



RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas



Technical report: An Evaluation of Current Pig Feeding Practices on Smallholder Farms in Masaka and Kamuli Districts Uganda

*Expanding Utilization of Roots, Tubers and Bananas and
Reducing Their Postharvest Losses*



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EXECUTIVE SUMMARY

It has been documented that pig feed cost represents 60-70% of the total variable costs. These results point to the needs to compound cheap and affordable feed resources on farms to reduce on cost. In order to achieve this an in-depth understanding of the current feeding practices, availability and level of feeding is required. This longitudinal study was designed to find out what main pig feed resources farmers use and what are the current feeding practices on smallholder farms. The longitudinal survey was conducted in the period of August and November 2015. The month of August is usually considered a typical dry season while the month of November is typically wet season. The study was carried out for 90 days. A total of 24 farms were followed with 2-4 pigs per farm resulting in 81 pigs that were involved in the study.

The results show that pig farmers in Kamuli mostly relied on sweetpotato vines and maize bran, weeds and cassava leaves to feed pigs in the dry season. The other types feed used on farms in small amounts included home mixed rations, swill and cassava roots. In Masaka the results show that maize bran comprised nearly half (45%) of the pig diets in the dry season. Home mixed rations and swill were also an important part of the diets. The other feed ingredients used by farmers in small proportions were banana peels, cooked sweetpotato roots, cassava leaves, sweetpotato vines, avocado and weeds.

In the wet season, sweetpotato vines were still the dominant ingredient in the pig diets in Kamuli. Maize bran and weeds continued to be important feed types. Cassava leaves were not used in diets while home mixed rations were found. In Masaka, maize bran was still the dominant (44%) feed ingredient on farms. Weeds, swill and banana peelings were also important. Other feeding ingredients used during this season were home mixed rations, sweetpotato vines, papaya fruits and Elephant grass (Napier grass).

Overall, during the dry season, there was a higher reliance on purchased and collected feeds. Furthermore, farmers were more inclined to mix homemade feeds during this period. The severe feed shortages during the dry periods may be forcing farmers to adopt these coping strategies. Maize bran comprised the largest proportion of feed in pig diets during this time. Other feed ingredients in pig diets during the dry season included banana leaves, cooked

sweetpotato and papaya fruits suggesting opportunistic feeding. On the other hand, the most common feeds used in the wet season are produced on farm. Sweetpotato vines (22%), weeds (18%) and banana peelings (4%) contributed almost half of the total diet. Maize bran was still a dominant feed during the wet season. The other feed ingredients that were used included cassava leaves, sweetpotato peels, young pumpkin leaves, small non-commercial cassava roots and swill.

Generally, the share of forages in pig diets becomes more important in rural setting than urban setting: Masaka district showed more variety of feed resources compared to Kamuli district. Sweetpotato vines and roots were a major feed ingredient in Kamuli while maize bran was in Masaka despite being expensive. Nevertheless the bulk of feeds used on farms are obtained free of charge in all study sites, particularly in the wet season.

The daily amount of fresh feed offered to pigs was on average 7.5kg (5.1-10.5kg) and 2.8kg (2.1-3.5kg) in Kamuli and Masaka, respectively. Moreover, pigs from the rural areas of Kamuli recorded a higher ($P<0.001$) daily DM intake of 1.8kg per day compared to pigs in urban areas of Masaka that consumed on average 1.0kg DM per day. Consequently, pigs in rural areas were consuming more nutrients (300g of CP and 4,305 Kcal/kg-1 of DE) per day than those in urban areas (100g of CP and 2,584 Kcal/kg-1 of DE). These differences are likely to be due to the fact that farmers in Kamuli were feeding more of forage based diets (sweetpotato vines and weeds) while those in Masaka district were feeding more of the cereal based diets (maize bran and home mixed rations).

Pigs showed record poor growth rates (ADGs) due to inadequate amount and quality of feeds offered: the average daily gain of pigs was very low in both districts (109g/day and 77 g/day in Masaka and Kamuli, respectively).

These findings suggest the need to strengthen farmers' capacities to utilize the available resources more efficiently without compromising on the nutritional requirements of the pigs. In particular, since sweetpotato vines represent a high proportion of the diet and is a highly perishable product, conservation technologies such as silage making can contribute to alleviate feeding constraints, particularly in the dry seasons.

