Perception and practices of farmers on the utilization of sweetpotato, and other root tubers, and banana for pig feeding in smallholder crop-livestock systems in Uganda

M M Dione, D Pezo, G Kyalo[1], L Mayega[2], G Nadiope[3] and B Lukuyu

International Livestock Research Institute, P.O. Box 24384, Kampala, Uganda
m.dione@cgiar.org
[1] International Potato Center, PO Box 22274, Kampala, Uganda
[2] District Local Government, PO Box 365, Masaka, Uganda
[3] Iowa State University-Uganda Program, PO Box 218, Kamuli, Uganda

Abstract

Limited access to quality feeds and reliable feed supply are amongst the priority constraints of smallholder pig production in Uganda. Among the feeds given to pigs, sweetpotato (SP), banana and other root tubers residues are common. However, information on farmers' perceptions and practices on the proper use of these residues for pig feeding is limited. Therefore, this study aimed at assessing those aspects, as well as to identify opportunities for better use of these residues in the pig-SP systems. A qualitative survey was undertaken in Masaka and Kamuli, two districts of Uganda with high pig population and SP production. Focus Group Discussions (FGD) and Key Informant Interviews (KII) were undertaken with 80 small scale pig and SP producers and 24 key informants.

Results from this study revealed that the majority of pig farmers in those districts use SP and other RTB crop residues as animal feed. During the rainy season, farmers scored high the utilization of SP crop residues, with the latter being the leading contributor to the pig diet especially in the rural area. SP crop residues are usually fed to pigs fresh without processing. Among the residues, fresh raw vines represent the largest part fed to pig (70%), as compared to roots and peels. The way these residues are offered vary, for example in peri-urban areas with easier access to commercial feeds, farmers feed the crop residues mixed with concentrates; whereas in rural areas with limited access to commercial feeds, crop residues tend to be given without supplementation. However, the full potential of SP and other RTB crop residues for pig feeding is not yet fully exploited as farmers accept that a large amount is wasted (37% in Masaka and 40% in Kamuli). In Masaka, the proportion of SP crop residues utilized at household level mostly for pig feeding was 40%, while in Kamuli was 52%. This study demonstrated that there is potential for better use of SP and other RTB crop residues as pig feed in the smallholder pig farming systems in Uganda, but the major constraint as pointed out by farmers is the poor access to technologies for preserving these resources. Therefore, there is a need for further exploration of strategies for conserving SP and other RTB crop residues during the harvesting period for use in pig feeding during times of feed scarcity.

Key words: *crop residues, quality feed*

Introduction

In Uganda, the demand for animal products is increasing due to the ever increasing human population, improved income and urbanization (Tatwangire 2013). Pork has become an increasingly important animal food source in the diets of Ugandans. In the 1960s, pork accounted for only 1-2% of the per capita consumption of meat (11-12 kg /year); whereas currently it accounts for at least one third of the 10 kg consumed per capita/year (FAOSTAT 2010). Pig rearing has a high potential to provide economic gains for smallholder farmers, because they are easy to rear and profitable due to their high fecundity rate, as well as short generation interval; therefore could become a quick way for income generation to improve the livelihoods in poor households.

However, there are constraints that hinder the development of the pig sector in Uganda. One of the most important is the cost of feeding (Ouma et al 2014). A recent study showed that feeds and feeding accounts for 62% of the total cost of pig production in smallholder farms in peri-urban areas of Uganda (Lule et al., 2014), but this could even be higher in farms that are dependent on commercial concentrates. Other constraints associated to feeding include extreme seasonal variations, poor quality and high cost of commercial feeds that leads to inadequate supplementation (Ouma et al 2014).

