 kg bags

Both Chavakali and Wodanga wards are dominated by very small scale farming households with less than 0.5 acre (Table 2.3 and Figure 2.2). Wodanga had a lager diversity of crops grown (10) compared to Chavakali (8) according to the individual interviews. Tea was the dominant crop Chavakali followed by Maize/beans intercrops and Kales, whereas in Wodanga Maize/beans followed by assorted vegetables and bananas were the most dominant crops (Figure 2.3). Households in surveyed areas are composed of approximately 7 people per household at all the sites.

The long rainfall season 'Igudu' is from March to July, while the short rainfall season '?' is from September to November. It is in the main dry season 'Kimiyu' from January to February, when almost no precipitation takes place. Finally, 'Chuvai' refers to the harvesting season from July to August and December and these months are characterized by very low rainfall (Table 2.4).

All agricultural activities are rain-fed except for <1% who practice drip irrigation and <20% who practice bucket irrigation on vegetables during the dry season and this are mainly farmers who live near the river or other water sources. Labour is generally available and is mostly required in the rain season for land preparation at Kshs 3000 per 0.5 of an acre and a daily wage of Kshs 200 per day plus lunch for planting, weeding and harvesting. Respondents indicated that labour cost has been increasing over time. This is attributable to the scarcity as potential workers especially family members seek other jobs like boda boda (Motorcycle public transport and hair dressing) as well as casual work in the construction sector in the nearby towns. Approximately 80% of youth leave the farms in search of alternative jobs instead of providing labour in the farms.

Table 2.3. Average land sizes owned by different categories of farmers in Chavakali and Wodanga wards, Sabatia sub-county

	Chavakali Ward		Wodanga Ward	
	Range of land size in acres	%of households that fall into the category	Range of land size in acres	% of households that fall into the category
Category of farmer				
Small farmer	<0.25	45	<0.1	20
Medium farmer	0.25 – 0.5	25	0.2 – 0.5	70
Large farmer	>1.0	15	>0.5	10
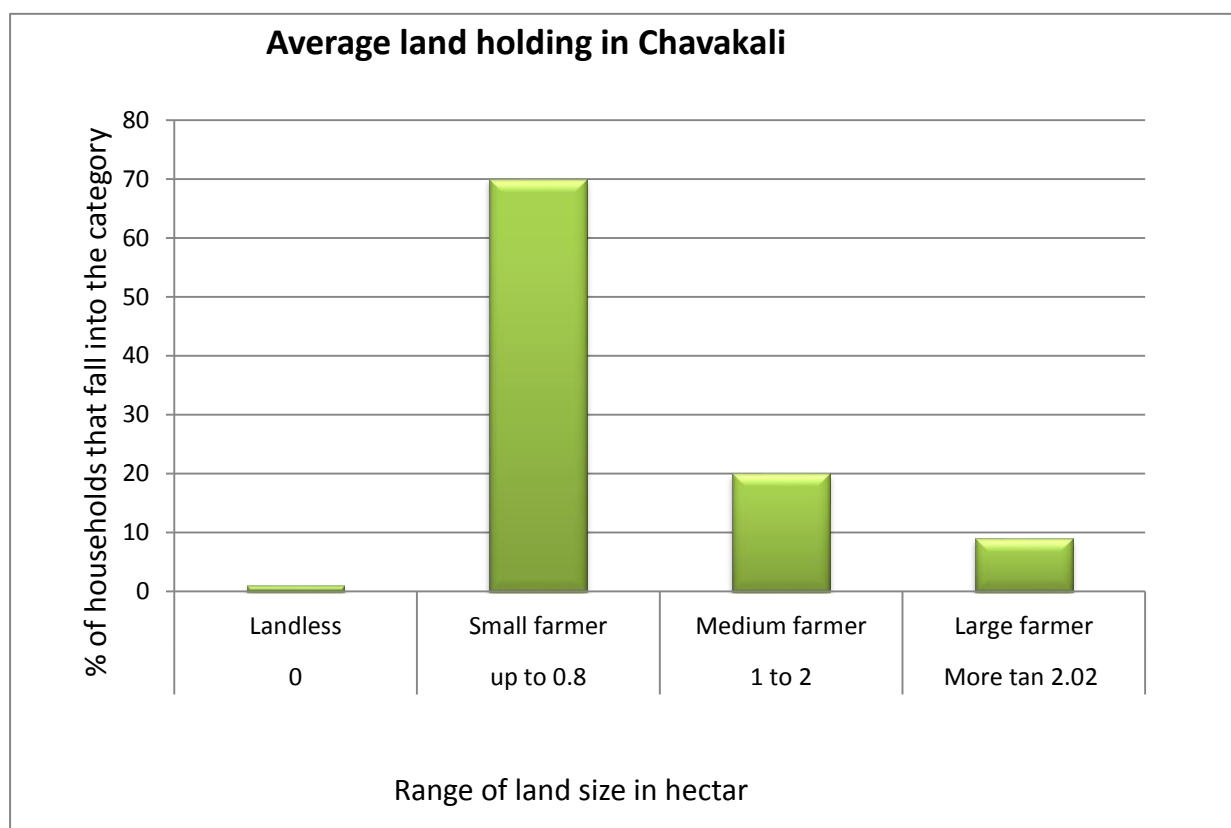
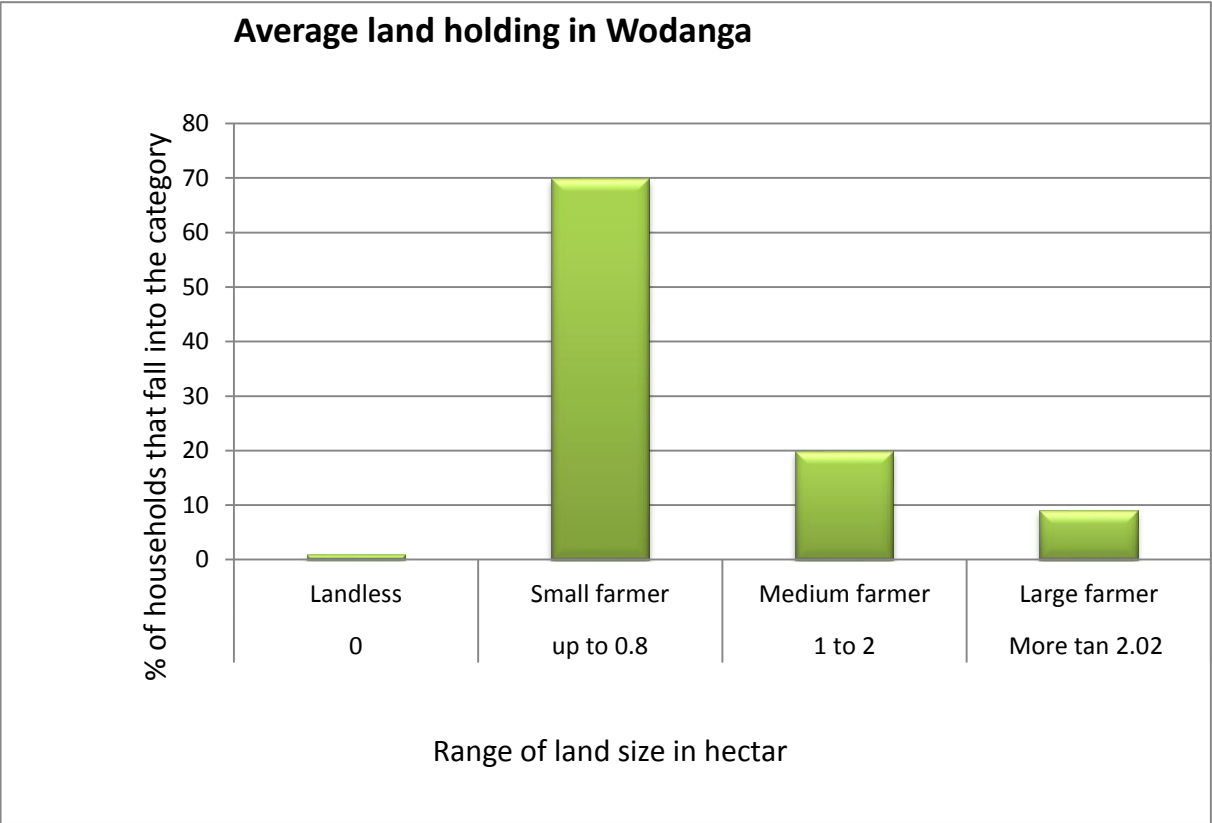**Figure 2. 2. Average landholdings in Chavakali Ward (left) and Wodanga Ward (right) Sabatia sub-county**

Average area (ha) per hh of dominant arable crops in Chavakali

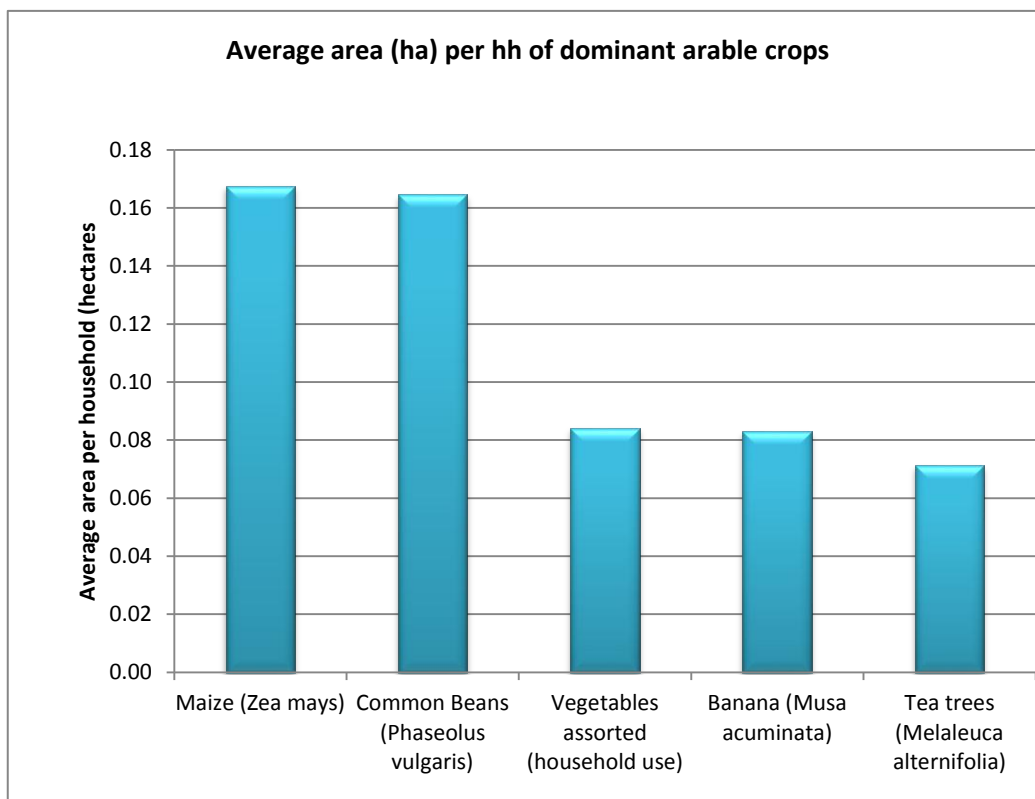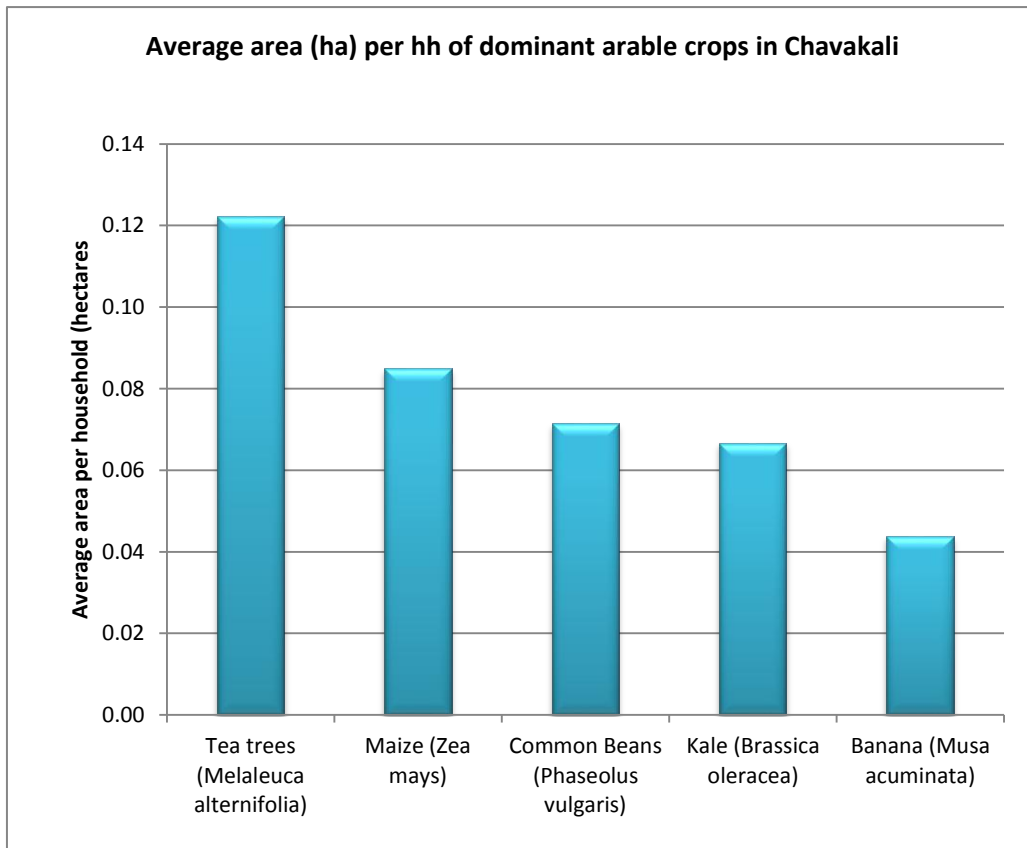**Average area (ha) per hh of dominant arable crops**

Figure 2. 3. Average area (ha) per household of dominant arable crops Chavakali ward (left) and Wodanga ward (right), Sabatia sub-county

Table 2. 4. Cropping seasons occurring in Sabatia sub-county

Name of season	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Igudu (planting & weeding)			×	×	x	x						
Chuvai (harvesting)							███	███				
Short Rains season									███	███	███	
Chuvai (harvesting)												███
Kimiyu (dry season)	███	███										×

Livestock production

Different livestock species kept for various purposes form an integral part of agriculture and almost every farming household keep ruminants or indigenous chickens. Major livestock species kept, their uses, proportion of households that own the species and mean herd/flock sizes of each ward are presented in Table 2.5. Both improved and local dairy cattle provide milk, manure and are sold as meat to supply substantial income when the need arises, and to pay dowries. The improved ones are in addition sold as breeding stock. Majority of the farmers (90-100%) keep poultry for Eggs, meat, manure and sale for income; and local goats (60%) for sale for income, meat and manure. Improved dairy cattle form constitute only 26% of the cattle population in the sub-county and dairy goats are approximately 1,000 (Table 2.5). Indigenous chicken is the predominant enterprise in the sub-county with slightly over 100,000 birds in 2012 and 2013. However, the subcounty remains a huge animal product deficit area. The deficit ranges from 52% for milk to 99% for honey in terms of annual consumption (Table 2.6). According to the 2013 Vihiga County livestock annual report and confirmed by the respondents, milk and meat deficits were bridged through importation of raw milk and live animals for slaughter from neighbouring sub-Counties of Nandi and Uasin Gishu. Eggs were imported mainly from Uasin Gishu.

In terms of livestock improvement, most of the farmers use locally available bulls which are of low quality for breeding purposes. There are only three AI provides in the sub-county and the cost of insemination is high ranging from US$ 12.5 to 18.75 (KE 1200 to 1500). AI service providers are majorly in Chavakali town and thus the distance leads to delays in insemination necessity repeats which increase the cost. The sub-county also does not have a milk cooling plant which constraints marketing for the few enterprising dairy farmers. However, there are two working cooler operating below capacity in the neibouring sub-counties of Hamisi and Emuhaya within Vihiga county

Most famers (80%) in Chavakali keep on average one to two improved dairy cattle per household, while those of Wodanga kept more local cattle (80%) than improved dairy cattle Table 2.8). On average Chavakali farmers keep 1.2 TLU per household while those in Wodanga keep 0.8 improved TLU per household (Figure 2.4). Majority of the farmers selected for individual interviews were those in common interest groups and many of them had received initial support from various donor supported projects including Heifer International give a cow programme, Njaa Marufuku Kenya (GoK), Western Kenya Community Driven Development and Flood mitigation (WKCDD-FMP) and National council of people with Disability (NCPWD). Dairy goat production was also higher in Chavakali than in Wodanga for the same reason

In the last three years 2010 to 2014 various programs and initiatives have supported programs on capacity building on AI, provision of dairy breeds and fodder establishment (Table 2.7).