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1. INTRODUCTION

Pig production is a dynamic and rapidly growing sector in Uganda. It plays a very important role in meeting livelihoods and income for emergency needs and school fees of smallholder farmers in Uganda. More than 1.1 million households raise pigs in rural and peri-urban settings in Uganda (UBOS, 2012). An assessment of the pig value chain revealed key constraints in animal health, breeding, feeding and marketing (Ouma et al., 2013). In particular feeding was highlighted as the major constraining factor. Amongst the most important feed constraints were (i) costly and poor quality commercial feeds on the market and (ii) lack of knowledge on low cost locally prepared feed rations despite the abundant cheap local feed ingredients on farms (Pezo et al., 2014). This was exacerbated by strong seasonal effect that result in fluctuations in feed quantity, quality and price (Pezo et al., 2014). As a result farmers were practicing opportunistic and inadequate feeding on farms (Ouma et al., 2014).

It has been documented that feed cost represents 60-70% of the total variable costs for raising pigs (Lule et al., 2014). These results point to the needs to compound cheap and affordable feed resources on farms to reduce on cost. In order to achieve this an in-depth understanding of the current feeding practices, availability and level of feeding is required. This longitudinal study was designed to find out: What main pig feed resources farmers use? What are the current feeding practices on smallholder farmers? What gaps and opportunities exist for improving pig feeding on farms? What proportion of sweetpotato vines and roots are incorporated in pig diets? What is the performance of pigs under the current farmer practice? This longitudinal study was carried out in Masaka and Kamuli districts of Uganda.

1.1 Objectives

The main objectives of the study were:

1. Document the current feed and feeding practices used by pig farmers on smallholder farms
2. Determine the nutritive content of available feed ingredients or combinations used by the farmers
3. Assess the performance of pigs on the current feeding rations.

2. MATERIALS AND METHODS

The study was carried out with pig farming households in Masaka and Kamuli districts of Uganda. The study was led by the International Livestock Research Institute (ILRI) and the International Potato Center (CIP) and implemented in collaboration with district partners: CHAIN Uganda, VEDCO and ISU-Uganda. The study districts, Kamuli and Masaka, were selected because they have a high population of pigs and high poverty levels hence pig production is a key source of income. Three sub-counties were selected per district: Nyendo Ssenyange, Buwunga and Mukungwe sub-counties in Masaka and Bugulumbya, Butansi and Namwendwa sub-counties in Kamuli. All the sub-counties in Kamuli were typical rural sub-counties while those in Masaka were mixed as follows: Nyendo Ssenyange in urban, Mukungwe in peri-urban and Buwunga in rural settings. The type of setting is likely to have a significant influence on availability and type of feed resources.

The longitudinal survey was conducted in the period of August and November 2015. The month of August is usually considered a typical dry season while the month of November is typically wet season. The study was carried out for 90 days. During this period, farmers fed selected pigs on their usual diets. Data was collected on a biweekly basis by project staff based in each district. However, farmers were asked to provide feed data through recall. The feed data collected included type and amount of feeds offered to pigs. Data on the feeding times and person in charge of feeding the pigs were also collected. Weight data were collected from selected pigs the day project staff visited the farm. To weigh the pigs, data collector and the farmer had to put the pig in a gunny bag and a digital weighing scale with a margin of error of 100g was used. The pigs were weighed in the mornings before being fed. The data was entered in Microsoft Excel after collection.

2.1 Sampling

A list of pig farmers in each sub-county was generated. This was done by the partners with the support of local government officials in those sub-counties. A total of four farmers were randomly selected in each sub-county. In total 12 farmers were selected per district for the longitudinal survey. A total of 2-4 pigs were selected and tagged for monitoring on each farm depending on the availability of pigs. A typical pig selected had to be a weaner of about 2 months and reared for slaughtering. Based on a mutual agreement, the host farmers committed themselves not to sell the selected pigs until the trial was over. In return, the

project offered an incentive of buying all the pigs involved in the trial. The project then gave the pigs back to the farmers as a token of appreciation after the end of the survey.