A study conducted in 35 villages in Kamuli, Masaka and Mukono districts of Uganda showed that pig production is dominated by small scale producers who practice crop-livestock farming system, with high dependence on crop residues such as SP, cassava leaves and peels and yam leaves for livestock feeding (Ouma et al 2014). In those systems SP contributes about 20% of the total crop residues fed to pigs in Uganda (Ouma et al 2014).The SP crop residues that are

currently used as feed resources include sweetpotato vines (SPV), non-commercial sweetpotato roots (SPR) and sweetpotato peels (SPP). It has been reported that farmers in Soroti and Dokolo districts, northeastern Uganda feed 1.9-2.7 kg of SPV per day to pigs in addition to unknown amounts of SPP (Peters et al 2001). This amount is within the range (1.3-2.8 kg/day) that smallholder farmers in Vietnam feed to their pigs (Tu P et al 2010). There is huge opportunity for using SP crop residues for feeding pigs in Uganda, given that the country is the highest producer of SP in Africa (FAOSTAT 2010). This study aimed at assessing the current perceptions and practices of pig and SP crop producers on the utilization and conservation of SP, banana residues and other root tubers in smallholder pig systems and constraints related to their use in Uganda.

Material and Methods

Site selection

Masaka and Kamuli districts were purposively selected for this study. These districts were already study sites for ongoing projects on Smallholder Pig Value Chains Development (SPVCD) and RTB postharvest systems, implemented by the International Livestock Research Institute (ILRI) and the International Potato Center (CIP) respectively. The selection process of those districts for the SPVCD project has been documented by Ouma et al. (2014). Masaka district is located in the Central region and has the highest pig density in the country (>50 heads/km^2), whereas Kamuli district is located in the Eastern region, and has a medium pig density (10-20 heads/km^2). In both districts, most farmers practice crop-livestock systems, with a large number of them growing SP at small scale, mostly for home consumption.

Farmers and key informants selection

In each district, two sub-counties with high pig population and SP production were selected, following the recommendations by resource people such as the District Veterinary Officer (DVO) in Masaka and the pig specialist from an NGO called Volunteers Efforts for Development Concerns in Kamuli. In each sub-county, 20 villages were randomly selected. In each village, two active pig farmers at the same time SP growers (one male and one female for each group) were randomly selected from a sampling frame generated by the local partners (Table 1).

Key Informant Interview (KII)

In each district, one key informant interview workshop was organized with 12 participants composed of 2 youth leaders (one male and one female), the District Production Officer, the DVO, a pig farmer leader, a womans' group leader, the Community Development Officer, the Secretary of Production, a pig farmers' cooperative leader, a Food Security Community leader, a representative of a NGO and a leader from a grass-root organization. All participants were conversant with pig production and feeding using SP in their communities. The workshop was facilitated by well-trained extension staffs who have been involved for at least two years in pig and SP projects led by ILRI and CIP, respectively. Among the topics discussed with the key informants were the utilization and feeding of SP, banana and other root tubers, as well as constraints related to the SP-pig production systems.

Focus Group Discussions (FGDs)

Two FGDs were organized in each sub-county with men and women separately. Each group's sessions was facilitated by two local trained extension workers in addition to the research staff. The FGD checklist was administered in local languages (Luganda in Masaka and Lusoga in Kamuli), and the meetings were held in villages where participants hailed from. Data was recorded on flip charts and notebooks and submitted for further analysis by the research team

Table 1. Study design and participant's selection

District	Sub-county	No. of villages	No. of participants per focus group discussion session		No. of key informants
			Group 1 (Men)	Group 2 (Women)	
Masaka	Kabonera	10	10	10	12
	Mukungwe	10	10	10	
Kamuli	Butansi	10	10	10	12
	Bugulumbya	10	10	10	

Results

Perception of the uses of crop residues in Masaka and Kamuli districts

In Masaka, there were differences between male and female farmers about their perception of the use of crop residues

with regard to animal feeding. In general, there were agreements amongst both gender groups that the most important use of crop residues is feeding. The most frequently crop residues for used for feeding are SP, cassava, banana, yam, pawpaw and pumpkin residues. The least used crop residues for feeding were bean and groundnut haulms, which are rather preferred for mulching. Males identified a wider variety of crop residues used for animal feeding than female farmers; whereas the latter listed more crop residues under other uses, particularly in the case of some fruits, i.e., jackfruit, mangoes, avocados and guava. Men tend to prefer selling crop residues for animal feed more whereas women emphasized on the use of crop residues for mulching as the second option after animal feeding (Table 2a). Whereas in Kamuli, there was no remarkable variation between men and women However, cereal residues such as millet and rice were reported by men only, and beans, groundnuts haulms and pigweed were reported by women only (Table 2b).