Table 2.5. Livestock population trends

Species		2013	2012	2011	2010	2009
Cattle	Grade/Crosses	7,240	7,180	6,850	6,820	6,740
	zebu	24,900	24,930	25,970	26,100	19,400
Goats	Local (meat)	6,900	6,980	6,880	6,830	3,240
	Dairy (Grade)	1,250	1,200	1,100	1,090	1,080
Sheep	Hair	1,730	1,920	2,070	2,080	3,970
Poultry	Indigenous chicken	102,600	102,440	99,840	98,360	73,000
	Layers	3,050	2,500	4,550	6,500	3,500
	Broiler	0	2,400	2,250	2,500	1,500
	Ducks	320	400	450	560	1,650
	Turkey	410	650	805	1,150	1,070
	Geese	200	205	210	270	260
Pigs	-	125	106	97	70	48
Bee Hives	KTBH	108	110	110	140	130
	Langstroth	460	450	400	400	340
	Long hives	35	20	20	20	35
Rabbits	-	6,900	6,980	6,880	6,830	2,240
Emerging Livestock	Quails	400	495	430	450	420

Table 2.6. Livestock products consumed in comparison to production levels in Sabatia sub-county in 2013

Livestock product	Annual consumption	Annual production	Deficit	% Deficit	Product requirements estimates/person/year
Milk (Litres)	12,655,463	6,074,620	6,580,843	52	91
Meat (kg)	4,99,840	1,626,200	3,366,640	67	36
Eggs (Numbers)	21,635,640	5,590,880	16,044,760	74	156
Honey (kg)	2,496,420	18,500	2,477,920	99	18

Table 2.7. Dairy production projects in Vihiga sub-county 2010 to 2013

Funding agency	Group funded	Locality	Type of project	Funding level (KShs)	Funding year	Remarks
Njaa Marufuku Kenya (GoK)	Mukingi Self Help Group	Lyaduywa	Dairy goat	150,000	2010/11	4 does and 1 boar purchased in 2011
Western Kenya Community Driven Development and Flood mitigation (WKCDD-FMP)	Chofumbo A/V	North Maragoli	AI banking	5,000,000	2013/14	On-going
	Bukulunya CDDC	Bukulunya	Dairy cattle	1,500,000	2012/13	26 cows purchased for farmers
	Demesi CDDC	Demesi	Dairy cattle	1,080,000	2012/13	28 cows purchased for farmers
			Napier production	1,080,000	201/2012	?
National council of people with Disability (NCPWD)	Busali East physically disabled	Busali East	Dairy cattle	1,000,000	2013/14	15 heifers purchased

Table 2. 8. Proportion of farmers owning different species of livestock, average herds per household (HH) and use in Sabatia sub-county

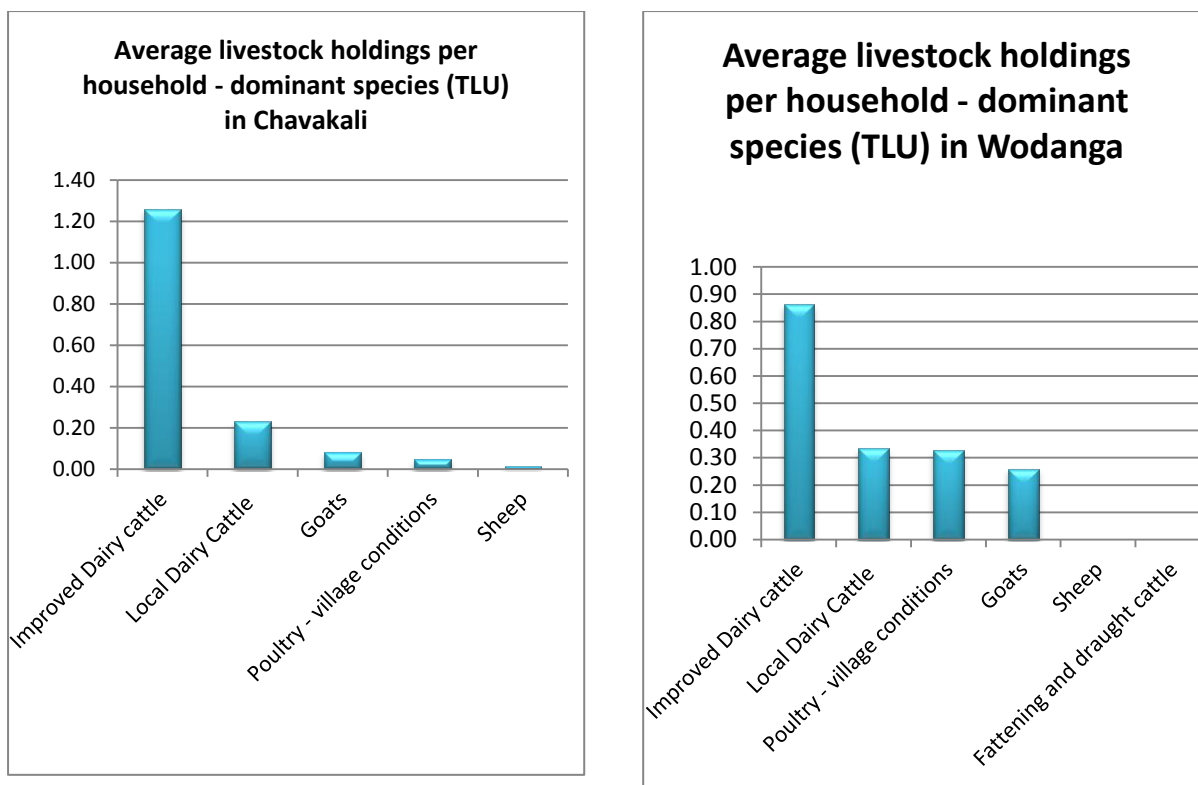|		Chavakali Ward		Wodanga ward	
Livestock species	Use	HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)
Improved dairy cows	Milk, manure and breeding stock sale (income)	80	2	<20	1-2
Local dairy cows	Milk, manure, meat, sale for income and dowry	30	2	80	1
Sheep	Meat, cultural rituals and sale for income	10	6	<10	2-3
Local Goats	Meat, manure and sale for income	90	4	<20	3
Dairy goats	Milk, Sale as breeding stock for income and manure	40	7	<1	2
Pigs	Pork, manure, traditional rituals and sale for income	10	6	<1	2-3
Indigenous poultry	Eggs, meat, manure, sale for income and social activities	100	20	90	5-10
Commercial poultry	Eggs, meat, manure and sale for income	20	30	<1	50-100
Quails	Meat, cultural and Sale for income	-	-	<2	50-60
Turkeys	Meat and sale for income	10	7	<1	2-5
Geese	Meat, manure and sale for income	-	-	<1	2-3
Rabbits	Milk, manure	30	6	20	10

Figure 2.4. Average livestock holdings per household - dominant species (TLU) Chavakali Ward (left) and Wodanga (right), Sabatia sub-county

Generally, livestock input services such as feeds and veterinary drugs are available but were reported to be costly. Government veterinarians are mainly involved in vaccinations but are unavailable for animal health services. Private veterinary services are generally costly for most farmers. For example, treating East Coast Fever (ECF) costs farmers KShs 4,000 per treatment and KShs 250 per deworming per animal. In addition farmers incur costs through airtime for phones and transport. The most common diseases are ECF, mastitis and internal worm.

Artificial Insemination (AI) services are readily available from private service providers in Chavakali. The cost for a single insemination is KShs 1,000-1,500 per insemination for semen from Kabete; KShs 3,500 to 5,000 for unisexed and upto KShs 6000 to 12,000 sexed imported semen. Farmers incur addition costs of 50% per repeat insemination per cow, this is a common complain of all the farmers. Improved bulls cost KShs 300-500 per service but the breed quality and disease is a concern to farmers. Therefore the high rates of repeats coupled by high cost require consideration in the improvement of dairy productivity in the sub-county.

Agricultural and livestock inputs (farm implements, crop seeds, fertilizers, herbicides, pumps, acaricides, feed supplements) are readily available from agro-vets within the sub-county. Credit facilities for crop or livestock production are available from commercial and micro-finance institutions; Table banking and merry-go-round especially for ladies, upcoming youth and women enterprise fund, and SACCO (SACODEV, MFATE) within Sabatia sub-county and Vihiga County. However many farmers do not access loans especially from commercial banks and micro-finance institutions because of high interest rates, collateral requirements, long loan processing period, defaulting by group members. Continuous subdivision of land into small pieces and lack of title deeds contributes to the lack of collatoral to access loans.

Feed types and sources throughout the year and feeding systems

According to group PRA, 30% of farmers in Chavakali who keep improved dairy cattle have constructed recommended zero grazing units, while in Wodanga it is only 10% of the farmers. However, all those with dairy goats have recommended housing structures in the two Wards. Majority tether the animals in the compound and bring the feed during the day but keep the animals in a section of the family house for security purposes and the same happens to free range local cattle. The cut and carry grasses manually chopped with a 'panga' (local machete) and very few motorized choppers before. Feed for the improved animals are often supplemented with commercial concentrates, such dairy meal, maize bran and minerals though not in adequate amount because of the high cost.

Napier grass is the dominant planted fodder though the acreage planted is small due to limited land (Figure 2.5). Napier stunt disease is reported to be major constraint to herbage productivity per unit land in the sub-county that needs to be addressed. Rhodes grass, Calliandra, desmodium and sweet potato were reported from group PRA but the area grown is too small to meet supplementary feed needs of even one dairy animal for one to two months in a year. Napier grass is again the predominantly purchased feed in all the Wards (Figure 2.6). Commercially mixed ration forms only a small proportion (2-5%) of the purchased feed.
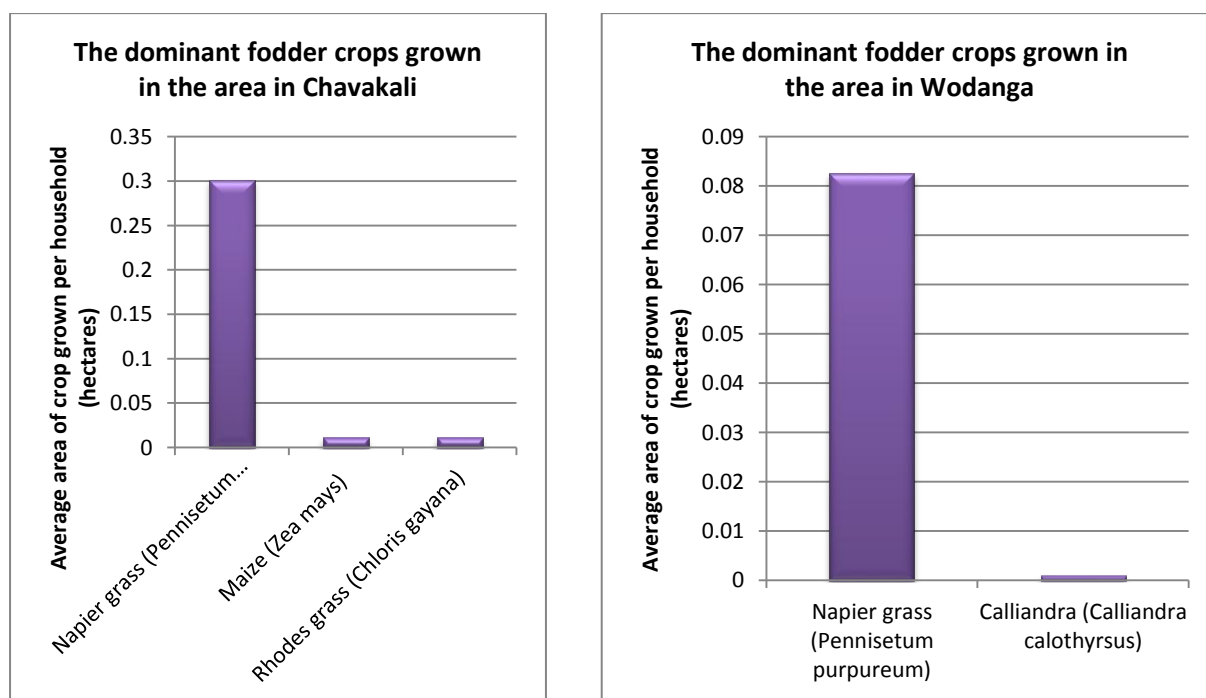

Figure 2.5. Dominant fodder crops grown in Chavakali Ward (left) and Wodanga Ward (right), Sabatia sub-county
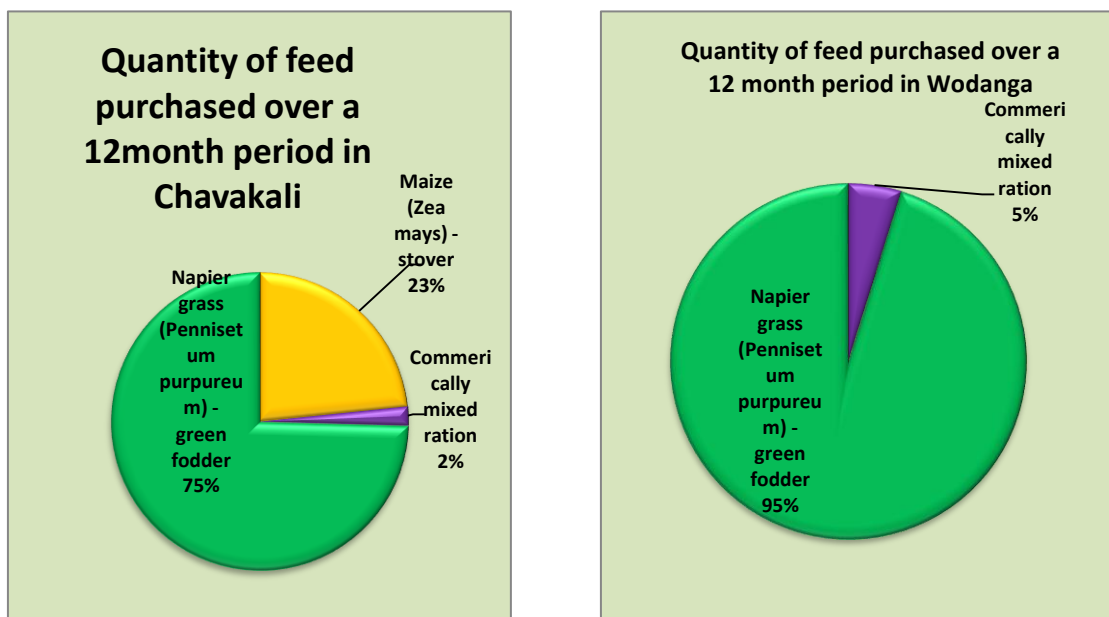
Figure 2.6. Quantity of feed purchased over a 12mth period grown in Chavakali Ward (left) and Wodanga Ward (right), Sabatia sub-county

Cultivated green feed and collected naturally occurring forages especially weeds from farms are the primary component of the feed in Sabatia sub-county since planted fodder is not adequate due to the small farm sizes (Figure 2.11). Grazing contributes more to feed availability in Chavakali than in Wodanga possibly due to the slightly large average farm size in Chavakali and drastically reduces during the dry season, January to February. In Wodanga crop residues form a significant portion of feed availability and this includes all crop residues ranging from vegetable, banana pseudo-stems and residue after harvesting to maintain the cattle since farmers cannot grow enough fodder due small farm sizes per household. Farmers also purchase significant amounts of fodder especially Napier grass to supplement cultivated and collected feeds.

Cultivated fodder contribute the largest proportion of DM (40-41%) and ME (30-33%) followed by naturally occurring and collected feeds at 30-36% in the total diet of Chavakali and Wodanga (Figures 2.8 and 2.9). Due to the small farm sizes in both Wards, grazing contributes only 21-25% DM and 18-22% ME to the diet. The grazing is mainly in the homestead and in the farm after crop harvest. The highest proportion CP also comes from cultivated fodder in Chavakali (52%) and it is also high in Wodanga, while naturally occurring and collected contributes 29%) in Chavakali and was high in Wodanga (32%). Purchased feeds contribute only 2% CP to the total diet of both Wards (Figure 2.10).
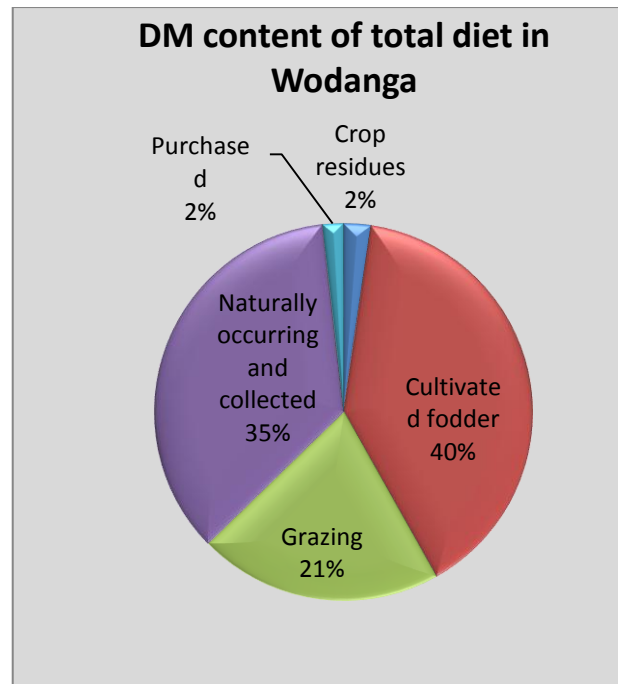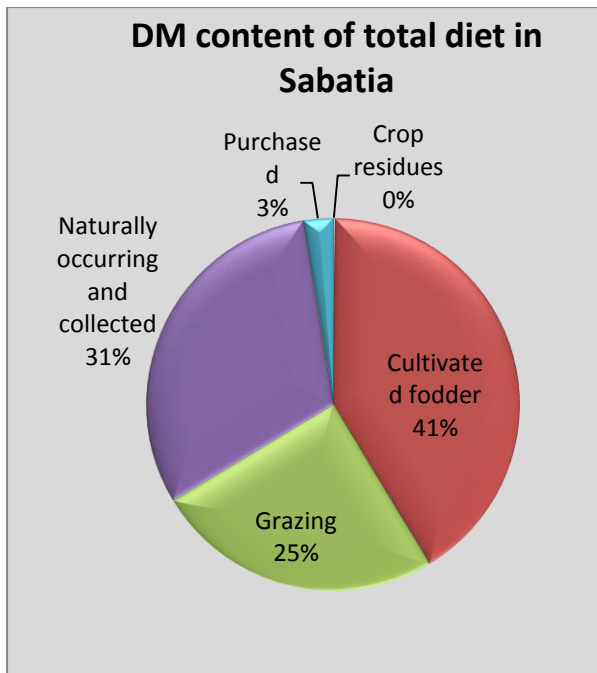
Figure 2.7. Proportion of dry matter (DM) content in the total diet Chavakali (left) and Wodanga (right), Sabatia sub-county
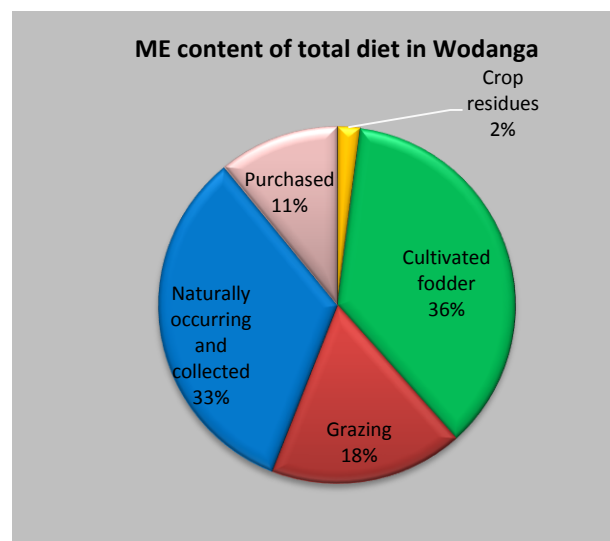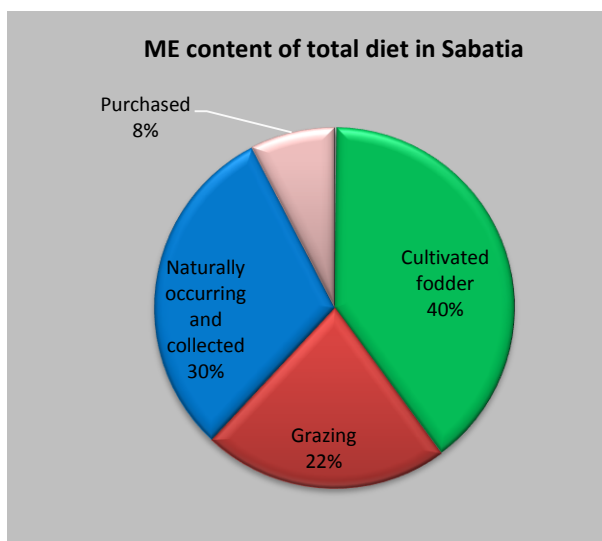