2.2 Study design

The design of the longitudinal survey comprised 2 districts, 3 sub-counties per district and 4 farmers per sub-county (table 1). A total of 24 farms were followed with 2-4 pigs per farm resulting in 81 pigs involved in the study. Some farmers only had two pigs especially in Masaka and in those farms only two pigs were monitored.

Table 1: Sub-counties, farmers and pigs covered in the survey

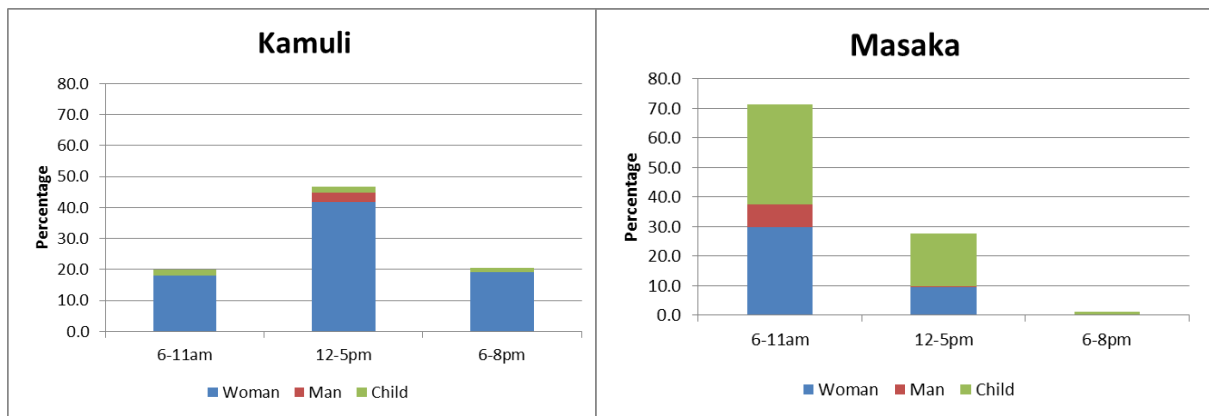
District	Sub-county	No. farmers	No. of pigs
Kamuli	Namwendwa	4	17
	Bugulumbya	4	15
	Butansi	4	15
Masaka	Buwunga	4	3
	Mukungwe	4	9
	Nyendo-Ssenyange	4	15

3. RESULTS

3.1 Labor and time allocation in feeding pigs

Data on the time of day that pigs were fed and who from the household fed the pigs was collected. The results are shown in Figure 1. The results indicate that women and children provided most of the labor for looking after and feeding pigs. In particular, children provided more labor for feeding pigs in Masaka than in Kamuli. Men were more available to feed pigs in the afternoon hours in Kamuli district and in the morning hours in Masaka district. Pigs were mostly fed in the morning hours in Masaka while in Kamuli pig feeding takes place mostly in the afternoon hours. In both districts the men provided minimal labor for feeding pigs. These findings are in line with the results documented by Pezo et al. (2014) who indicated that women and children are the most involved in feeding pigs in Uganda.

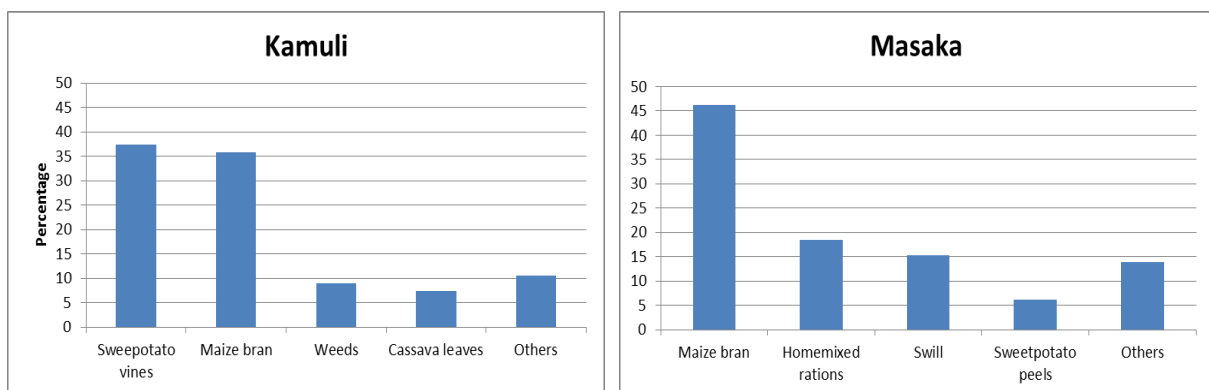
Figure 1: Feeding times of pigs by gender in Kamuli and Masaka districts