Table 2a. Perspectives of men and women farmers in Masaka district on the uses of crop residues (%)

Crop	Animal feeding		Burnt		Mulching		Sold		Other	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Sweetpotato	85	90	0	0	0	0	15	10	0	0
Cassava	71	58	0	0	0	0	28	0	0	43
Beans	55	4	5	43	35	49	5	0	0	4
Maize	60	60	0	0	20	40	20	0	0	0
Banana	84	43	0	0	0	28	15	10	0	20
Yams leaves	70	100	0	0	0	0	25	0	5	0
Pawpaw fruits	95	82	0	0	0	13	0	0	5	5
Jack fruit	75	30	0	3	0	0	15	18	10	49
Guava	94	43	0	25	0	0	0	3	5	30
Avocado	94	35	0	8	0	10	0	0	5	48
Pumpkins	70	100	0	0	0	0	15	0	15	0
Groundnuts haulms	0	3	0	13	0	84	100	0	0	0
Mangoes fruits	80	28	0	3	0	0	10	23	10	46
Tomatoes waste	80	0	0	0	0	0	20	0	0	0
Cabbages	90	0	0	0	0	0	10	0	0	0
Eggplant peels	60	0	0	0	0	0	25	0	15	0
Pigweed *(Amaranthus* sp.)	90	0	0	0	0	0	10	0	0	0

These figures represent results from a proportional pilling exercise with 20 men and 20 female participants; For the case of burning, the ash is used as fertilizer; Under others, females mentioned craft making with cassava and banana residues; cuttings for planting in the case of females; whereas males did not specify uses

Table 2b. Perspectives of men and women farmers in Kamuli district on the uses of crop residues (%)

Crop	Animal feeding		Burnt		Mulching		Sold		Others	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Sweetpotato	72	70	20	0	3	5	5	20	0	5
Banana	35	65	0	0	50	30	15	0	0	0
Cassava	70	59	20	0	3	0	5	0	3	40
Yams	85	90	0	0	15	10	0	0	0	
Maize	60	50	13	0	25	10	3	20	0	20
Fruits	100	-	0	-	0	-	0	-	0	-
Beans	-	4	-	43	-	48	-	0	-	5
Rice	20	-	5	-	30	-	40	-	5	-
Millet	10	-	10	-	50	-	10	-	20	-
Groundnuts haulms	-	5	-	0	-	95	-	0	-	0
Pigweed *(Amaranthus* sp.)	-	20	-	0	-	80	-	0	-	0

Variation of pig diet composition throughout the year

The relative contribution of different types of feeds to the overall feeding varies across the year (Figure 1). In peri-urban farms, commercial feeds play a greater role during the months of January to April; large part of this period in the dry season, when most crop residues, cut and carries and grazing forages are less available. During the months of May to November, farmers include more fodder sources (i.e., crop residues such as SP) in pig diets. The crop residues more frequently used are SPV, SPP and non-marketable SPR, yam leaves and stems; cassava leaves and peels; banana leaves, peels and pseudo-stems; and maize stover. The forages most commonly fed to pigs were Napier grass (*Pennisetum purpureum*) and pigweed (*Amaranthus sp)*. Among other feeds are included swill, kitchen left overs, vegetable waste and fruits (e.g., guava, mango, pawpaw, jack fruit).