Figure 2.8. Proportion of crude energy (ME) content in the total diet Chavakali (left) and Wodanga (right), Sabatia sub-county
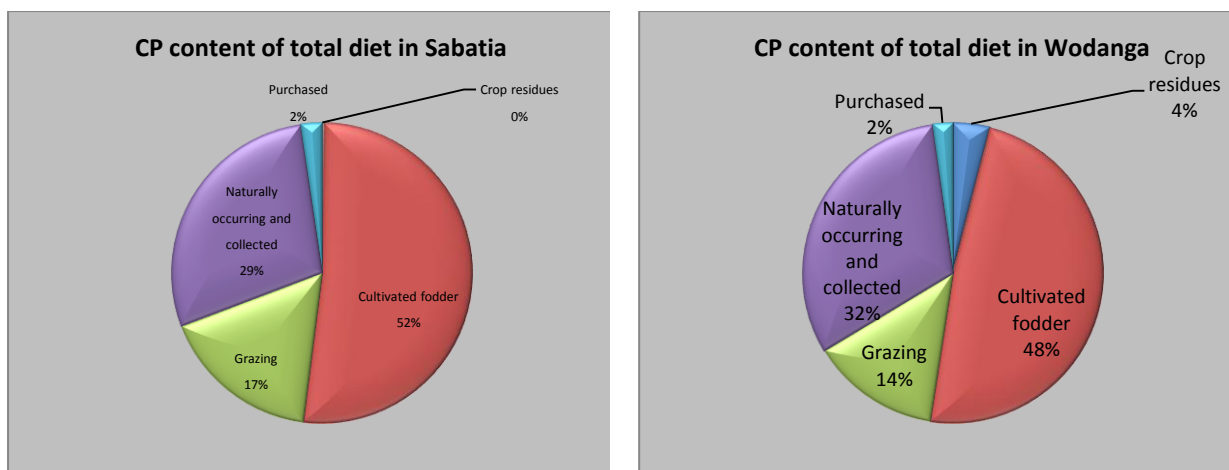
Figure 2.9. Proportion of crude protein (CP) content in the total diet Chavakali (left) and Wodanga (right), Sabatia sub-county
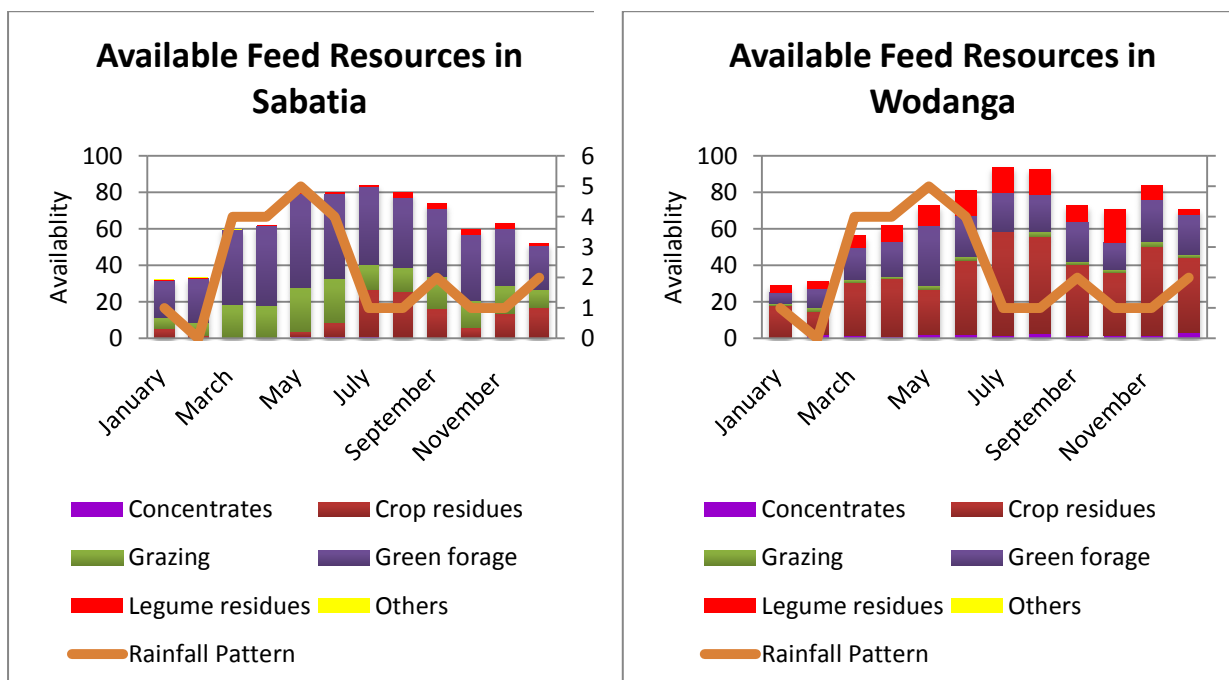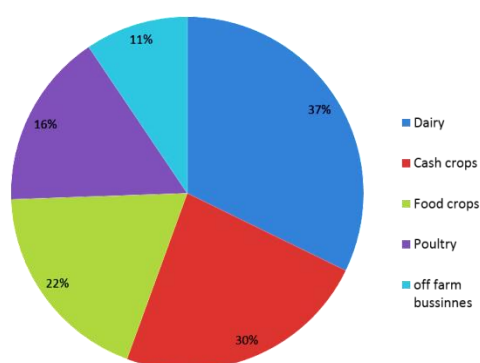

Figure 2.10. Variation of feed availability throughou the year in Sabatia (left) and Wodanga (right) Wards in Sabatia

Major income sources

In Chavakali groups of respondents, the main contributors to income are dairy (37%) and cash crops (30%) mainly tea; while in Wodanga major income was from food crops and cash crop (Tea) and dairy generates only 10% (Figure 2.11). In Chavakali, more participants also get income from food crops (22%) followed by poultry (16), while in Wodanga it is poultry meat (25%) followed by remittance (18%). The results indicates the general importance of agriculture and livestock husbandry for the livelihoods of Sabatia sub-county.
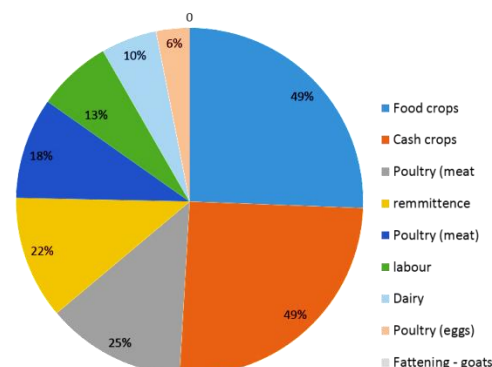
Figure 2.11. Contribution of livelihood activities to household income (as a percentage) in Chavakali Ward (left) and Wodanga Ward (right), Sabatia sub-county

Challenges and opportunities

The main issues that farmers face in the farming systems are listed in Table 2.9. Feeds problems and and costly animal health services were considered important in Chavakali and Wodanga Wards. Inadequate feeds were majorly attributed to small farm sizes, Napier diseases, lack of credit to hire land and invest in feed production, lack of knowledge on ration formulation to improve the quality of crop residues and the high cost of commercial feeds. Control of tick borne diseases is a major concern to farmers in Sabatia sub-county. Chemical pesticides (acaricides) for indivual spraying are expensive since the collapse of communal dips. Furthermore, the inefficient individual spray has contributed to tick resistance to the acaricides. Inadequate improved breeds were considered a key problem in Sabatia more than in Wodanga could be attributed to the importance the former attach to dairy enterprise since the Ward has more improved dairy cattle. Artificial Insemination (AI) services that could help disseminate improved genetics but are costly and unreliable. Farmers depend on private AI service providers mainly from Chavakali and Mbale and due distance transport increases the cost and delayed service which leads to repeats which costs 50 to 100% of the first insemination.

A lack of credit facilities is also a clear constraint to the further development of crop and dairy production in Sabatia sub-county. Whereas, credit facilities exists from commercial banks and micro finance institutions, lack of collateral, unfavourable repayment schedules coupled unstable prices of agricultural products discourages farmers from going for the loans. Internally generated credit from merry-go-round and Table banking does not provide enough capital to invest in agricultural activities. Milk marketing was also highlighted as a problem in both Wards because farmers mainly depend on market from neighbours, however because of the high poverty levels (64%) this marketing channel does not provide reliable market. There is organized transport to reach the urban markets and also there are no cooling plants in the sub-county.

The list of potential solutions in Table 2.9 suggests that farmers require initial assistance from outside for them to improve dairy productivity.

Table 2.9. Ranking of main problems in livestock production and proposing possible solutions by farmers from Sabatia, and Wodanga Wards Sabatia sub-county after pairwise ranking in each PRA

Challenges	Ranking in Sabatia Ward	Ranking in Wodanga Ward	Possible solutions
Lack of/difficulty to reach milk markets	4	4	• Set up a milk cooling plant • Organize milk transport together
Lack of improved breeds	2	4	• Train and provide initial capital for local A.I. services providers • Initial capital to acquire improved breeds • Address issues of dairy cattle fertility
Inadequate technical knowledge on fodder, feeding management	2	4	• More technical knowledge in feeds production, processing and feeding through training and tours • Reduce costs of feeds by procuring them together (cooperative)
Costly animal health services	1	2	• Preventive strategies through effective tick control • Vaccination campaigns • More technical knowledge in animal health services including hygiene
Lack of credit facilities to invest in feed and commercial concentrates	3	3	• Merry-go-round • Provide affordable credit facilities • Institute farmer friendly collateral for loans • Form input access groups
Inadequate feed especially due limited land, Napier stunt disease and prolonged dry periods	2	1	• Promote fodders tolerant to stunt disease • Adopt 'Tumbukiza' method • Credit facilities to hire land and invest in feed production • Technologies on improving quality of crop residues

Conclusions

Sabatia sub-county is characterized predominately by smallholder mixed crop-livestock production systems on approximately less than a hectare (2.5 acres) of land. Dairy and food crops are the primary sources of household income. Farmers in Sabatia Ward have predominantly improved dairy cattle while those of Wodanga keep predominantly local cattle. Improved dairy production is constrained by inadequate feeds, high cost of disease control and poor breeds. Unorganized milk marketing is also a constraint. To mitigate these constraints farmers (and other stakeholders) will be required to (i) lease land and expanding area under fodder crops with those fodder crops that tolerant to Napier grass stunt disease, (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Chapter 3. Assessing the dairy value chain and potential to enhance productivity through improved feeding in Marani sub-county, Kisii, Kenya

Francis N Muyekho[1], Donald Siamba[1], Humprey Agevi[1], Gabriel Tennesi[3] and Elistone M. Koronge[2]

[1] Masinde Muliro University of Science and Technology
[2] District Livestock Production, Marani sub County, Kisii County
[3] Kisii University

Marani is one of the sub-counties, forming the administrative regions of Kisii County, Western Kenya. The Feed Assessment Tool (FEAST) was used to characterize the feed-related aspects of the livestock production system in Marani Sub-County, Kisii County of Kenya. The assessment was carried out through focused group discussions and completion of short questionnaires at 2 sites representing peri-urban and typical rural setup. Marani sub-county is characterized predominately by mixed crop-livestock production systems. Dairy, cash crops and food crops are the primary sources of household income.

Cattle are the most important livestock species. Improved crop and dairy production is constrained by inadequate technical knowledge on fodder production, processing, feeding and general livestock management; lack of credit facilities, improved breeds and high cost of health services. Other constraints are poor milk markets and inadequate land for crop and feed production. To mitigate these constraints farmers (and other stakeholders) will be required to take an integrated approach to improve livestock production through provision of technical knowledge in feeds production, processing and feeding through training and tours, improving access to AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings and access to credit facilities to enable farmers invest in the crop and livestock production enterprises and also milk marketing strategies

Background

Marani is one of the sub Counties of Kisii County (Figure 3.1). It has 4 administrative wards and 13 sub-locations. The sub-county covers an area of 123.7 km^2 and 96 km^2 of the land is arable. It has a human population of 113,308 consisting of 23,732 households (Kisii County website). The annual population growth rate is estimated at 2.1%. The sub-county is characterized by a hilly topography with several ridges and valleys. The western zone lies below 1,500m above sea level, while the Eastern zone lies between 1500-1800m above sea level. The growth of cash crops such as tea, coffee, pyrethrum and subsistence crops such as maize, beans and potatoes are supported by the red volcanic soils.

Figure 3.1. Map showing location of Marani Sub County in Kisii County

The sub-county receives a bimodal rainfall pattern which ranges from 1200 to 2400mm with average annual rainfall of 1500mm. The long rains are received between March and June while the short rains are received from September to November. The months of July and January are relatively dry. The maximum temperatures range between 21°C – 30°C while the minimum temperatures range between 15°C – 20°C. The sub-county is dominated by the Upper Midland 1 (UM1) which covers 90 km2 with only 6% of the land in the Lower Midland 1 (LM1). Seventy five percent of the sub-county has red volcanic soils (Nitosols) which are deep in organic matter. It has only one river called Mwamogusii, Isanta which is 23 km in length.

Methodology

Selected farmers from Sensi and Mwagichana wards of Marani sub-county participated in focussed group discussions using the participatory rural appraisal (PRA) approach to provide an overview of the farming system and to identify constraints and opportunities for improving livestock production in each of the selected wards using the Feed Assessment Tool (Duncan et al., 2012). Key informant farmers were selected from each category of land holding size from each of the discussion groups. Accordingly, 9 farmers, 3 from each category of land holding were purposively selected and individually interviewed from each of the study wards to gathers both quantitative and qualitative information according to major wealth groups based on relative land size owned

The Sensi site is crossed by a tarmacked road from Kisii to Marani market Centre, while Mwagichana was a typical rural set up accessed by only a marrum road which is inaccessible during the heavy rain seasons. Overall 20 persons participated in the group discussion at each site (Table 3.1).

Table 3. 1. . Group composition of farmer representatives

Site	Men	Women	Total
Sensi[1]	13 (6)	7 (3)	20 (9)
Mwagichana[1]	14 (5)	6 (4)	20 (9)

[1]Sub-County administrative wards
Number of individual interviewed in parentheses.

Results and discussion

Mixed crop-livestock farming is widely practiced in the sub county. The high and reliable rainfall coupled with moderate temperatures and good soils is suitable for growing crops like tea, coffee, pyrethrum, maize, beans and bananas as well dairy farming. About 78% of the county is arable of which 57% is under crop. Agriculture is therefore, an important part of the livelihoods of the people of Marani.

Marani sub-county is dominated by small scale farming households with a few farmers having more than one acre (Table 3.2). Despite the small landholdings farmers grow 9-10 crops (Figure 3.2 a & b and 3.3 a & b) on the same piece of land with the dominant crops being intercropped maize/beans, coffee, bananas and vegetables (assorted). Households in surveyed areas of Marani are composed of approximately 6-8 (range 4-10) people per household at both sites. With an average of 0.25 acres (range 0.5-3 acres), households from farmers in Sensi ward utilize substantially less land than those in Mwagichana that use 1.0 acres (range 0.25-3 acres)

Cropping seasons
Marani experiences four different cropping seasons spread quarterly over the year. The high rainfall season '**Risimeka**' is from March to June, while short rains occur from September to December. It is in the main dry season '**Tindacha**' from January to February, when almost no precipitation takes place. Finally, '**Omwobo**' distinguishes a transition from July to September (low/start of rainfall season) (Table 3.3).

Land owned by farmers is not enough for all their farming activities. Inter-cropping is practiced especially for cereal crops and beans. All agricultural activities are rain-fed except for 10% of farmers from Mwagichana ward who practice bucket irrigation on vegetables during the dry season. Labour is generally available and is mostly required in the rain season for land preparation, planting and harvesting. Labour costs KShs 100 – 150 plus food (tea and lunch). Due small landholdings, there is no mechanized farming and as a result land preparations costs KShs 3000 per 0.5 of an acre. There is high rural –urban migration of youth (70%) especially of males in search of jobs.
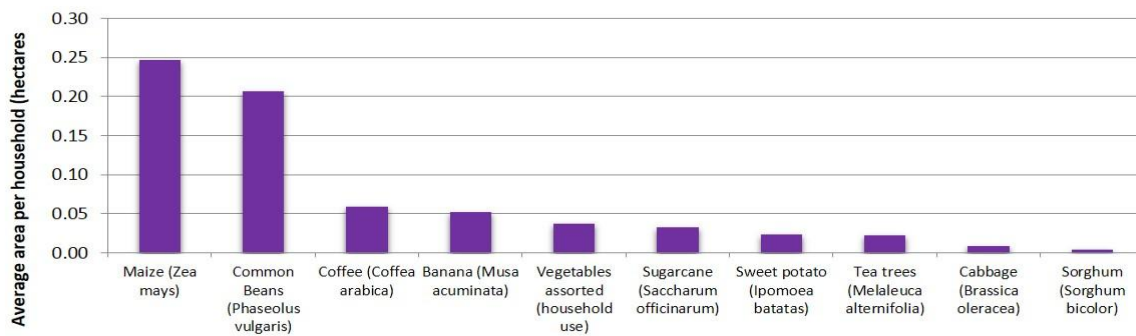
Table 3.2. Average land sizes owned by different categories of farmers in Sensi and Mwagichana wards, Marani sub-county

	Sensi Ward		Mwagichana Ward	
Category of farmer	Range of land size in acres	%of households that fall into the category	Range of land size in acres	%of households that fall into the category
Small farmer	≤0.25	60%	<0.1	Check with files &charts
Medium farmer	0.25 – 0.5	30%	0.1 - 1	
Large farmer	0.5 - 3	10%	>1	

Table 3.3. Cropping seasons occurring in Marani

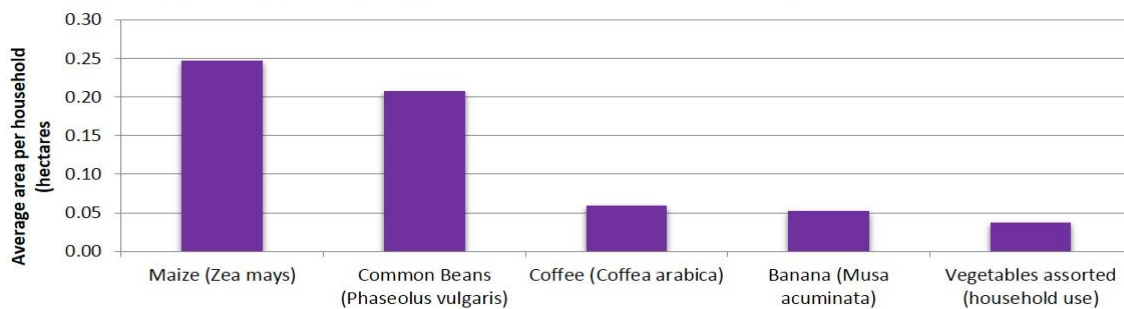| Condition (Name of season)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry (Tindacha)												
Long Rains (Risimeka)												
Short dry (Omwobo)												
Short Rains (?)												