3.2 Feed resources used for feeding pigs

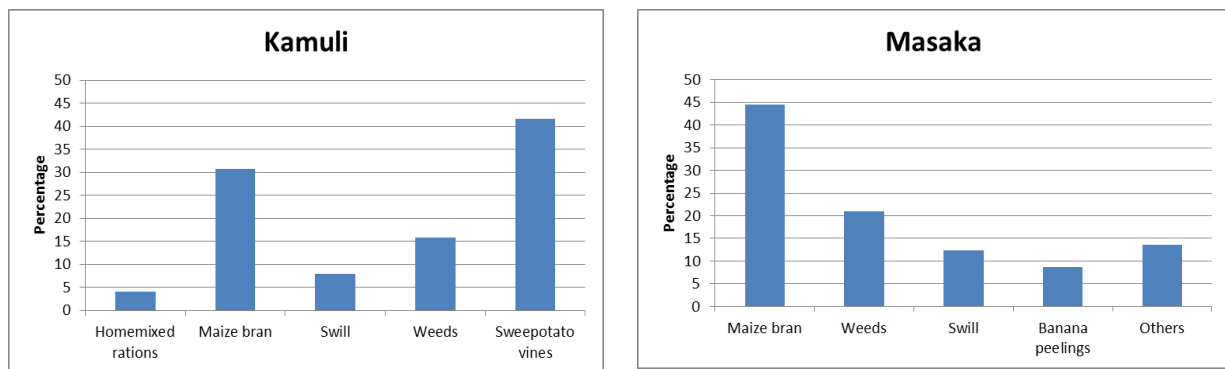
The study documented all the feeding ingredients used by the farmers. In addition, the proportion included in the diet and the number of times the ingredients were included in the diets was also recorded. The most common used feed resources and their proportions in the diets in the dry season in Kamuli and Masaka are shown in Figure 2. The results show that pig farmers in Kamuli mostly relied on sweetpotato vines and maize bran, weeds and cassava leaves to feed pigs in the dry season. The other types feed used on farms in small amounts included home mixed rations, swill and cassava roots. In Masaka the results show that maize bran comprised nearly half (45%) of the pig diets in the dry season. Home mixed rations and swill were also an important part of the diets. The other feed ingredients used by farmers in small proportions were banana peels, cooked sweetpotato roots, cassava leaves, sweetpotato vines, avocado and weeds. Generally Masaka district had a wider range of feed types probably because two of the study sub-counties were located in peri-urban and urban areas.

Figure 2: Dry season feed resources in Masaka and Kamuli



The most common used feed resources and their proportions in the diets in the wet season are shown in Figure 3. In the wet season, sweetpotato vines were still the dominant ingredient in the pig diets in Kamuli. Maize bran and weeds continued to be important feed types. Cassava leaves were not used in diets while home mixed rations were found. In Masaka, maize bran was still the dominant (44%) feed ingredient on farms. Weeds, swill and banana peelings were also important. Other feeding ingredients used during this season were home mixed rations, sweetpotato vines, papaya fruits and Elephant grass (Napier grass).