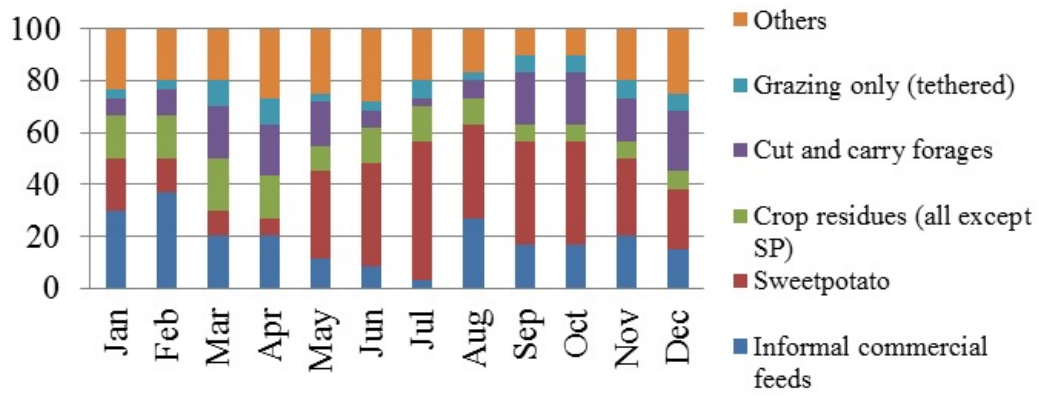

Figure 1. Relative contribution of different feedstuffs to the diet of pigs throughout the year according to farmers (%)

Although SP crop residues are part of the diet all year round, the SPV are adequately available for use as pig feed for eight months of the year (May to December), whereas the use of SPR and SPP is higher when roots are harvested. These months are also the ones when SPV make the greatest contribution to pig diets (Figure 2). However, during the crop growing period, some farmers practice partial defoliation of SPV, and use those to feed pigs. During the first dry season that usually covers four months of the year (January - April), SPV become scarce and less available for pig feeding. According to farmers, after the roots are harvested the vines can only last for a maximum of four days before they are desiccated or scorched, due to lack of proper conservation technologies.

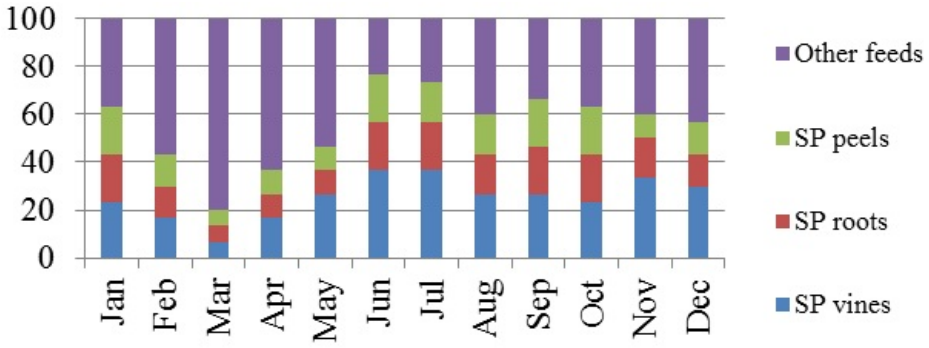

Figure 2. Contribution of SP and other feeds to the total diet throughout the year according to farmers (%)

During periods of SP scarcity, farmers often use other feeds they consider of lower nutritional value as compared to SP and other RTB residues. Among those are: chicken manure, swill, jack fruit, local bananas' brewers waste, maize stover and tree leaves such as from *Ficus natalensis*. Few smallholder farmers could afford buying commercial feeds, and even fewer had easy access to those.

Use of SPV at household level

Among the SP crop residues, the SPV are the leading contributor to pig diets with 70%, followed by SPP (25%) and SPR (5%).The majority of smallholder farmers (40 % in Masaka and 52% Kamuli), use SPV for feeding their pigs (Figure 3). In some cases farmers give or sell SPV to other farms. However, in Masaka and Kamuli, 38 and 40% of the SPV are not used respectively.

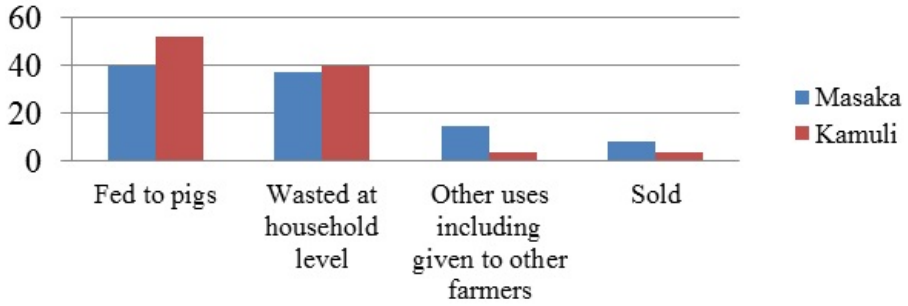

Figure 3. The use of SPV produced by smallholder farmers at household level (%)