Figure 3.2 a & b. Average area (ha) per house hold of dominant arable crops as perceived by farmers from Sensi ward in Marani sub-county.

(a) Crops grown in the area in Mwagichana ward

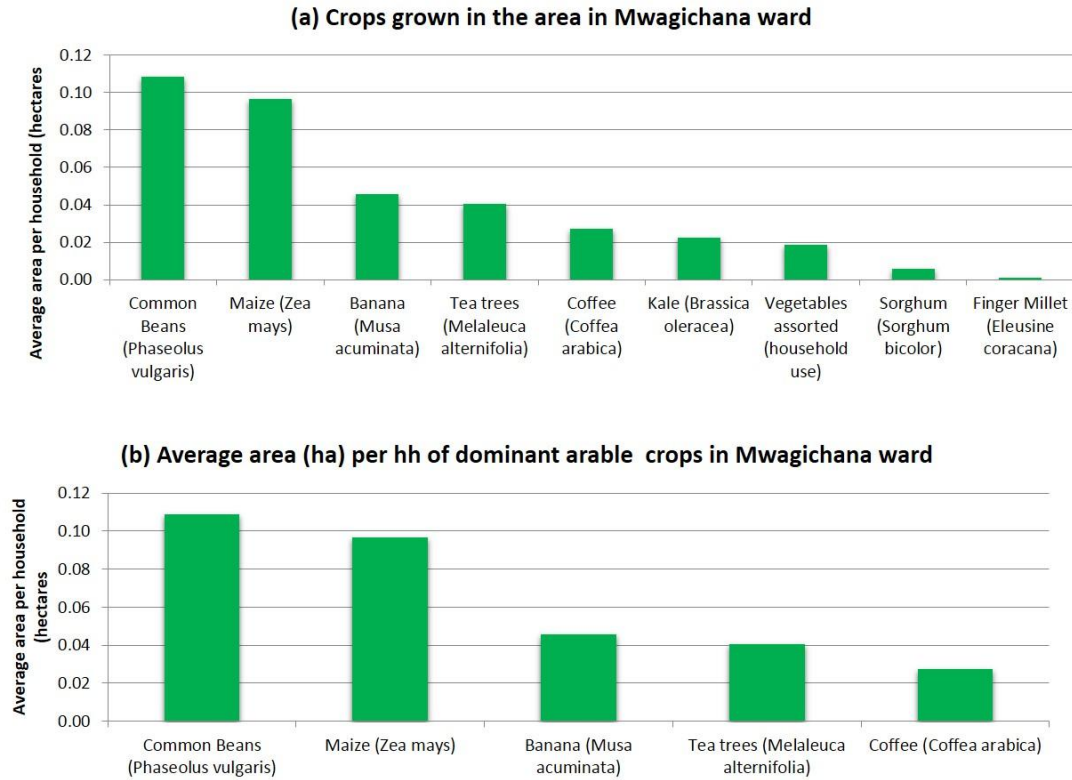## (b) Average area (ha) per hh of dominant arable crops in Mwagichana ward

Figure 3.3. a & b. Average area (ha) per house hold of dominant arable crops as perceived by farmers from Mwagichana ward in Marani sub-county.

Dairy breeds

Livestock Production forms an integral part of Agriculture and almost every farming household keep ruminants and almost all of them keep indigenous chicken (sub-county Annual Report 2012). Improved dairy cattle forms approximately 70% of the cattle population and the population has increased from 13,850 in 2008 to 19,566 by 2012 (Table 3.4). Common dairy cows are zebu crosses with Friesian, Jersey and Aryshire and between breeds. Indigenous cattle are mainly the East African Zebu and their numbers has been declining (Table 3.2). The increase in improved dairy cattle suggests the importance farmers attach to dairy farming in the sub-county.

In terms of livestock improvement, most of the farmers use locally available bulls which are of low quality for breeding purposes. Only a few farmers use artificial insemination (AI) due to the high cost which ranges from US$ 12.5 to 18.75 (KE 1200 to 1500). A.I. service providers are from outside the sub-county and these includes MOLSHED A.I. from Kisii Central and ENOCHEM A.I. from Kisii town.

Table 3.4. Livestock population trends

Type of livestock	Class	Years				
		2012	2011	2010	2009	2008
Cattle	Dairy/Crosses	19566	17766	16210	15,320	13850
	Zebu	6780	7068	7440	7640	8970
Poultry	Indigenous	27070	29920	34000	30000	35000
	Layers	2740	2930	3440	3200	3900
	Ducks	200	200	210	200	270
	Turkeys	20	25	30	30	57
	Geese	20	20	30	35	60
Goats	Local	4810	5500	5600	5210	5980
	Dairy/crosses	77	80	86	83	70
Sheep	Local	3640	3120	3270	3150	1948
Pigs	-	12	0	0	0	0
Donkeys	-	760	780	860	814	780
Emerging	Guinea Fowl	12	10	10	10	6
Rabbits	Crosses	180	180	280	304	300
Bee hives	KTBH	570	525	515	460	305
	Langstroth	70	65	60	45	29
	Local	120	120	120	82	90

Milk production trends and marketing in Marani sub-county

Milk production is an important means of regular income generation. Most of the milk is produced is from crossbreed dairy cows followed by purebreds and both account for 75% of the breeds (Tables 3.5). There are no organized milk marketing channels. Almost all milk produced in the district sold through hawking and the rest at the farm gate. The milk price ranges from Kshs 50- 60/= in rural and urban areas.

Table 3.5. Milk production and revenue estimates over the years

Type of dairy cattle	Milk Production ((Litres)[2])					
	2013	2012	2011	2010	2009	2008
Pure Dairy breeds	5,500.0	6,546.0	6,856.4	6,746.5	6,842.4	8,268.0
Crosses	7,100.2	8,246.4	8,173.2	7,686.4	7,789.5	7,730.1
Zebus	2,040.2	2,124.0	2,046.4	2,156.2	2,246.2	1,353.2
Total	14,640.40	16,916.40	17,076.00	16,589.10	16,878.10	17,351.30
Revenue (US$)[3]	9150	10573	10673	10368	10549	10845

[2]The cost of milk is estimated to be US$ 0.625 (KShs 50) per Litre of milk.
[3]US$ is equivalent to KShs 80

Livestock feeds and feeding

Due the small land holdings, the dairy animals are kept either under semi-zero grazing where they are tethered in the homestead during the day and provided with feed or under zero grazing with feed. Natural pasture and Napier grass make the bulk of livestock feeds in the area (Table 3.6). Supplementation is mainly done through use of maize stalk and banana pseudo-stems. Among the leguminous fodder crops, there were 1200 trees of Calliandra and 20,000 of Sesbania on only 26 farms, while 0.08 ha of Desmodium was on only 3 farms by 2012. Sweet potatos are planted on 27 ha for tubers as human food and the vines as used as a protein supplement for dairy cattle. Commercial concentrates (dairy meal) is also restricted to high yielders (>10 lt/day) because of the high cost of US$ 0.4 per kg and US$ 2 per kg of dairy minerals. Lack of adequate planted leguminous fodders and high cost of commercial concentrates suggests deficiency in protein among the feeds offered to dairy in the sub-county. Forage conservation is rarely practiced mainly due inadequate availability of forage throughout the year. Agricultural by-products are fed directly

Table 3.6. Forage types and agricultural by-product trends in Marani sub-county

Feed type	Year					
	2007	2008	2009	2010	2011	2012
Forage						
Improved pasture (ha)	0	0	0	0	0	0.1
Napier grass (ha)	336	380	416	1,520	1560	1,650
Natural pastures (ha)	4,080	420	404	1,010	1,000	900
Fodder shrubs (Number)	10,000	21,000	23,000	30,000	30,000	3,500
Desmodium (ha)	0.3	0.1	0.1	0.1	0.1	0.08
Sweet potato (ha)	N/A	N/A	N/A	N/A	N/A	27
Agricultural by-products (tons)						
Banana pseudo-stems/leaves	N/A	N/A	N/A	N/A	N/A	20,000
Banana peelings	N/A	N/A	N/A	N/A	N/A	5
Maize stover/leaf	N/A	N/A	N/A	N/A	N/A	4,000
Bean straw	N/A	N/A	N/A	N/A	N/A	400
Finger millet straw	N/A	N/A	N/A	N/A	N/A	500
Sugarcane tops	N/A	N/A	N/A	N/A	N/A	1,000
Molasses	N/A	N/A	N/A	N/A	N/A	10
Pineapple peelings	N/A	N/A	N/A	N/A	N/A	1
Chicken droppings	N/A	N/A	N/A	N/A	N/A	3

Source: Sub-county livestock annual report 2012; N/A Refers to data not available

Milk production is an important means of regular income generation with many farmers possessing crossbreds of Jerseys, aryshire and Friesians. Farmers from Sensi ward had 60% of the households keeping improved dairy cattle, while those of Mwagichana ward kept more local cattle (60%) (Table 3.7). The average number of improved cattle per household was 2 in Sensi Ward, while Mwagichana there was 1-2 of improved and/or local cattle. Both improved and local dairy cattle provide milk, manure and are sold as meat to supply substantial income when the need arises, and to pay dowries. The improved ones are in addition to meat sold as breeding stock. Majority of the farmers (90-100) in both sites keep poultry for Eggs, meat, manure and sale for income; and local goats (60%) for sale for income, meat and manure. The average livestock holdings (TLU) per household of dominant species are shown in Figure 3.4. The results suggest that the farmers selected for the individual interviews were more dedicated to dairy cattle (Table 3.9) than to the other livestock species as was suggested by overall group discussion in Table 2.

Table 3.7. Proportion of farmers owning different species of livestock, average herds per household (HH) and use in Marani sub-county

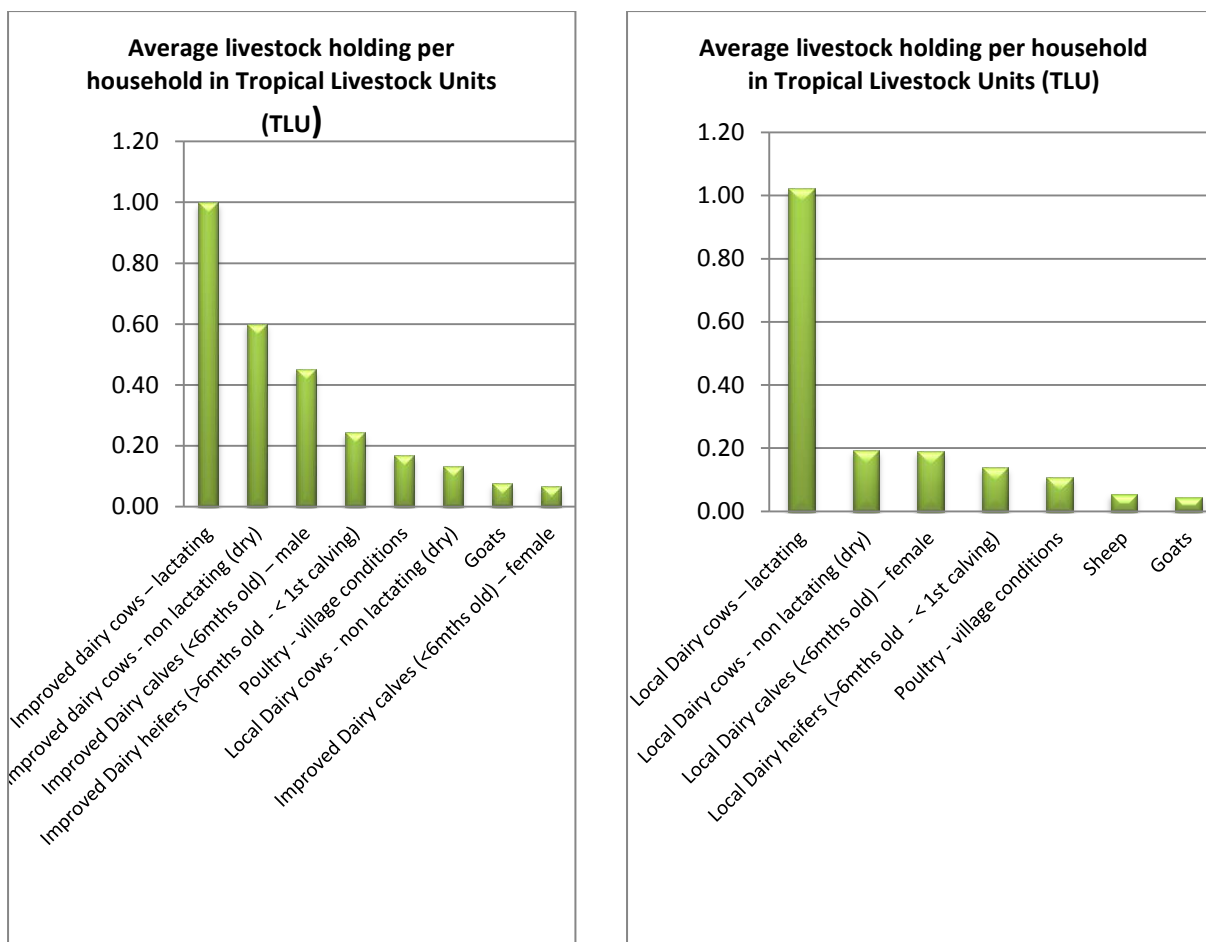| Livestock species	Use	Sensi Ward		Mwagichana Ward	
		HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)
Improved dairy cows	Milk, manure, meat and breeding stock sale (income), dowry	**60**	**2**		
				10	1-2
Local dairy cows	Milk, manure, meat and breeding stock sale (income), dowry	**0**	**0**		
				60	1-2
Sheep	Meat and sale for income	1	2	40	4-5
Local Goats	Meat and sale for income	60	2	60	4-5
Dairy goats	Sale for income, milk, meat, manure	-	-	10	2-3
Indigenous poultry	Eggs, meat, manure and sale for income	100	5-10	90	10-15
Commercial poultry	Eggs, meat, manure and sale for income	5	50-100	≤10	50-100
Donkey	Sale for income, draught power	2	1	10	1-2
Rabbits	Meat, Sale for income	2	3	-	-
Fish	Meat	10	100	-	-
Bee	Honey	10	10	-	-
Ducks	Sale, meat, eggs	-	-	<10	4

Figure 3.2. Average livestock holdings (in tropical livestock units, TLU) per household of dominant species in Sensi ward (left) and Mwagichana ward (right), Marani sub-county

Generally, livestock input services such as feeds and veterinary drugs are available but were reported to be costly. Both private and Government veterinarians are mainly involved in vaccinations, while private veterinarians provide animal health services to farmers in Marani. Veterinary services are generally available but not easily accessible, and they are costly for most farmers (Table 3.10). For example, treating East Coast Fever (ECF) costs farmers KShs 3,000 per treatment and milk fever KShs 2500.

Table 3.8. Common cattle diseases and their cost of treatment in the sub county

Disease	Cost per treatment (Kshs.)
East Coast Fever	3000
Bovine Anaplasmosis	1200
Enteritis	1200
Milk fever	2500
Salmonelosis	800
Metabolic disoders	200
Bacterial pneumonia scouring	200

Artificial Insemination (AI) services are lacking as there are no private AI providers in the sub-county itself. However, farmers can readily access the services from Kisii town which is 20 to 40 km away. The cost of semen for a single insemination is KShs 1,200-2,000 per single dose depending on the breed and KShs 1,000 to 1,500 for a repeat serve. In addition, farmers pay KShs 1,000 to 1,500 for AI service/transport depending on distance. The rates of repeat are high (up to 3 times). Improved bulls are mainly used for breeding at a cost of KShs 200-300 per service, while local bulls are offered at KShs 100. Farmers with high yielders fear using bulls because disease.

Agricultural and livestock inputs (farm implements, crop seeds, fertilizers, herbicides, pumps, acaricides, feed supplements) are readily available from agro-vets within the sub-county and from big agro-vet stores, KFA and cereal boards from the nearby Kisii town. There is generally credit from institutions for crop or livestock production from the neighbouring Kisii town i.e. from banks, SACCOs, Vision Point, Youth Fund and Women Fund) but majority of farmers fail to access the credit due lack of collateral and high interest rates . Within the sub-county farmers have access to a few small self-help credit and saving groups (e.g. Merry-go-rounds, Table banking) but they do not offer them capital to invest in commercial farming. Income is mainly obtained from crop, livestock and small businesses. These businesses include fishing and service provision. Few farmers have land title deeds and this contributes to lack of collateral for accessing loans to invest in farming.

Feed types and sources throughout the year and feeding systems
About 20% of the farmers who keep improved cattle stall-feed their animals with cut and carry grasses that are manually chopped with a 'panga' (local machete) or with a motorized chopper before feeding. Feed for the improved animals are often supplemented with concentrates, such dairy meal, maize bran and minerals. The rest of the farmers who keep improved cattle (80%) collect feed to stall feed but rarely chop before feeding. Animals are mostly kept in sheds, however, some people keep even improved cows under a tree and return them to house sheds at night for security purposes. Whereas, local cattle are mainly tethered under shade and also provided fodder through the cut and carry system, or they graze in any open land along road sides. Both men and women participate in feeding livestock, including also the tethering of animals farther away from the farmstead.