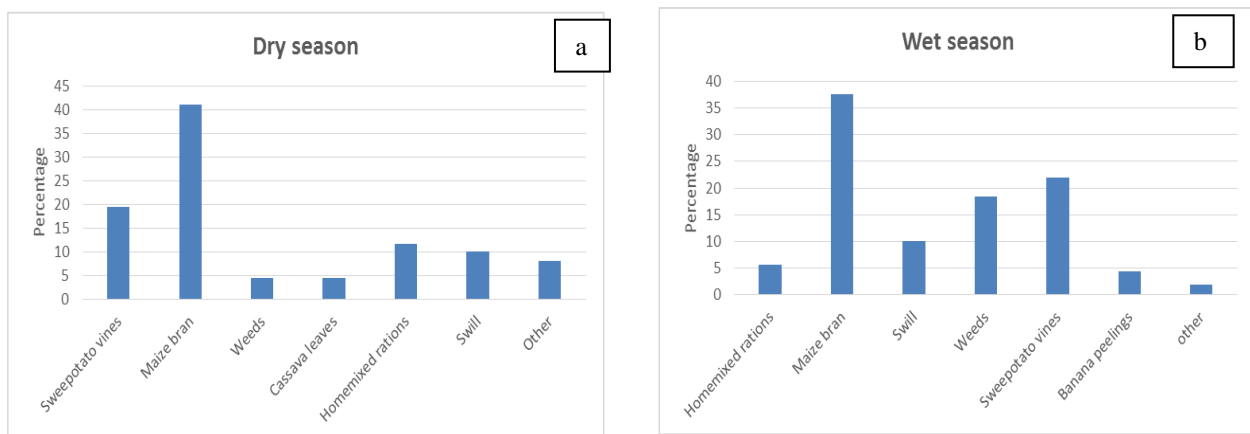
Figure 3: Wet season feed resources in Masaka and Kamuli



Overall, during the dry season, there was a higher reliance on purchased and collected feeds (Figure 4a). Furthermore, farmers were more inclined to mix homemade feeds during this period. The severe feed shortages during the dry periods may be forcing farmers to adopt these coping strategies. Maize bran comprised the largest proportion of feed in pig diets during this time. This is because it is the most available option that can be purchased during periods of feed scarcity or even obtained from the milling of the maize harvested by the smallholders, especially in Kamuli. Other feed ingredients in pig diets during the dry season included banana leaves, cooked sweetpotato and papaya fruits suggesting opportunistic feeding (feeding whatever ingredient is available at the time). On the other hand, the most common feeds used in the wet season are produced on farm. Sweetpotato vines (22%), weeds (18%) and banana peelings (4%) contributed almost half of the total diet. Maize bran was still a dominant feed during the wet season (Figure 4b). The other feed ingredients that were used included cassava leaves, sweetpotato peels, young pumpkin leaves, small non-commercial cassava roots and swill.

Generally the share of forages in pig diets becomes more important in rural setting than urban setting: Masaka district showed more variety of feed resources compared to Kamuli district. Sweetpotato vines and roots were a major feed ingredient in Kamuli while maize bran was in Masaka. The results confirm findings of Carter et al. (2015) who ranked the most important feed used by pig farmers as banana peels, sweetpotato vines and maize bran. The results are also in line with the findings of Carter et al. (2015) that leguminous forages (weeds spurge) tend to become commonly used during the periods of plenty especially in the months of October and November.