Figure 4. Pig feeding on SPV in Masaka district

Processing practices applied to SP and other RTB crop residues

SPV, yam and cassava leaves form the bulk of the crop residues fed to pigs in smallholder farms. However, most farmers reported that they are largely fed without any form of processing. The few farmers who process them do chop, dry or cook. When RTB crop residues are cooked, they are left to cool before offering to the pigs. Most of the time they are mixed with commercial feeds such as maize bran, silver fish and cottonseed cake when feeding. When offered in fresh form, these crop residues are hanged or placed into the floor of the pigsty. Formulations that include mixing with commercial feeds are mostly practiced in peri-urban or urban areas, while in rural areas it is more common to mix with chopped grasses. Table 3 describes the form of feeding, feed formulation and additives used with RTB crop residues.

Farmers declared that raw banana peels are not palatable and pigs fed on those get stunted. Also according to them, pigs that consume raw cassava leaves can develop diarrhea, vomiting and can even die.

Table 3. Sweetpotato and other RTB-based feed processing and feeding strategies

Type of crop residue	Form of feeding	Method of processing	Types of rations formulated	Feeding additives/ mixtures
SPPV, SPP, SPR	fresh	chopped; boiled;	mixed with cassava, banana peels, pigweeds, leafy vegetable or grasses	fishmeal, slaughter waste, maize bran
Cassava roots, peels and leaves	fresh (roots); dried (peels)	chopped, boiled; and pound	mixed with SPV, SPR, SPP and banana peels	maize bran, cottonseed cake
Banana peels	fresh	chopped, dried	mixed additives	maize bran; cottonseed cake; crude, roasted soil; chicken manure; salt; animal or human urine.
Yam leaves and bulbs	fresh	chopped; cooked	none	Maize bran; cottonseed cake

When given to piglets, SPV are usually wilted for 2-3 hours
Cooking is usually done to small SP and cassava as well as their peels
The fresh or roasted soil is a source of iron
Feeding systems remained constant for adult pigs (weaners, growers, finishers, sows and boars)

Feed conservation methods reported by farmers in their communities

Sun drying

In Kamuli district, female farmers' reported that they sundry the SPV and grind it to powder before mixing to commercial feeds such as maize bran, a technology promoted by the local government extension services, that is considered affordable by farmers. It also facilitates long-term storage according to them. In the case of maize, farmers keep the grain in a cool dry place, and sundry the maize bran. In Masaka district, drying of SPV and other RTB residues, followed by pounding was commonly practiced.

Silage making

Farmers have heard about silage making of agricultural byproducts, but mainly for cattle use. In Kabonera sub-county (Masaka district), silage making has been promoted by World Vision an international NGO, but its use was recommended only for dairy cattle. For most farmers in all sub-counties included in this study silage making from SP and other RTB crop residues was unknown. However, farmers expressed their will to adopt silage making and preservation of maize cobs because the raw materials were readily available to them and these feeds were perceived by farmers as contributing to the fast growth of their pigs.

Feed and feeding related problems and potential solutions suggested by farmers

The high cost of feeds, low quality of feed ingredients, and lack of knowledge on how to formulate rations were the most frequently mentioned constraints. Limitations in feed availability during the dry season, and the absence of feed conservation technologies were also cited as constraints in both districts. The absence of governmental regulatory roles on feed markets to prevent selling of poor quality feeds was also regarded as a very big issue. Specific constraints associated with the use of SP and other RTB crop residues for pig feeding include: scarcity during dry season; lack of storage facilities (SPV dry too fast within 3-4 days on the field, and roots get spoiled easily by rotting or attacked by pests, rats and worms) limits the efficient utilization of valuable crop residues in pig feeding. There is high labor demand for the collection (children and women are more involved in feed collection), transport and processing of SP and other RTB crop residues, as well as risks of poisoning when residues are not properly processed (ie: case of cassava leaves).