Napier grass is the dominant fodder crop grown in Sensi and Mwagichana ward though planted on 0.05 to 0.08 ha only due to the limited land size (Figure 3.3). In addition Sensi ward has small portions of fodder beat (*Beta vulgaris*). A few trees of Calliandra are grown in both wards. These feeds are inadequate and farmers in Mwagichana ward rely on purchased feeds mainly Napier grass, lucerne (50%) and Rhodes grass hay (25%) for supplementation, while those at Sensi only purchase additional Napier for supplementation. In additional, farmers at Mwagichana purchase commercial concentrates (dairy meal) to provide protein feeds while those at Sensi do not. Crop residues also form the bulk of the feed especially maize stalk leaf stripping and stove; bean straw, finger millet straw, and banana pseudo-stems and sweet potato vines. Except for banana pseudo-stems and sweet potato vines, the rest of the crop residues are only available during the dry season thus after harvest. Occasionally crop by products are treated with molasses by a few farmers before feeding.
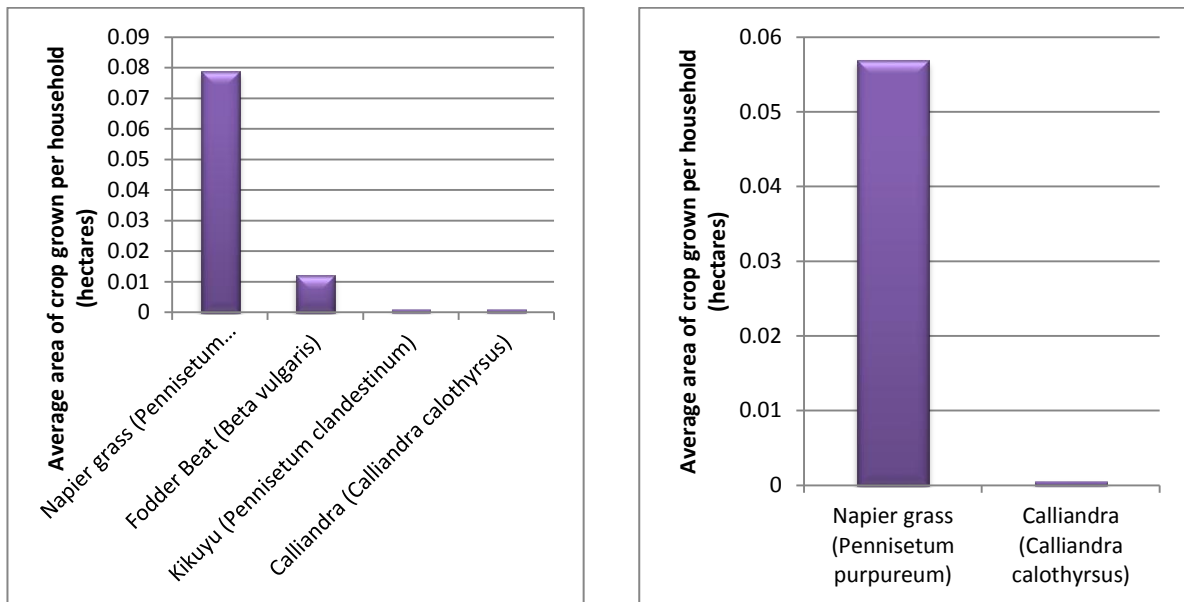
Figure 3.3. Dominant fodder crops grown in Sensi ward (left) and Mwagichana ward (right), Marani sub-county

In Sensi ward crop residue, cultivated fodder, and naturally occurring and collected feeds/grazing contributes almost equally to the DM (24-26%) and ME (21-28) content of the diet, while in Mwagichana the biggest contribution of DM (57%) and ME (58) comes from planted fodders followed by naturally occurring and collected feeds (Figures 3.4 and 3.5). Trends in the contribution of CP% were similar to those of DM% and ME for the two sites (Figure 3.6). Purchased feeds contributed 1% at Sensi and 3% at Mwagichana an indication that farmers in Marani do not purchase adequate concentrates especially protein for their dairy cattle.

Green feed (planted or collecting naturally occurring forages) and crop residues were the most available feeds and followed the rainfall pattern. Green feed available throughout the year but with high quantities during the wet season April to November (Figure 3.7). Crop residues were also available throughout the year but with the highest quantities after cereal and legume harvests (July to September and December to February). Availability of crop residues throughout the year can be attributed to banana pseudo-stems and vegetables wastes that do not necessarily follow the cropping season. Farmers in Sensi ward purchase more concentrate feeds throughout the year than those at Mwagichana and this could be attributed to the fact that there were more improved cattle in Sensi than Mwagichana. However, what farmers refer to as concentrate feeds are predominately commercially mixed rations (dairy meal) and maize.
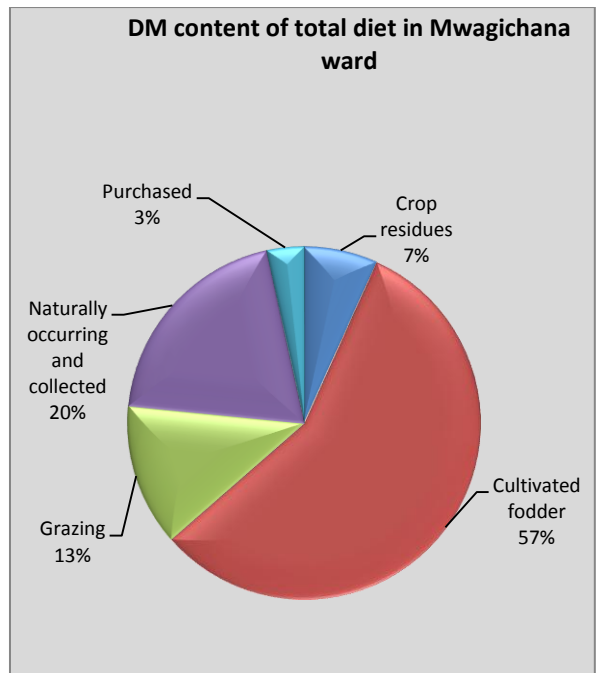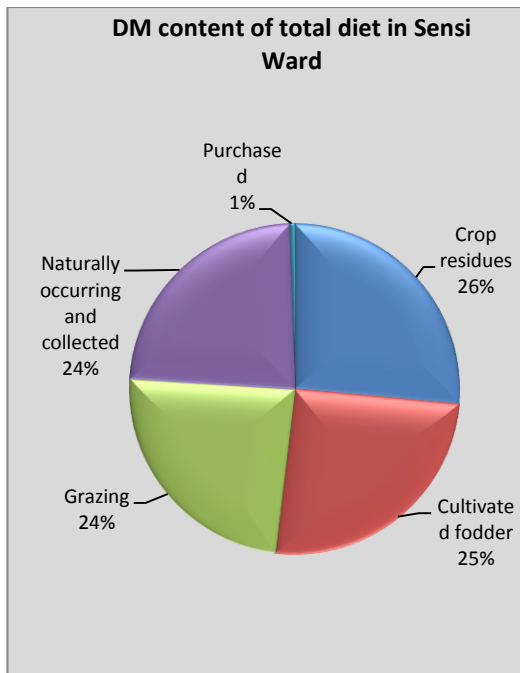
Figure 3.4. Types of feed and their contribution to DM content to total diet in Sensi ward (left) and Mwagichana ward (right), Marani sub-county
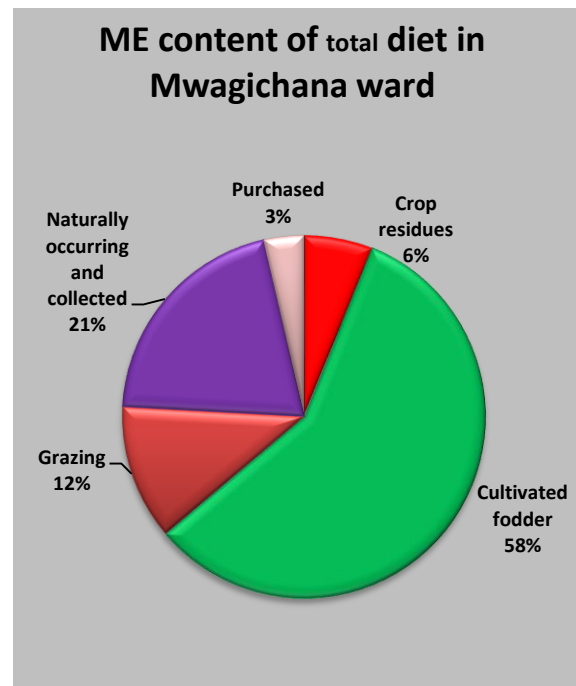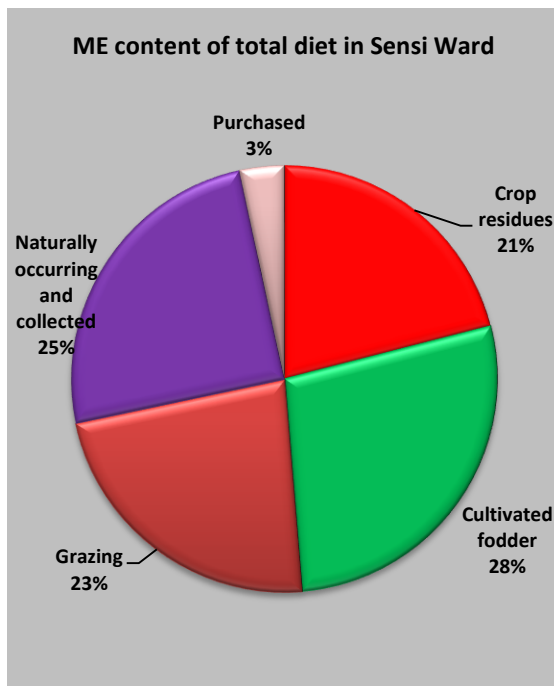

Figure 3.5. Types of feed and their contribution to ME content to total diet in Sensi ward (left) and Mwagichana ward (right), Marani sub-county
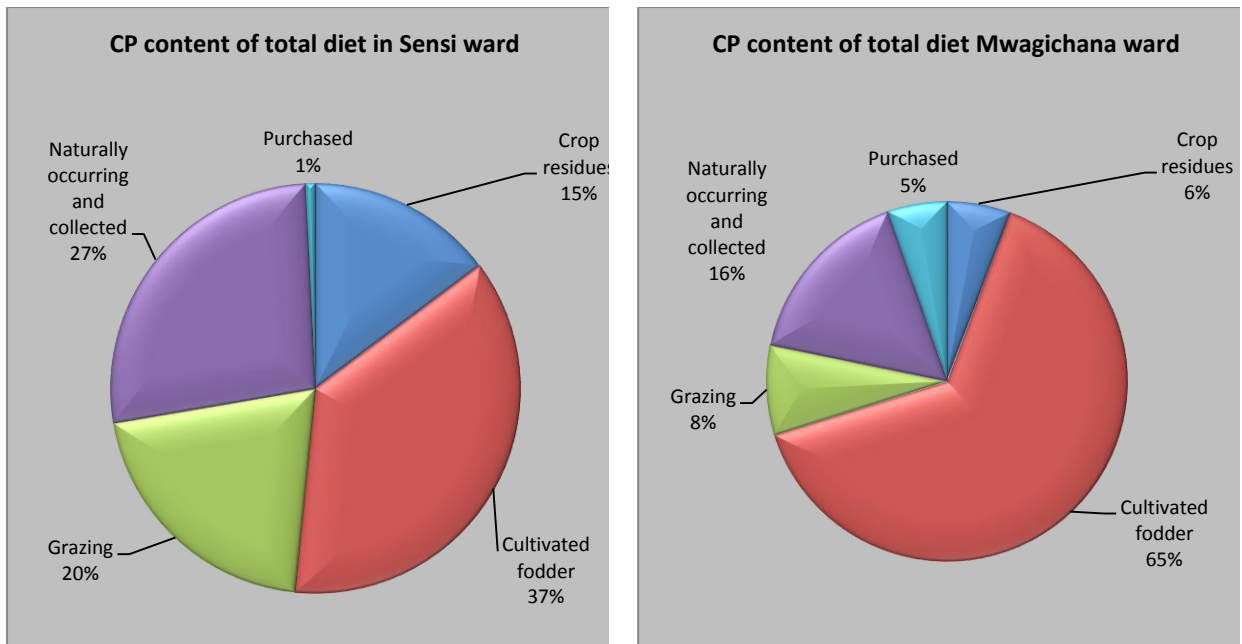
Figure 3.6. Types of feed and their contribution to CP% content to total diet in Sensi ward (left) and Mwagichana ward (right), Marani sub-county
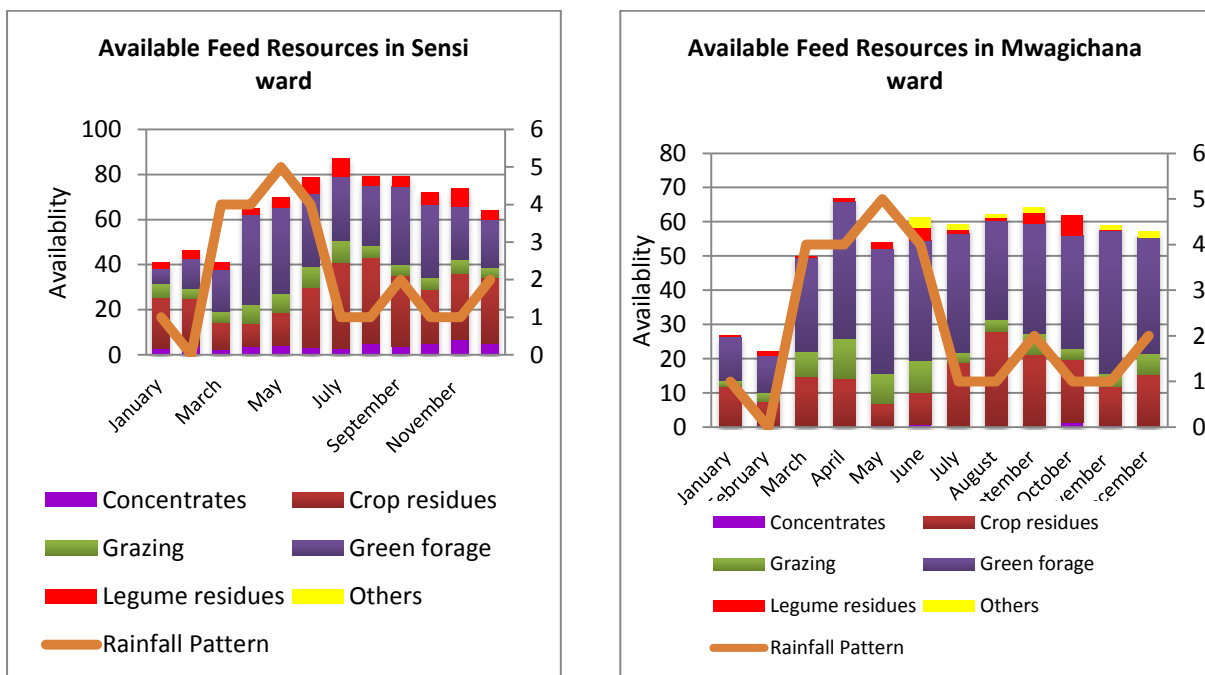

Figure 3.7. Available feed resources in Sensi ward (left) and Mwagichana ward (right), Marani sub-county

Major income sources

In Sensi ward, the main contributors to income was dairy (42%) followed by cash crops (mainly tea 40%) and off-farm business (Figure 3.8). In Mwagichana, food crops followed by cash crops were perceived to be the main contributors to income. Among the livestock poultry both for sale for meat and eggs contributed 21% and 17% respectively. The respondents did not perceive dairy as a major contributor to their income and this could be attributed to the predominantly local cattle in the area. Farmers did not also factor
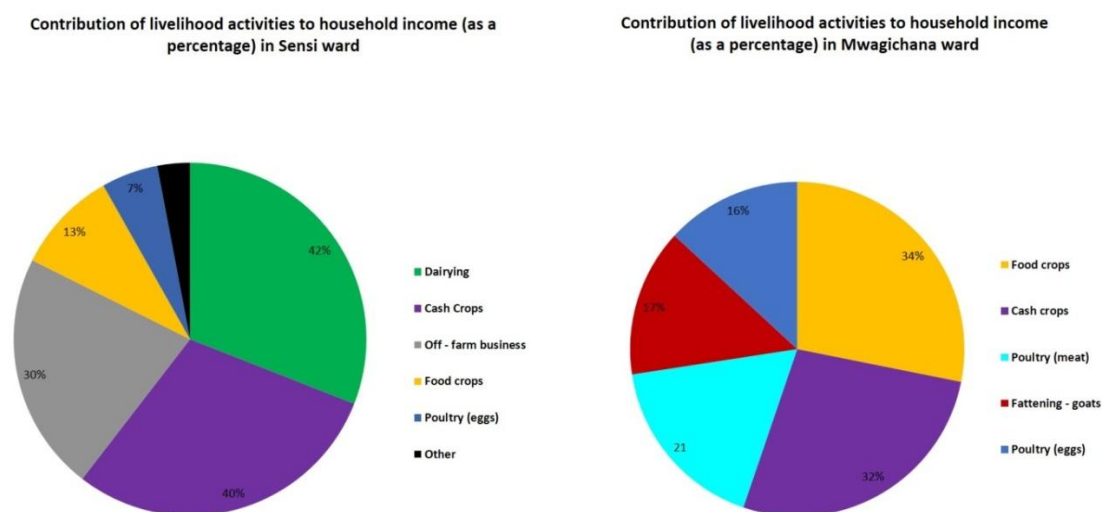

Figure 3.8. Contribution of livelihood activities to household income (as a percentage) in Sensi ward (left) and Mwagichana ward (right), Marani sub-county

Challenges and opportunities

Overall, the main issues that farmers face in the farming systems are listed in Table 3.9. Inadequate technical knowledge on fodder production, processing, feeding and livestock management were considered priority problems in both Sensi and Mwagichana wards. In Sensi ward, lack of improved breeds was priority number 2, while Mwagichana it was lack of credit facilities to invest in crop and livestock production that was priority number 2 (Table 3.9). Costly animal health services were priority number 3 across the two sites. Milk marketing was a problem Sensi because farmers have more improved breeds per household thus produce slightly more milk than those in Mwagichana.

A lack of credit facilities is also a clear constraint to the further development of crop and livestock production in Marani. This may be linked to lack of collateral and farmer unfriendly conditions by the creditors. Farmers in Marani do not have adequate animal health services and most of this services accessed from Kisii where the transport costs are high. Artificial Insemination (AI) services could help disseminate improved genetics; however, the service is not reliable within the area and is costly to farmers. As a result, a lack of technical knowledge is also a clear constraint to the development of livestock production. Farmers' perceptions of potential solutions to their problems are shown in Table 3.9. The list of potential solutions suggest that farmers expected solutions to come from outside instead of engaging themselves in finding them.

Table 3.9. Pairwise ranking of main problems in livestock production and proposed solutions by farmers from Sensi, and Mwagichana wards

Challenges	Ranking in Sensi ward	Ranking in Mwagichana ward	Possible solutions
Lack of/difficulty to reach milk markets	4	-	• Ensure milk quality • Set up a milk cooling plant • Organize milk transport together
Lack of improved breeds	2	5	• Train and provide initial capital for local A.I. services providers • Acquire improved breeds • Address issues of dairy cattle fertility
Inadequate technical knowledge on fodder production, processing, feeding and livestock management	1	1	• More technical knowledge in feeds production, processing and feeding through training and tours • Reduce costs of feeds by procuring them together (cooperative) • Training in record keeping
Costly animal health services	3	3	• Preventive strategies through effective tick control by revival of communal dips and routine hand spraying • Vaccination campaigns • More technical knowledge in animal health services including hygiene
Lack of credit facilities to invest in crop and livestock production	-	2	• Merry-go-round • Provide affordable credit facilities • Institute farmer friendly collateral for loans
Inadequate land for feed production	-	4	• Family planning • Practice zero grazing • Credit facilities to hire land and invest in feed production

Conclusions

Marani sub-county is characterized predominately by mixed crop-livestock production systems. Dairy, cash crops and food crops are the primary sources of household income. Cattle are the most important livestock species. Improved crop and dairy production is constrained by inadequate technical knowledge on fodder production, processing, feeding and general livestock management; lack of credit facilities, improved breeds and high cost of health services. Other constraints are poor milk markets and inadequate land for crop and feed production. To mitigate these constraints farmers (and other stakeholders) will be required to take an integrated approach to improve livestock production through (i) provision of technical knowledge in feeds production, processing and feeding through training and tours, (ii) improving access to AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, (iii) access to credit facilities to enable farmers invest in the crop and livestock production enterprises and also milk marketing strategies.