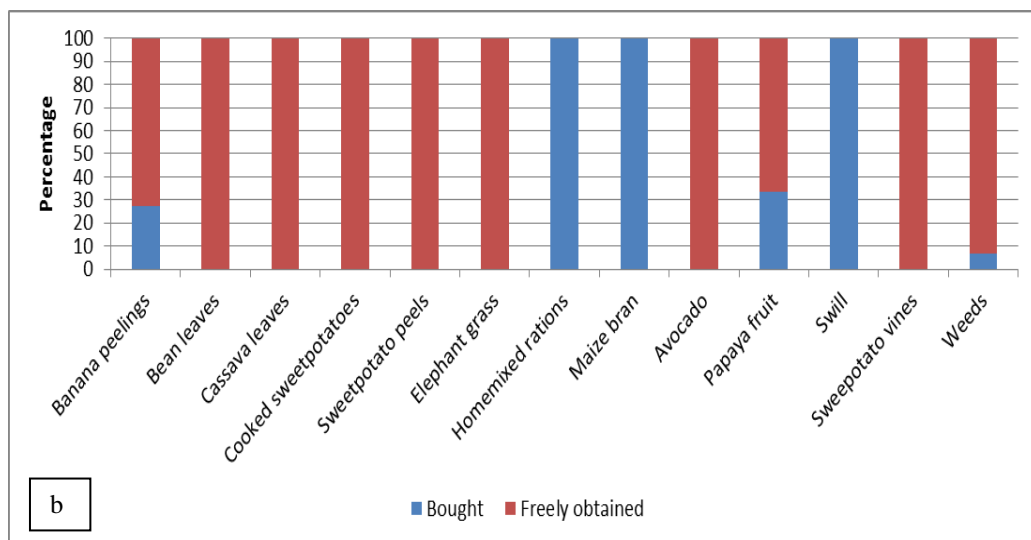
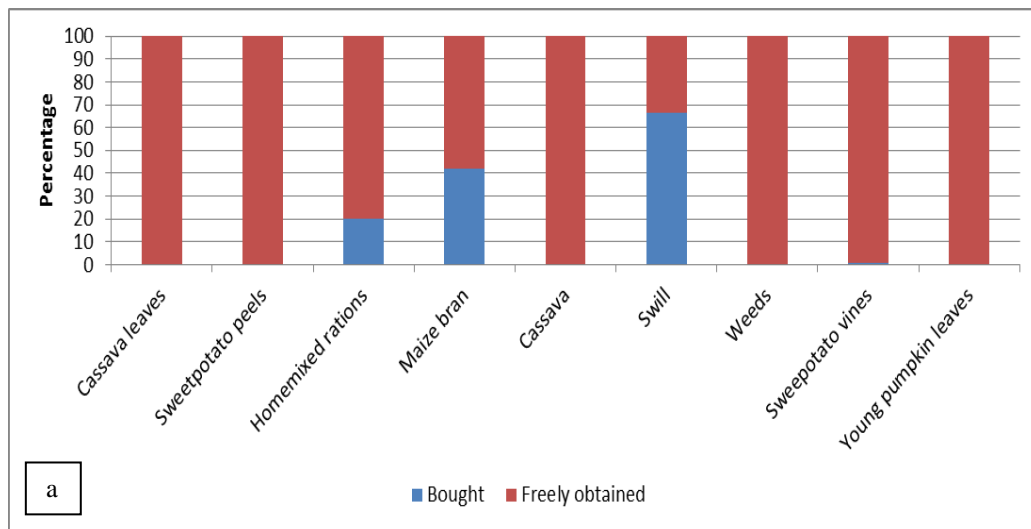
Figure 4: Feed resources in the dry and wet season in the study area



3.3 Sources of feed ingredients on farms

The pig farmers were asked to indicate the sources of compounded and feed ingredients they use on farms. The categories were kept simple: either they were freely obtained or they are purchased. Prices were provided in case feeds were bought. Results show that most feeds were obtained free of charge in both Kamuli and Masaka. In Kamuli feeds that were purchased included maize bran (42%) and ingredients used to make home mixed ration (20%). Swill (67%) was purchased from local restaurants and other food centers. Some farmers were beginning to trade in sweetpotato vines (0.8%). The feeds that were obtained free of charge were usually collected from either own or neighbors' gardens (Figure 5a). In Masaka, maize bran and ingredients to prepare home mixed rations were purchased. Similarly swill was bought, usually from local restaurants. A proportion of banana (27%), papaya fruit (44%) and weeds (7%) were also bought. The rest of the feed ingredients were obtained free of charge from own or neighbors farms (Figure 5b).

Figure 5: Sources of feed ingredients in Kamuli (top) and Masaka (bottom) districts



3.3.1 Prices of off farm feed ingredients

The prices of commonly traded feeds in Kamuli and Masaka are shown in Table 2. There were more purchased feedstuffs in Masaka than Kamuli, largely because study sites in Masaka were more in peri-urban and urban settings than in Kamuli. As expected, home mixed rations with an average price of Ugsh 1,142 (US\$ 0.33) per kg is slightly cheaper than the commercial feeds that cost an average of Ugsh 1,300-1,500 (US\$ 0.38-0.43) per kg. The rationale of farmers mixing feeds is to ensure a high quality product at a lower cost. Of

interest is the fact that maize bran is cheaper (Ugsh 375; ~US\$ 0.11) in rural areas than in more urbanized areas (Ugsh 629; ~US\$ 0.18). This is likely to be due to the lower competition for cereal by-products from small-scale mills in rural settings than in more urban ones.