Among the solutions envisaged by farmers are: implementation of research and training efforts on feed conservation technologies for SP and other RTB crop residues, as well as promotion of dual purpose SP varieties; and groups formation and empowerment for collective marketing of pigs and SP.

Figure 5. Child collecting SPV to feed pigs in Masaka district

Discussion

The high demand of SP and other RTB crop residues in smallholder pig systems found in this study confirm what has been documented in Uganda by other authors in rural settings and peri-urban (Pezo et al 2014). However, in all cases the use of SP and other RTB crop residues is seasonal and rather opportunistic. Hence there is an opportunity to systematise the production and use of these residues in smallholder production systems.

The method of feeding SP and other RTB crop residues to pigs vary, for example in peri-urban areas where there is easier access to commercial feeds, farmers feed the crop residues mixed with concentrates; whereas in rural areas crop residues tend to be given without supplementation because of limited access to commercial feeds. However, the use of RTB crop residues is not only limited to pig feeding. Beside this activity, a considerable proportion of these are sold to fellow farmers for other uses such as craft making with cassava and banana residues especially with women. Men are most likely to sell RTB crop residues than women, who usually use RTB crop residues for crop related activities including manure and crop mulching. These observed trends confirmed reports that pointed out the fact that in the smallholder pig value chain systems in Uganda, men are more market oriented as compared to women who are more involved in the day-to-day pig management (Ouma et al 2014).

There is poor access to knowledge and processing technologies for improving the use of RTB crop residues. This resulted into lack of ration formulation based on SP and other RTB crop residues, hence poor utilization of these residues. However some farmers have implemented practices that may help to cope with anti-quality factors. For example, cooking or wilting cassava leaves help to reduce potential HCN toxicity, especially in bitter varieties (Borin et al 2005). In other cases, efforts have been made to extend their use by sun drying the crop residues, a sort of hay making; or to make more effective use by chopping them into smaller pieces to promote consumption, as in the case of SPV. However, as SPV are preferably offered in fresh form, either thrown in the pigsty or hung on a rope, the capacity for digesting dietary protein is reduced due to the presence of the anti-trypsin factor (Dominguez 1992; Dominguez et al 2011).

The availability of SPV for 6-8 months of the year provides an opportunity to conserve them for use during dry season and also for mixing these with poor quality feeds. The conservation of RTB residues is not a common practice; therefore the availability of crop residues during the harvesting period exceeds the demand by the herd, resulting in significant wastage (37 and 40% of SPV in Kamuli and Masaka, respectively). In contrast, during periods of feed scarcity farmers

often destock the herd to a manageable size as a coping strategy. This, however, makes pig prices drop significantly because many farmers make sales at the same time, affecting the profitability of these businesses. Silage making of SP crop residues (Van An et al 2005), and hay making of cassava leaves (Nuh Phuc et al 1996) would help to reduce wastage and control the presence of anti-quality factors, resulting in increased farm productivity in smallholder pig farms in Uganda. In this study, farmers and stakeholders have pointed out that SP silage making is a potentially easy and affordable technology that producers could use to conserve SPV and SPR for feeding pigs in times of shortage (Dione et al 2014). Silage of SPV and SPR together with cassava leaves can replace more than 70% of the protein from fish meal (or 35% of total diet crude protein), reducing feed costs without affecting growth and carcass quality of pigs (Nguyen et al 2010). However, the technology has not yet been validated amongst smallholder pig producers under Ugandan conditions.

Conclusion

- This study highlighted major practices and strategies deployed by farmers in response to feeding constraints. It also demonstrated that there is potential for the use of SP and other RTBs as pig feed in the smallholder pig farming systems in Uganda, but the lack of knowledge across production, processing, conservation and utilization of SP and other RTB residues limits their use especially for pig feeding. Strategies for conserving these valuable feed resources for pig feeding during the harvest period for use during times of scarcity need to be explored, validated and scaled out.

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Conflict of interest statement

Authors declare no conflict of interest

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