Chapter 4. Characterization of the livestock production system and potential to enhance productivity through improved feeding in Kisumu West, Kisumu, Kenya

By Francis N. Muyekho[1], Donald Siamba[1], Humphrey Agevi[1], Dickens Nyagol[2] and Dosa Karugara[3]

[1] Masinde Muliro University of Science and Technology
[2] ICIPE
[3] District Livestock Production Officer, Kisumu West sub-county

The Feed Assessment Tool (FEAST) was used to characterize the feed-related aspects of the livestock production system in Kisumu West sub-county of Kisumu County of Kenya. The assessment was carried out through focused group discussions and completion of short questionnaires at 2 sites representing peri-urban and typical rural setup. At each site 20 farmers attended group PRA followed by nine key farmers consisting of 3 each representative owning small, medium and large scale farms. It was found out that Kisumu West sub-county is characterized predominately by smallholder mixed crop-livestock production systems on approximately less than 2 acres of land. Dairy and food crops are the primary sources of household income. Farmers in Kisumu West sub-county keep predominantly local cattle. Improved dairy production is constrained by inadequate feeds/management skills, high cost of disease control and poor breeds. Unorganized milk marketing is also a constraint. To mitigate these constraints farmers prioritised (i) skills in fodder production and exposures to varieties that are tolerant to Napier grass stunt disease and drought; knowledge on feed preservation and processing (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Background

Kisumu west is one of the sub-Counties of Kisumu County and is situated along the shores of Lake Victoria covering the area from the Kisumu airport to Maseno encompassing the whole of Nyahera up the hill, bordering part of western and rift valley. It is located at 0.080S and 34.50E and has an area 171 km2. It has five administrative Wards namely: South West Kisumu Ward, Central Kisumu Ward, Kisumu North Ward, West Kisumu Ward and North West Kisumu Ward (Figure 4.1). The PRA was conducted in North West Kisumu and Kisumu Central Wards.

The climate of the whole county is modified by the presence of the lake. The county has an annual relief rainfall that ranges between 1200 mm and 1300 mm with a bimodal pattern. The long rains are reliable while the short rains can be unreliable in the drier parts of the sub-county. The temperature ranges between 20 0C and 35 0C with a mean annual rainfall of 230C. The humidity is relatively high throughout the year. The altitude of Kisumu West sub-county is approximated to be between 990 and 1470 metres above the sea level. There are three agro-ecological zones namely the Upper Middland Zone 3 (UM3) and Lower Midland Zone 1 which have adequate and reliable rainfall and the LM4 agro-ecological zones which is drier with unreliable short rainy season (Jaetzold et al. 2009). The soils are volcanic but vary depending on the parent material they are formed from. In the higher regions (UM1), soils are dark red clays which are fertile and well drained.
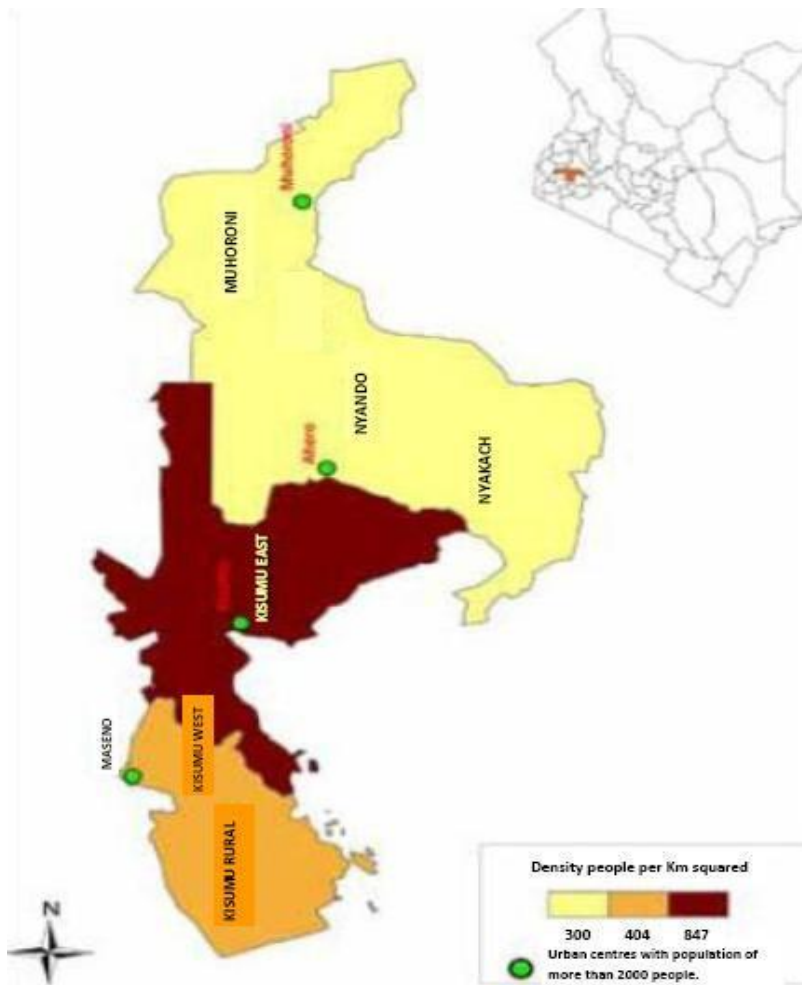
Figure 4.1. Map showing sub-counties of Kisumu county

Methodology

The study was carried out in Kisumu Central and North West Kisumu wards of Kisumu county. Secondary information, obtained from the literature and published reports was integrated with primary information collected through focussed group discussions using the Feed Assessment Tool (FEAST) This was used to characterize the livestock production system and, in particular, feed-related aspects. The FEAST tool is a rapid and systematic method that combines a PRA (Participative Rural Appraisal) with individual farmer interviews. The PRA provides an overview of the farming system, in particular, the livestock production system. It also helps identify major problems, issues and opportunities within the livestock production system. The individual farmer interview gathers both quantitative and qualitative information according to major wealth groups based on relative land size owned. The assessment was carried out through two structured group discussions and completion of short questionnaires by key farmer representatives in Nyahera sub-location and in Kisumu Central and North West Kisumu Wards in Kisumu West sub-county on 5th December 2013.

The composition of the groups is shown in Table 4.1. Participating farmers were chosen by ICIPE staff working on push-pull technology and the sub-county Livestock Production Officers (PDO) of Kisumu West sub-county Ministry of Agriculture and Livestock. Overall 24 persons participated in the group

discussion in North West Kisumu Ward and 20 in Kisumu Central Ward (Table 4.1). From each PRA group 3 representatives of different wealth classes (Table 4.2) were chosen for the individual interviews. The following are findings of the assessment and conclusions for further action.

Table 4.1. Group composition of farmer representatives for feed assessment in Kisumu West sub-county, Kisumu County Kenya

Site	Men	Women	Total
Kisumu Central Ward (Nyahera sub-Location)[1]	14 (5)	6 (4)	20 (9)
North West Kisumu Ward (Marera sub-location)[1]	9 (4)	15 (5)	24 (9)

[1]Sub-County administrative Wards (what in brackets for the Wards is the venue of PRA)
Number of individual interviewees in parentheses

Results and discussion

The high and reliable rainfall coupled with moderate temperatures and good soils is suitable for growing crops. About 92% (119.7 km^2) of the sub-county is arable but currently only 28.8 km^2 is utilized for crop production. Crops grown include maize, beans, groundnuts, sweet potatoes, fresh vegetables and bananas. North West Kisumu Ward is dominated by small scale farming households with less than 2 acres of land, while Kisumu Central Ward is dominated by very smallholder farmers with less than 0.5 of an acre (Table 4.2 and Figure 4.2). In North West Kisumu Ward Maize and beans are the dominant crops, while in Kisumu Central maize and groundnuts dominate the farming system according to the individual interviews. Other subsistence crops North West Kisumu include bananas, kales, and groundnuts, while in North West Kisumu they are beans, cassava and sweet potato. Figure 4.3 shows the average area (ha) per household of dominant arable crops. Households in the surveyed area are composed of approximately 5-6 people per household. With 80% of the households having an average of 0.5 acres, farmers in North West Kisumu utilize substantially less land than those of Kisumu Central where 70% utilize 0.5-2 acres of land. Both Wards experience four different cropping seasons spread throughout the year. The long rainfall (high rainfall) season **'Chiri'** is from March to June, while the short rainfall season **'opon'** is from September to November. It is in the main dry season '**Oro**' from January to February, when almost no precipitation takes place. Finally, 'Oro-Opon' refers to the harvesting season from July to August and December and these months are characterized by very low rainfall (Table 4.3).

Land owned by farmers is not enough for all their farming and livestock activities. Farmers mainly practice inter-cropping of legumes and cereal crops especially beans and groundnuts with maize or sorghum. Others lease land for crop production. Due to shortage of land size, no fallowing or crop rotation takes place. Agricultural inputs such as fertilizer, seeds, agro-chemicals are available from agro-veterinary stores but are reportedly expensive for farmers to afford in adequate amounts. All agricultural activities are rain-fed except for 1% who practice drip irrigation and 20% who practice bucket irrigation on vegetables during the dry season and this are mainly farmers who live near the river or other water sources. Contrary to agricultural inputs, irrigation equipment is not available within the community except from Kisumu. Labour is generally available and is mostly required in the rain season for land preparation at Kshs 3000 per 0.5 of an acre and a daily wage of Kshs 200 per day plus lunch for planting, weeding and harvesting. Approximately 80% leave the farms in search of alternative jobs instead of providing labour in the farms.

Table 4.2. Average land sizes owned by different categories of farmers in North West Kisumu and Kisumu Central wards, Kisumu County

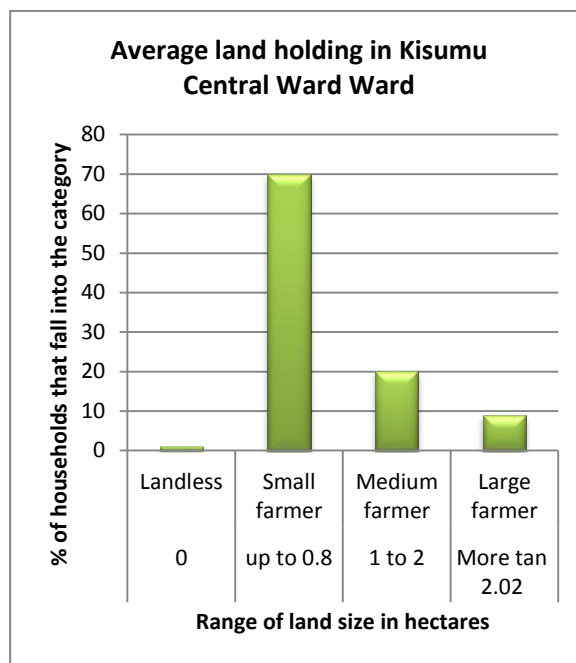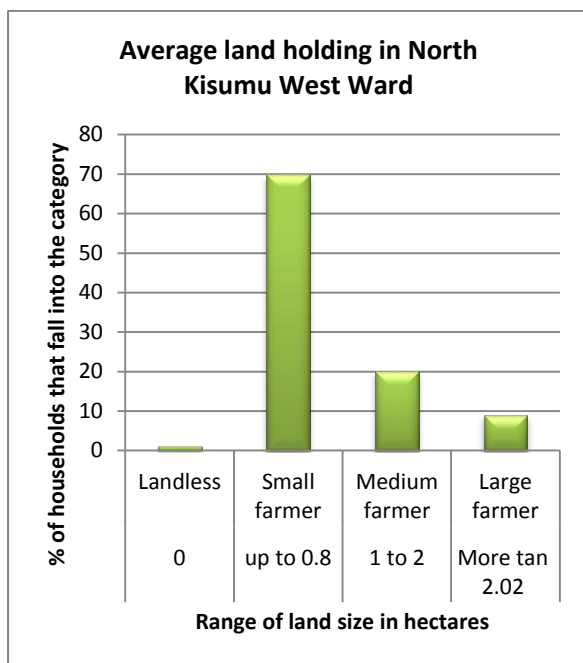|	North West Kisumu Ward		Kisumu Central Ward	
Category of farmer	Range of land size in acres	%of households that fall into the category	Range of land size in acres	% of households that fall into the category
Small farmer	<0.5	20	<0.5	80
Medium farmer	0.5 – 2	70	0.5 - 2	15
Large farmer	3 – 5	10	>3	5

Figure 4.2. Average landholdings in North Wes Kisumu Ward (left) and Kisumu Central Ward (right) Kisumu West sub-county
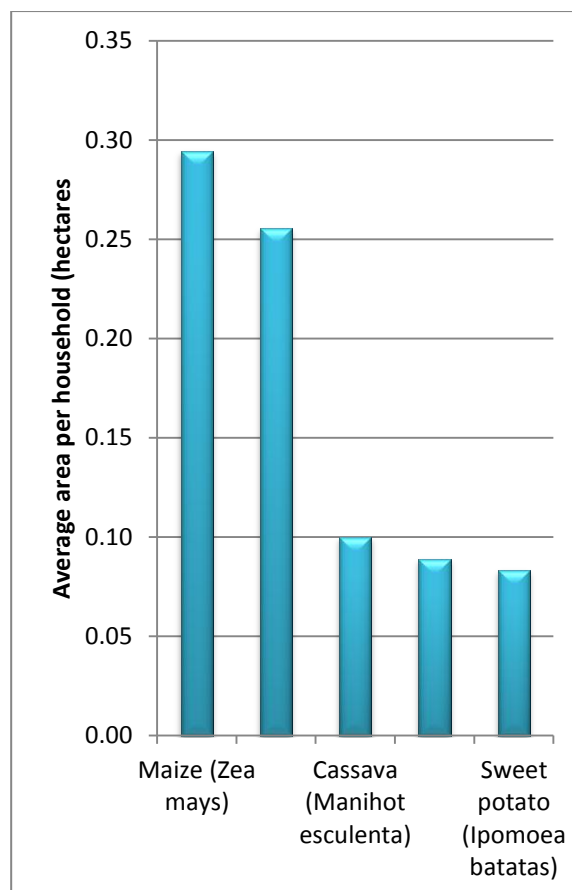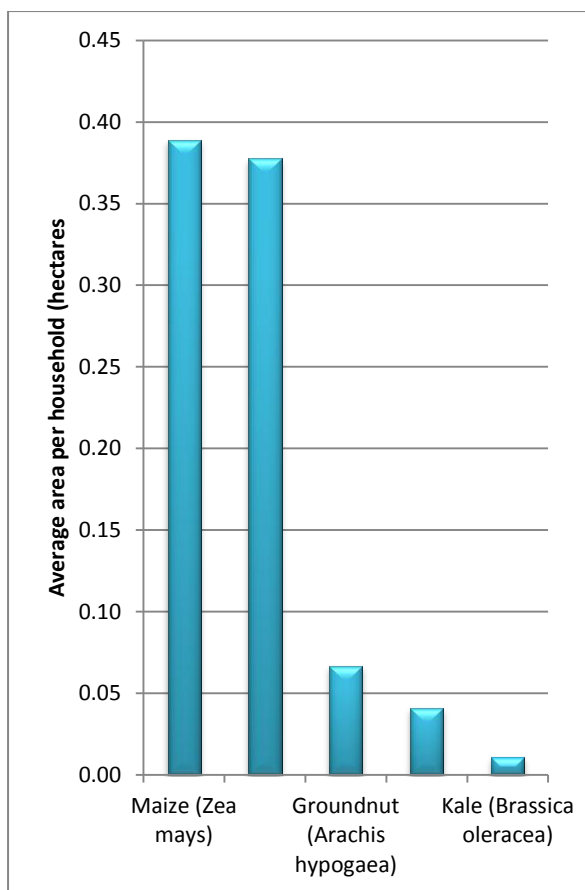
Figure 4.3. Average area (ha) per household of dominant arable crops North West Kisumu Ward (left) and Kisumu Central Ward (right), Kisumu West sub-county

Table 4. 3. *Cropping seasons occurring in Kisumu West sub-county*

Name of season	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Long dry season (Oro)	■	■										■
Long Rain Season (Chiri)			×	×	×	×						
Short dry season (Oro-Opon)							■	■				
Short Rain Season (Opon)									■	■	■	

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Livestock production

Different livestock species which serve various purposes are raised in the areas surveyed. Major livestock species raised, their uses, proportion of households that own the species and mean herd/flock sizes of each ward are shown in Table 4.4 Improved dairy cattle constitute only 4% of the cattle population in the sub-county and there are only 75 dairy goats (Table 4.4). Indigenous chicken is the predominant enterprise in the sub-county with approximately 185,560 birds in 2013. Other livestock species reared are listed in Table 4.4. Provide service provides for Artificial Insemination (AI) in the sub-county are Maseno veterinary farm and Jumbo agro-vet in Maseno; and Luanda dairy in Vihiga County. Only a few farmers use AI due the high cost per insemination which ranges from KShs 1,000 to 1,500 for semen from Kabete. It is also clear that these services are far from rural farmers. There four bull schemes in the sub-county most farmers prefer this because it is cheap (KSh 200 for local and 500 for improved bull) and efficiency with no repeat. The bull custodians are Mr Richard Odundo and Mr David Nyarir

The main source of forage is natural with an estimated hectare of 4,243. There are only 520 of improved pastures and 620 hectares of Napier grass in the whole sub-county. The sources of protein feed are from fodder shrubs (21,215 trees) and 82 ha of Desmodium and Lucerne according to the sub-county livestock production officer. Unfortunately most the fodder trees are not utilized as per recommendations. The farm and agro-industrial by products used as feed include maize bran and cotton seed cake mainly from Kisumu but this only utilized by very few farmers. Other feeds commonly used are molasses, fish meal, bean and cereal crop residues, banana pseudostems and sweet potato vines.

There are only two livestock supported projects in the sub-county namely push-pull technology spearhead by ICIPE where Napier and/or Mulato II are promoted with desmodium for the control of stemborer; Heifer International have been promoting fodder crops under the send a cow program and Techno-serve have been promoting indigenous poultry as a source of income. Overall, the sub-county is a net importer of livestock products.