Table 2: Average prices (Ugsh. per kg) for purchased feeds in Kamuli and Masaka districts

Feed type	Kamuli		Masaka	
	Mean	SD	Mean	SD
Banana peels	.	.	52.7	23.0
Sweetpotato peels	.	.	353.9	204.8
Home mixed	.	.	1,142.1	200.2
Maize bran	375.1	201.8	629.3	248.6
Swill	200	.	93.9	28.7
Weeds	.	.	98.5	81.1

3.4 Nutritive value of the diets

The nutritive value of all feeds in the study was obtained from the literature (Table 3). The values were used to determine the nutritive content of the diets that were fed to pigs by the farmers. Only three nutrient content indicators were used: dry matter (DM), crude protein (CP) and digestible energy (DE). As shown in Table 3, most locally available forage-based feed ingredient are of high nutritive value with a mean CP content of 15% (range 6-25%; SD 7.6). They compare relatively well to home mixed rations that have a CP content of 24.5% and maize bran with a mean CP content of 13%.

Table 3: Nutritive values of feed ingredients used by pig farmers in Masaka and Kamuli

Feed type	DM %	CP %	DE (Kcalkg⁻¹)
Concentrates			
Home mixed rations	85.3	24.5	2128
Maize bran	84.7	13.0	2690
Mean	48.9	18.7	2409
Forages based			
Cassava leaves	22.9	22.9	2709
Sweetpotato peels	26.4	6.21	3489
Weeds	15.2	25.1	2738
Sweetpotato vines	15.9	14.9	2024
Young pumpkin leaves	14.0	18.0	-
Banana peelings	13.1	24.0	2128
Fresh bean leaves	25.4	7.1	3759
Cooked sweetpotato	26.4	6.2	3489
Napier grass	18.8	17.1	535
Avocado fruit	18.4	6.5	3326
Papaya fruit	8.0	10.8	3182
Weeds	17.3	23.4	1877
Mean	18.0	15.0	2660
Max	26.0	25.0	3759
Min	8.0	6.0	535
Standard Deviation	6.0	7.6	955

Sources: Feedipedia; Carter, 2015)

3.4.1 Feed offered and nutrient intake of pigs in Kamuli and Masaka districts

The daily fresh feed offered to pigs on farms in Kamuli and Masaka is shown in Table 4. Farmers offered on average 7.5kg (5.1-10.5kg) and 2.8kg (2.1-3.5kg) in Kamuli and Masaka, respectively. This difference is likely to be due to the fact that farmers in Kamuli were feeding more of forage based diets (sweetpotato vines and weeds) while those in Masaka district were feeding more of the cereal based diets (maize bran and home mixed rations).

The nutrient intake of pigs on farms is shown in Table 5. Pigs from the rural areas of Kamuli recorded a higher ($P < 0.001$) daily DM intake of 1.8kg per day compared to pigs in urban areas of Masaka that consumed on average 1.0kg DM per day. Consequently, pigs in rural areas were consuming more nutrients (300g of CP and 4,305 Kcalkg⁻¹ of DE) per day than those in urban areas (100g of CP and 2,584 Kcalkg⁻¹ of DE). This, again, may be because the diets in rural areas are mainly forage based compared to cereal based diets fed in urban areas.

Furthermore diets intake in rural areas showed higher variations (range 1.4-2.4kg) compared to intake in urban areas (range 0.8-1.3kg).

Table 4: Daily fresh feed offered (Kg) to pigs in Kamuli and Masaka

Week	Kamuli		Masaka	
	Mean	SD	Mean	SD
1	5.1	4.4	2.7	2.3
2	5.2	4.6	3.2	3.1
3	5.6	4.6	2.1	1.4
4	6.2	4.6	2.1	1.1
5	6.2	3.4	2.6	2.3
6	7.7	5.8	2.5	1.6
7	7.7	6.2	2.9	1.8
8	8.8	6.0	3.5	1.4
9	10.5	6.2	2.6	1.8
10	9.1	5.8	3.3	1.8
11	9.2	6.0	-	-
12	8.2	6.5	-	-
Mean	7.5	5.3	2.8	1.9
Max	10.5	6.5	3.5	3.1
Min	5.1	3.4	2.1	1.1