Table 4.4. Estimated Livestock population statistics in 2013

Type of livestock	Category	Total number
Cattle	Dairy	1,237
	Zebu	27,320
	beef	0
Poultry	Indigenous	185,560
	Layers	684
	Broilers	1724
	Ducks	385
	Turkeys	180
	Geese	65
Goats	Local	12,325
	Dairy	75
Sheep	Local	9,178
	Dorper	0
	Wool	0
Pigs	Boars	27
	Sows	46
	Piglets/fatteners	267
Bee hives	KTBH	24
	Langstroth	63
	log	0
Rabbits	Bucks	147
	Does	235
	Kids/weaners	1,568
Donkeys	General	39
Emerging livestock	Guinea/fowls	12
	Quails	2,347

Source: Kisumu West sub-county District Production Officer

Milk production is an important means of regular income generation with many households (35%) in Kisumu Central Ward possessing two improved crossbreed dairy cattle compared to 5% Kisumu West ward. Farmers in North West Kisumu Ward generally keep more local cattle than those in Kisumu Central (Table 4.5). In addition to providing milk and manure, these are also sold for meat to supply substantial income when need arises and payment of dowry. The improved dairy breeds especially in Kisumu Central are in addition occasionally sold as breeding stock. Majority of the households (60-70%) in North West Kisumu keep local breeds of small ruminants (goats and sheep) for meat, manure and sale for income than those of Kisumu Central. Most farmers also keep indigenous chicken but there were no dairy goats and commercial chicken in the both Wards. The average livestock holdings (TLU) per house hold is shown in Figure 4.4 and generally agrees with those described in the group interview.

The most common livestock production systems in Kisumu West sub-county are:

- The zero-grazing system is practiced by farmers who have improved livestock and this is mostly in both Kisumu Central Ward. Farmers in this category practice cut and carry feeding systems. Fodder is often chopped before feeding and often supplemented with concentrate feeds. They also occasionally mix the grass with molasses and legumes.
- Tethering is practiced by 70% households who keep crossbreed and local dairy cattle in both of the Wards. Cattle are tethered to graze alongside the farms boundaries, homestead or roadside during the cropping season. They are provided with supplementary feed from the farm or collected from outside.
- Free range grazing is practiced by 25% of the farmers and mainly for local cattle in both wards by households who have slightly large farms.

Livestock input services such as feeds and veterinary drugs are available but were reported to be costly. Government veterinarians are mainly involved in vaccinations but are unavailable for animal health services. Private veterinary services are generally costly for most farmers. For example, treating East Coast Fever (ECF) costs farmers KShs 4,000-7,000 per treatment, black water costs Ksh 2,000, Anaplasmosis costs KShs 700 and deworming KShs 500 per animal. Para-vets are available and slight cheaper but not qualified enough in disease diagnosis.

Artificial Insemination (AI) services are readily available from private service providers. The cost for a single insemination is KShs 700 for semen from Kabete per insemination if served by Government staff and 1,200 per insemination inclusive of the service if served by private service providers. However Government service is not regularly available. For imported unsexed semen, the cost ranges between KShs 3,000 to 4,000 and up to KShs 10,000 for sexed semen. Farmers incur the same costs as first insemination per repeat insemination cow and repeats are quite frequent according to the farmers interviewed. Improved bulls cost KShs 500 per service and KSHs 300 for local bull but the breed quality and disease is a concern to farmers. Therefore the high rates of repeats coupled by high cost require consideration in the improvement of dairy productivity in the sub-county.

Agricultural and livestock inputs (farm implements, crop seeds, fertilizers, herbicides, pumps, acaricides, feed supplements) are readily available from agro-vets within the sub-county. Credit facilities for crop or livestock production are available from commercial and micro-finance institutions; Village savings, Maseno Green Sacco, Table banking and merry-go-round especially for ladies and upcoming youth and women enterprise fund. However many farmers do not access loans especially from commercial banks and micro-finance institutions because of high interest rates, collateral requirements, long loan processing period, defaulting by group members (in cases where groups qurantee each other). Many farmers do not have title deeds to act as collatoral to access loans.

Table 4.5. Proportion of farmers owning different species of livestock, average herds per household (HH) and use in Sabatia sub-county

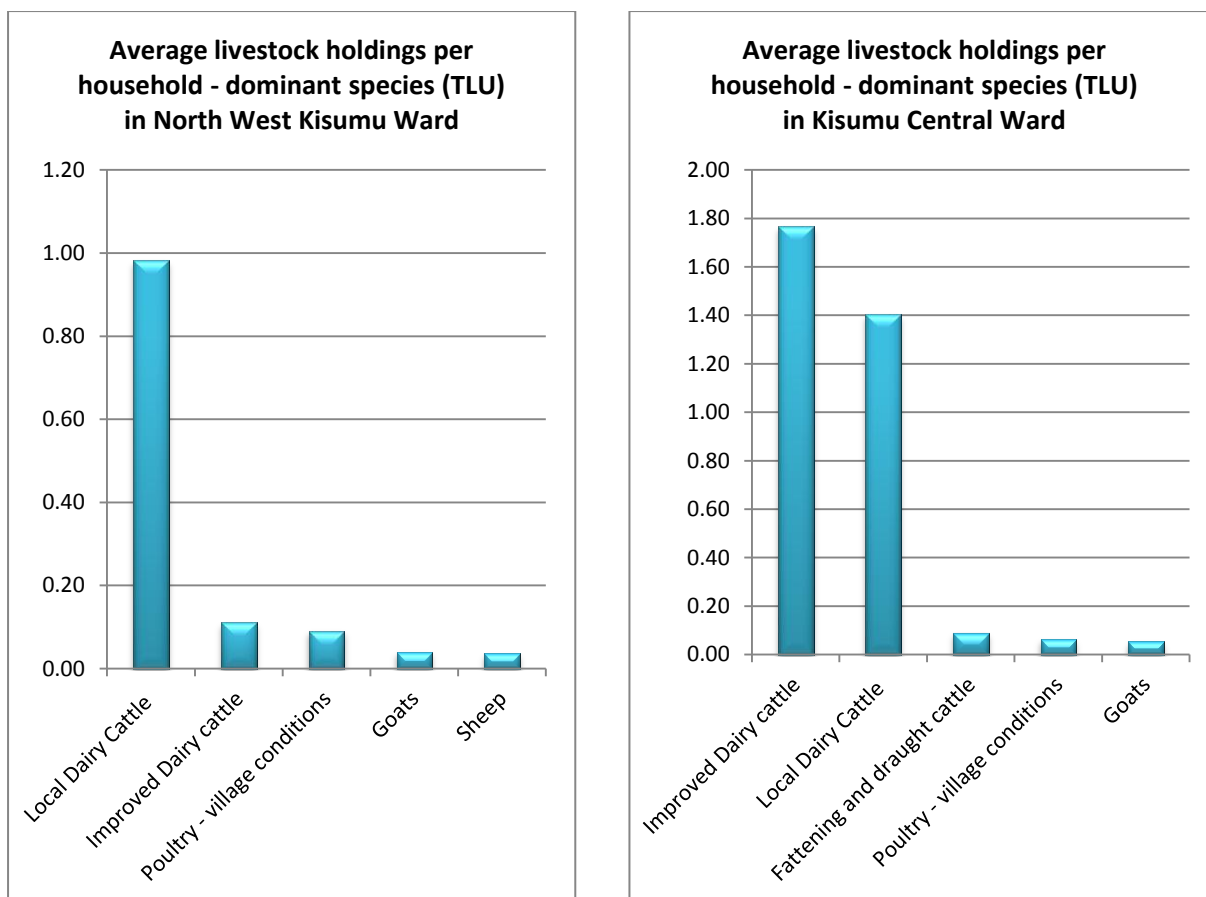| Livestock species	Use	North West Kisumu Ward		Kisumu Central Ward	
		HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)
Improved dairy cows	Milk, manure and breeding stock sale (income)	5	2	35	2
Local dairy cows	Milk, manure, meat, sale for income and dowry	30	3	65	2
Draught cattle	Ploughing, sale for cash income, meat, manure, breeding and dowry	1	1	1	1
Sheep	Meat, cultural rituals and sale for income	70	2	35	2-4
Local Goats	Meat, manure and sale for income	60	2	18	2
Dairy goats	Milk, Sale as breeding stock for income and manure	-	-	-	-
Pigs	Pork, manure, and sale for income	<1	5	-	-
Indigenous poultry	Eggs, meat, manure, sale for income and social activities	80	10	100	10
Commercial poultry	Eggs, meat, manure and sale for income	-	-	-	-
Quails	Meat and Sale for income	<1	15	-	-
Ducks	Meat and sale for income	1	2	-	-
Fish	Food and sale for income	<1	70	18	1,500 per pond
Rabbits	Milk, manure	<1	5	1	2
Donkeys	Transport and draught	<1%	2	-	-
Pigeon	Sale for cash and food	-	-	12	3

Figure 4.4. Average livestock holdings per household - dominant species (TLU) North West Kisumu Ward (left) and Kisumu Central (right), Kisumu West sub-county

Feed types and sources throughout the year and feeding systems

The major type of feed for improved dairy cattle is Napier grass and is grown on very small plots 0.05 to 0.08 hectares of land on average in each of the Wards Figure 4.5. In addition to small area planted Napier stunt disease is major constraint to herbage productivity per unit land in the sub-county that needs to be addressed. Calliandra, Leucaena and Sesbania were mentioned as protein supplementary feeds grown during individual farmer interviews. However, when the number of trees planted was computed in acreage the amount grown very small except for Calliandra in Kisumu Central Ward (Figure 4.5). A few of the farmers in the group interview grew Desmodium and Mulato II as a component of the push-pull technology but the maximum area grown is 30 x 50 metres which provides very little feed for the dairy cow.

In North West Kisumu Ward the most commonly purchased according to the individual farmer interviews was Maize bran and commercially mixed ration (dairy meal), while in Kisumu Central Ward Napier grass (54%) and natural occurring pasture (52%) were the predominant feed purchased (Figure 4.6).
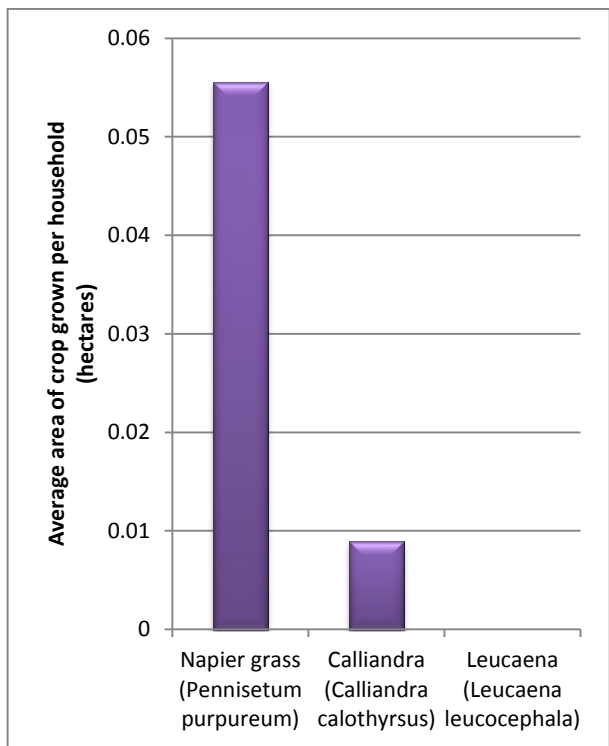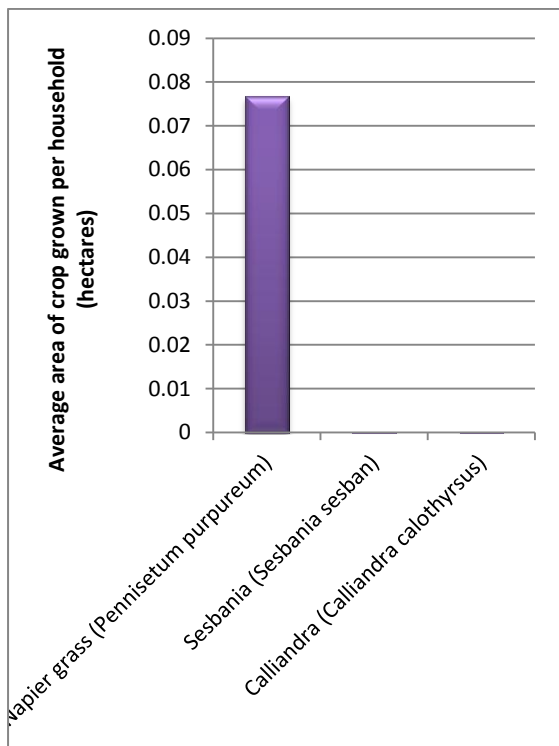
Figure 4.5. Dominant fodder crops grown in North West Kisumu Ward (left) and Kisumu Central Ward (right), Kisumu West sub-county
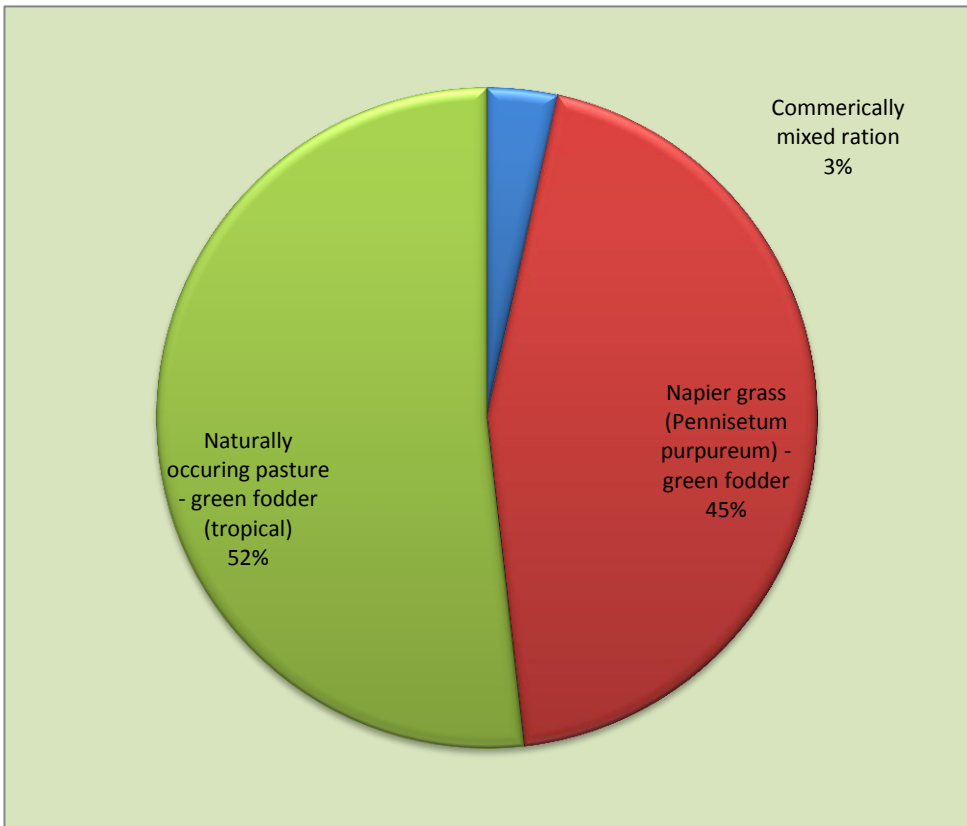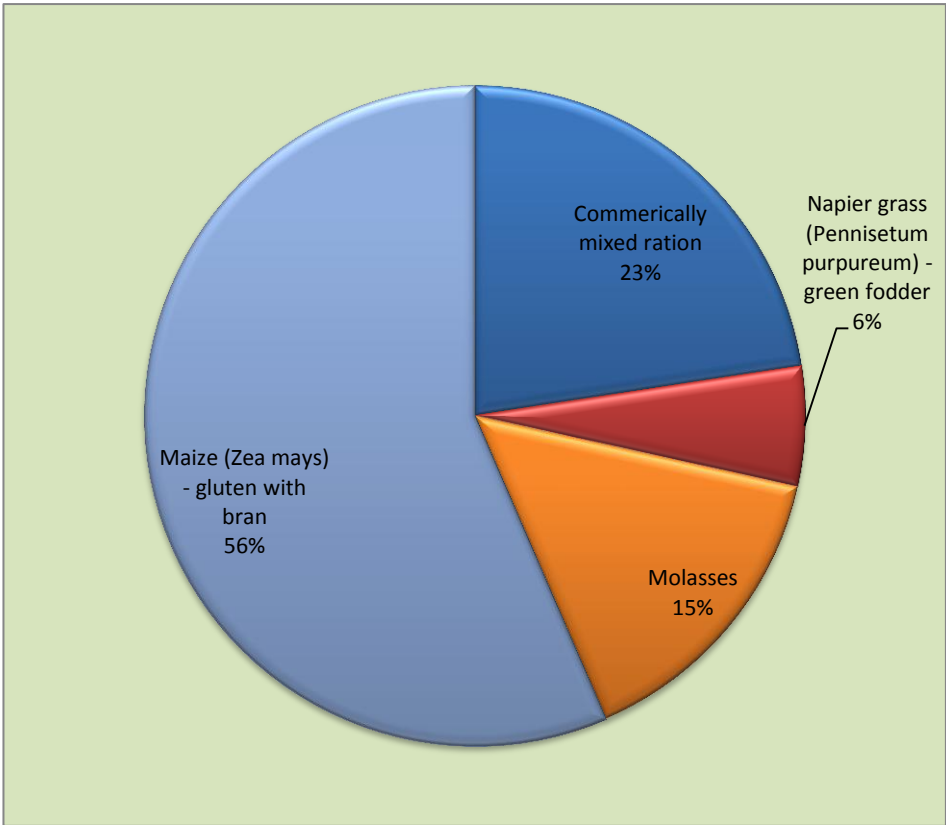
Figure 4.6. Quantity of feed purchased over a 12 month period grown in North West Kisumu Ward (above) and Kisumu Central Ward (below), Kisumu West sub-county

In both Wards grazing followed by naturally occurring contributed the largest proportion of DM and ME (Figures 4.7 and 4.8). Planted fodder on the hand contributed significantly more to DM (28%) and ME (26%) in Kisumu Central than in North West Kisumu Ward where they only contributed 16%. The highest CP in North West Kisumu came from grazing and purchased feed (Figure 4.9), while in Kisumu Central Ward the major contribution was from cultivated fodder (39%) followed by grazing and naturally occurring and collected feed at 29% each. Purchased feed contributed very little (1%) to CP in Kisumu Central Ward.

Naturally occurring and collected feed, green feed and grazing followed the rainfall pattern with more feed available in June to July and September to December (Figure 4.10). Crop and legume residual were more available during harvesting period June to August and December to January.
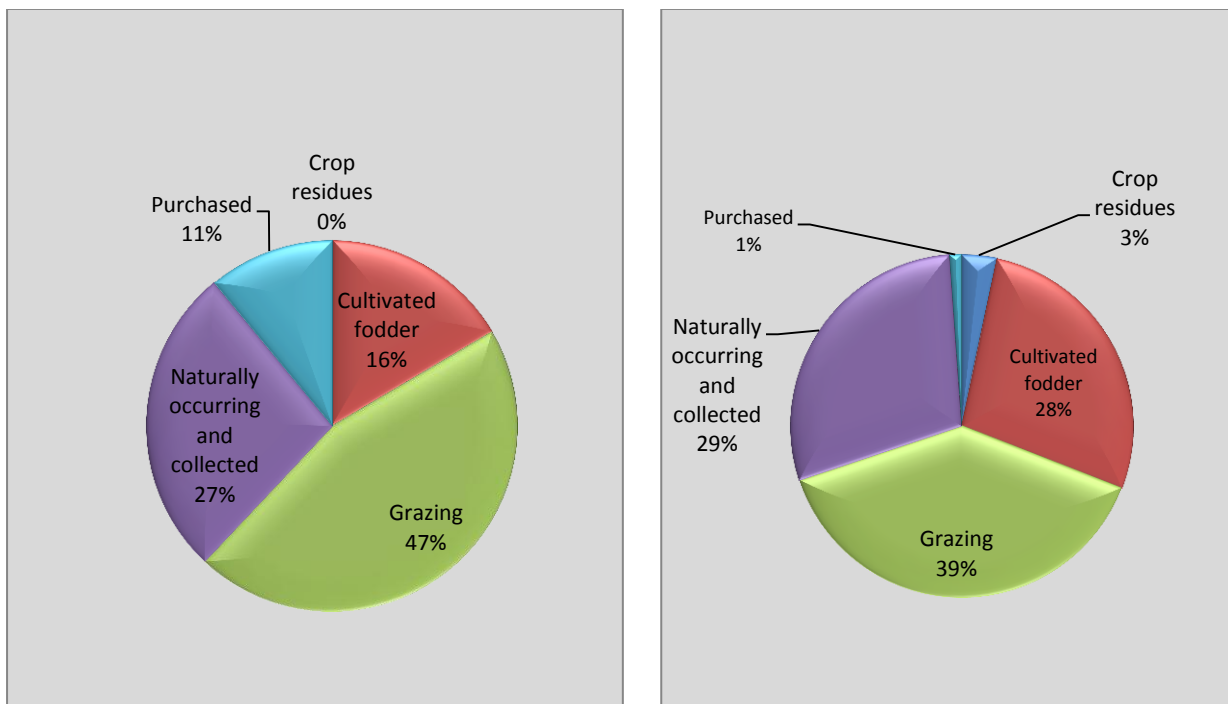

Figure 4.7. Proportion of dry matter (DM) content in the total diet North West Kisumu (left) and Kisumu West Wards (right), Kisumu West sub-county
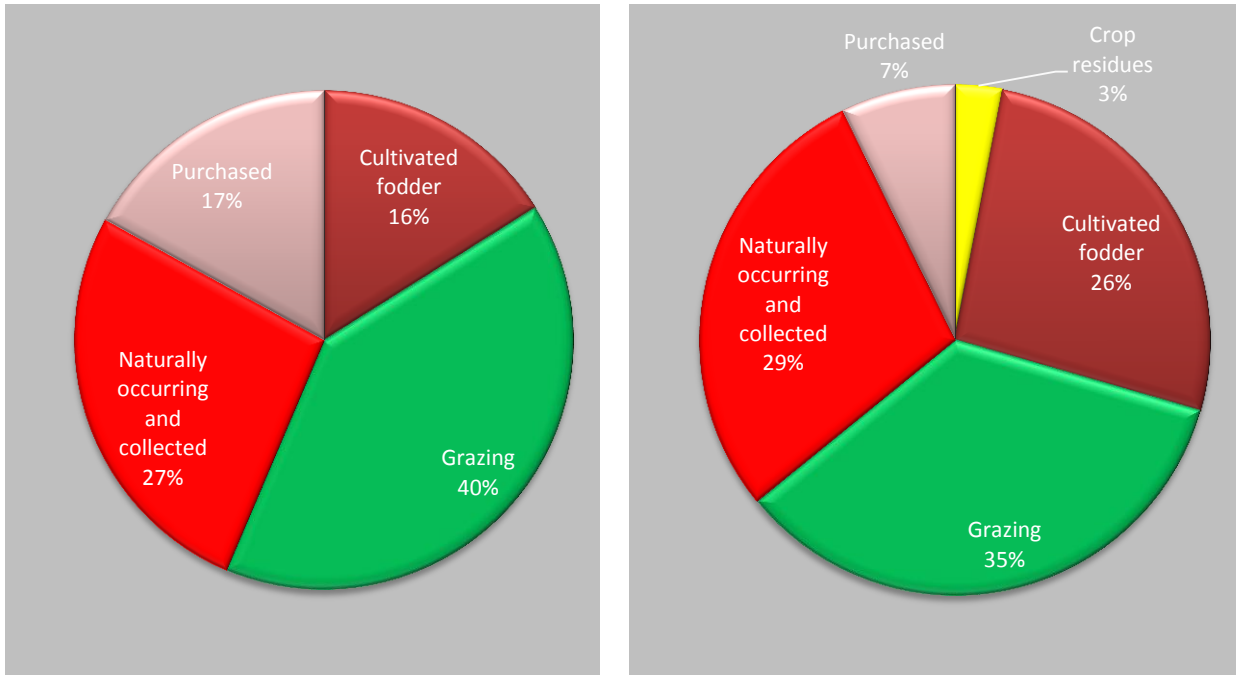
Figure 4.8. Proportion of crude energy (ME) content in the total diet North West Kisumu (left) and Kisumu Central (right), Kisumu West sub-county
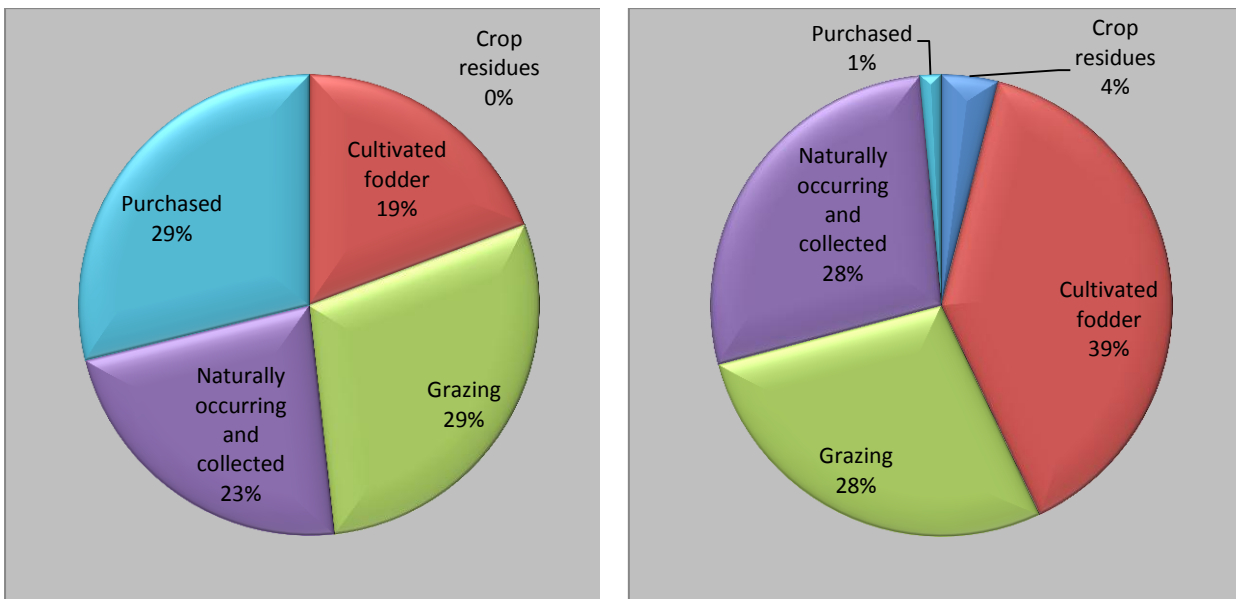

Figure 4.9. Proportion of crude protein (CP) content in the total diet North West Kisumu Ward (left) and Kisumu Central Ward (right), Kisumu West sub-county
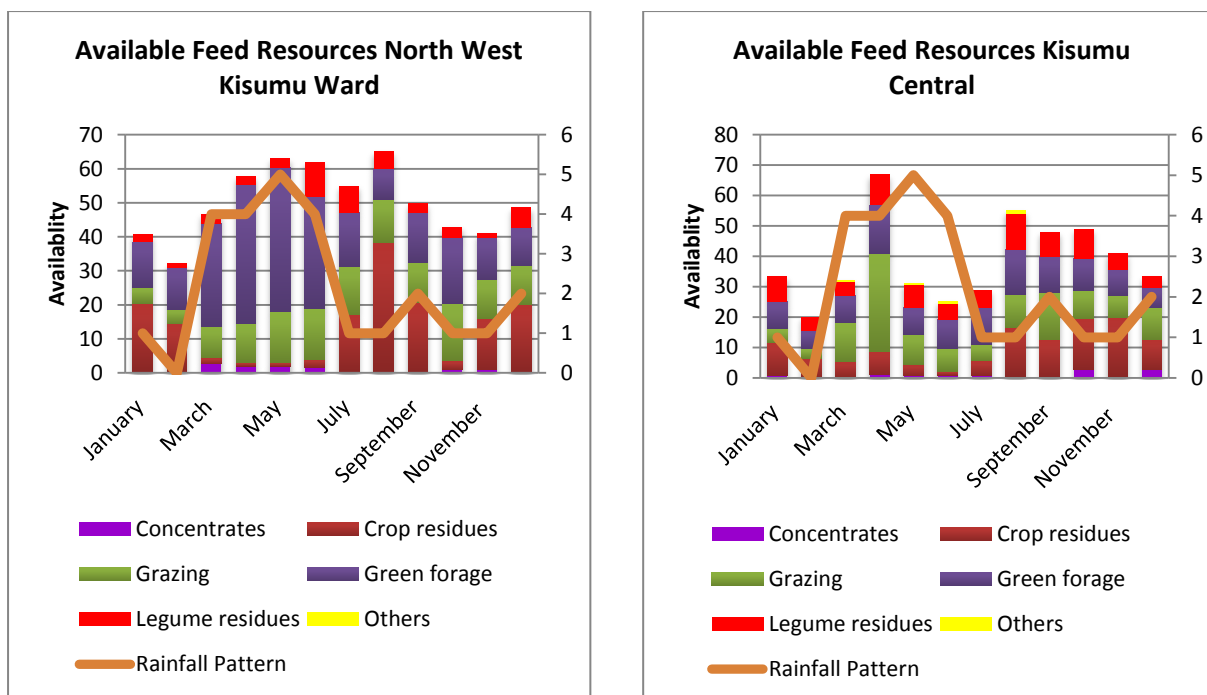
Figure 4.10. Variation of feed availability throughou the year in North West Kisumu (left) and Kisumu Central Ward (right) Wards in Kisumu West sub-county

Major income sources

The main contributors to income in both Wards are food crops (41 in North West Ward and to 47% in Kisumu Central Ward). According to the individual farmers interviewed dairy was found to contribute more in the North West Kisumu (23%) than in Kisumu West Ward (15%). This perception is contrary to the high number of improved cattle in Kisumu West (Table 4.5). This may be attributable to low production due to environmental constraints rather than genetic. Poultry meat was the second most important in terms of income generation in Kisumu West Ward. Majority of the farmers in North West Kisumu ward were involved in off-farm business and this could be attributed to the presence retirees and wives whose spouses are gainfully employed elsewhere. Figure 4.11 indicates the importance of agriculture and livestock in the livelihood of farmers in Kisumu West sub-county.
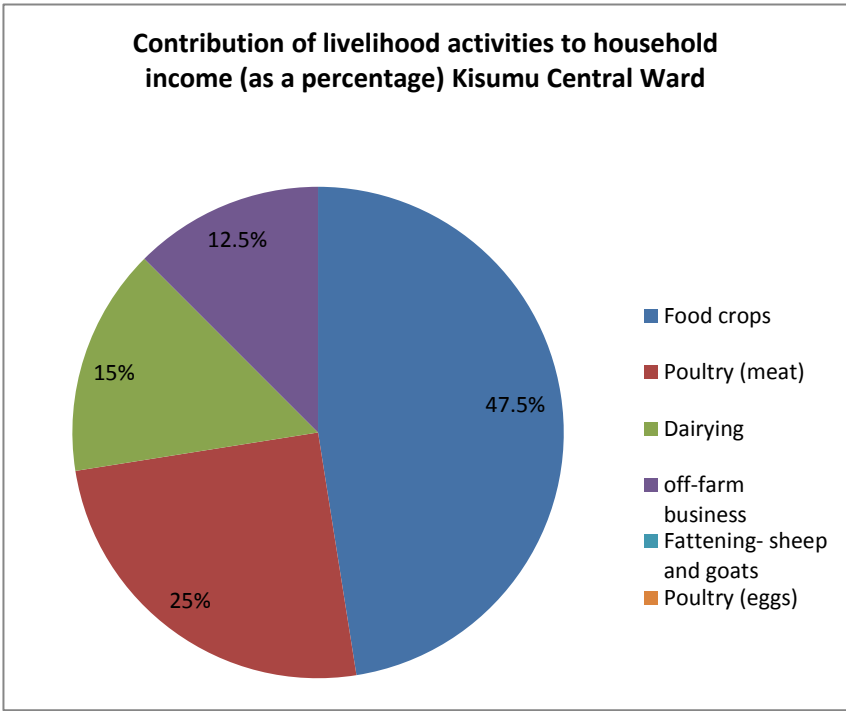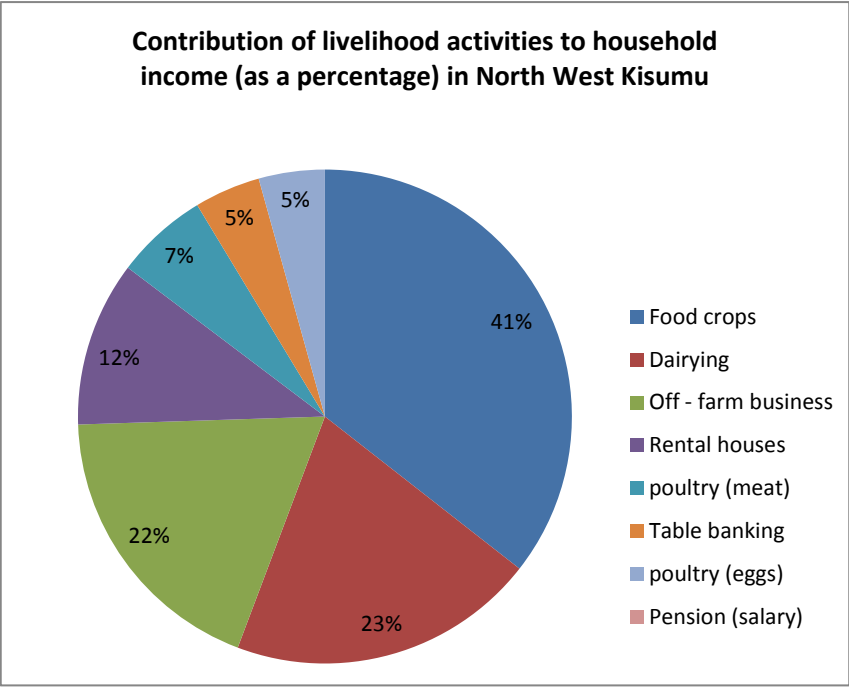
Figure 4.11. Contribution of livelihood activities to household income (as a percentage) in North West Ward (above) and Kisumu Central Ward (below), Kisumu West sub-county

Challenges and opportunities

Overall, the main issues that farmers face in the farming system and the potential solutions are listed in Table 4.6. Lack of initial capital to invest in crop and livestock production was a key priority in North West Kisumu Ward, while those in Kisumu West considered inadequate knowledge in livestock production/feeds as their number one priority. Costly animal health services were also considered important in both Wards. Inadequate feeds were majorly attributed to small farm sizes, Napier diseases, lack of varieties that can tolerate drought. Control of tick borne diseases is a major concern to farmers since they solely depend on private service providers who are expensive. Inadequate improved breeds were considered a key problem in both Wards. Artificial Insemination (AI) services that could help disseminate improved genetics are solely provided by private service providers and because of distance there are repeats which are costly and to farmers.

A lack of credit facilities is also a clear constraint to the further development of crop and dairy production in Kisum sub-county. Whereas, credit facilities exists from commercial banks and micro finance institutions, lack of collateral, unfavourable repayment schedules coupled unstable prices of agricultural products discourages farmers from going for the loans. Internally generated credit from merry-go-round and Table banking does not provide enough capital to invest in agricultural activities. Milk marketing was also highlighted as a problem North West Kisumu Ward but could also apply to other Wards within the sub-county. Farmers depend on market from neighbours but due to high poverty levels this marketing channel does not provide reliable market. There is organized transport to reach the urban markets and also there are no cooling plants in the sub-county.

Conclusions

Kisumu West sub-county is characterized predominately by smallholder mixed crop-livestock production systems on approximately less than 2 acres of land. Dairy and food crops are the primary sources of household income. Farmers in Kisumu West sub-county keep predominantly local cattle. Improved dairy production is constrained by inadequate feeds/management skills, high cost of disease control and poor breeds. Unorganized milk marketing is also a constraint. To mitigate these constraints farmers will be required to (i) skills in fodder production and exposures to varieties that are tolerant Napier grass stunt disease and drought; knowledge on feed preservation and processing (ii) improving access to animal health and AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, (iii) access to credit facilities to enable farmers invest in livestock production enterprises and also milk marketing strategies.

Table 4.6. Pairwise ranking of main problems in livestock production and proposed solutions by farmers from North West Kisumu, and Central wards, Kisumu West sub-county

Challenges	Ranking in North West Kisumu ward	Ranking in Kisumu Central ward	Possible solutions
Inadequate feed	4	2	• Plant a variety of fodder crops that are tolerant to drought and Napier stunt disease • Need for affordable quality concentrates • Group purchase of commercial feeds • Knowledge and skills in fodder and livestock management
Lack of improved breeds	3	3	• Train and provide initial capital for local A.I. services providers • Initial capital to acquire improved breeds • Address issues of dairy cattle fertility • Initiate group breeding • Skills on heat detection
Inadequate technical knowledge on fodder, feeding management	-	1	• More technical knowledge in feeds production, processing and feeding through training and tours
Costly animal health services	2	2	• Preventive strategies through effective tick control • Vaccination campaigns
Lack/access to markets	5	-	• Initiate group transportation and marketing of milk
Lack of affordable credit facilities	1	-	• Provision of starter capital for purchase of improved breeds • Credit facilities to hire land and invest in feed production
Cattle theft (rustling)		3	• Provincial administration to assist

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