Table 5: Average daily nutrient intake in Kamuli and Masaka districts

Week	DM (Kg)				CP (Kg)				DE (Kcalkg ⁻¹)			
	Kamuli		Masaka		Kamuli		Masaka		Kamuli		Masaka	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	1.4	1.3	1.0	0.9	0.2	0.2	0.1	0.1	3614	3133	2683	2532
2	1.5	1.4	1.0	0.8	0.2	0.2	0.1	0.1	3769	3407	2906	2308
3	1.6	1.5	0.9	0.5	0.2	0.2	0.1	0.1	4046	3655	2308	1372
4	1.7	1.3	0.8	0.5	0.2	0.2	0.1	0.1	4152	3165	2179	1371
5	1.4	0.8	0.9	0.7	0.2	0.1	0.1	0.1	3216	1907	2208	1681
6	1.8	1.4	0.9	0.5	0.3	0.2	0.1	0.1	4227	3309	2241	1389
7	1.7	1.4	1.0	0.5	0.3	0.3	0.1	0.1	4311	3791	2575	1244
8	1.9	1.3	1.3	0.6	0.3	0.3	0.2	0.1	4726	3570	3197	1600
9	2.4	1.8	1.0	0.4	0.4	0.3	0.1	0.1	5810	4470	2512	1255
10	1.9	1.4	1.1	0.8	0.3	0.2	0.2	0.1	4680	3483.1	3034	2924
Average	1.8	1.4	1.0	0.7	0.3	0.1	0.1	0.1	4306	3420.0	2584	1767

3.5 Average daily gains of pigs in Kamuli and Masaka

The average daily gain of pigs is shown in Table 6. The average initial body weight of pigs in Kamuli district was 8.5kg (+/-3.8) while those in Masaka district has an average initial weight of 7.9kg (+/-3.1). Results show that on average pigs in Masaka gained 108.6g/day while those of Kamuli district gained 77 g/day. A comparison of the gain on DM basis shows there is no significant difference in weight gains attained in the two districts. The weight gains recorded in this study were way below what have been recorded in an (on station) trial that was carried out in Uganda by Carter (2015) who recorded weight gain of up to 412g on a silage based diet and 200g on a forage based diet.

Table 6: Average daily weight gains (g) of pigs in Kamuli and Masaka

Bi-weekly measurements	Kamuli		Masaka		T-Value
	Mean	Std. err	Mean	Std. err	
1	54.4	10.9	99.5	11.2	0.006
2	83.4	20.02	104.7	11.1	0.404
3	51.6	8.1	119.6	13.9	0.000
4	127.6	25.9	106.5	14.1	0.506
5	68.4	28.2	112.8	21.4	0.220
Average	77.1	8.3	108.6	6.5	0.133
FCR	23.4		9.3		

4. CONCLUSIONS

- The results show that women and children provided most of the labor for looking after and feeding pigs.
- There is abundance of high quality locally available feed resources on farms. However these are inadequately utilized for pig feeding.
- Sweetpotato vines and roots, maize bran, weeds and cassava leaves are some of the most utilized feed resources for pigs feeding on smallholder farms in the dry season. Sweetpotato vines are the most dominant ingredient in the pig diets in the wet season.
- Farmers face severe feed shortages during the dry periods that force them to practice opportunistic feeding. During this period, farmers utilize a wide variety of feed types and home mixed rations are more common. There is a high reliance on purchased and collected feeds.

- Generally the proportion of forages in pig diets becomes more important in rural setting than urban setting.
- The bulk of the feeds used on farms are obtained free of charge in all study sites.
- Diets offered on farms are highly variable in quality especially those found in rural areas.
- Pigs record poor growth rates (ADGs) due to inadequate amount and quality of feeds offered.

5. RECOMMENDATIONS

- Farmers need to be trained on how to utilize the available resources more efficiently without compromising on the nutritional requirements of the pigs.
- Since sweetpotato vines represent a high proportion of the diet and is a highly perishable product, conservation technologies such as silage making can contribute to alleviate feeding constraints, particularly in the dry seasons.

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