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By
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Goats eating sweet potato vines, Kampala. (Photo by the author)

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ABSTRACT

Urban farming includes growing of crops and animal keeping. Due to the fast urbanization, farming in cities is practiced in many parts of the world and provides food and income for around 700 million people. This study was conducted in Kampala, the capital of Uganda. Uganda has a population of 27.8 million people with 82.6% of the population living below the poverty line. Kampala has 1.2 million inhabitants, with a high population density, 7, 378 persons per km^2 of land. Urban agriculture is widespread in the city. By-products from crops in the markets generate a lot of wastes that are used as feed and fertilizer, collected by the authorities or left dumped in the markets causing environment and health problems. The aim for this study was to identify the use of market crop wastes (MCW) as animal feed in the urban and peri-urban areas of Kampala. The study included interviews with 125 farmers as well as chemical analyses of the most commonly used wastes.

Livestock was very important for most respondents and contributed with 25-50% to their economy. A majority, 72% of the respondents were women who needed the income from livestock for buying food and to pay school fees for the children. Two thirds of the farmers were not using MCW as feed. Reasons were access to other feed resources, problems to transport the wastes and lack of knowledge about the MCW. The MCW mostly used as animal feed in Kawempe and Lubaga divisions were: banana (*Musa*) peels, sweet potato (*Ipomoea batatas*) peels, sweet potato vines, cassava (*Manihot esculenta*) peels, cassava leaves and cabbage (*Brassica oleracea*) leaves. A mixture of different fruit wastes was also very commonly used. Cassava leaves had the highest content of CP, 22.1%. Compared to the leaves, the peels had poor nutritional values with very low CP (2.6-6%) and high NDF values (52-75.3%). The NDF of the leaves ranged between 28 and 50%. The DM of all wastes was low, especially for the leaves, which had a DM between 11.9-21.9%.

Contamination of the MCW by e.g. nails, plastic bags and mud was a serious problem. Further, high prices of the wastes and costs/difficulties transporting the wastes were other constraints. By reducing the contamination of the MCW, more wastes could be used as feed. Further research about the ways to reduce the contamination of the wastes in the markets and research about the feeding value of MCW for different livestock species is needed. Workshops and written information about feeding and the potentials of MCW as feeds could be a way to increase the knowledge among the farmers.

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INTRODUCTION

Urban and peri-urban agriculture

Urban agriculture includes the growing of crops and animal keeping (e.g. livestock, bees, rabbits, guinea pigs and fish) in densely populated areas. Globally, around 200 million urban farmers provide food and income for around 700 million people. Urban agriculture is not a new phenomenon, and it has been practised for thousands of years in different parts of the world, e.g. Greece, Persia, Morocco, North America and Mexico. During the late 20th century, the development of urban agriculture has been fastest in Asia. In China for example, most major cities are nearly self-sufficient in the basic food crops. Since the 1970s, the rapid urbanization in the developing countries has caused high poverty rates in many cities. This urbanization together with factors such as: ineffective agricultural policies, crippled food-distribution systems, soaring inflation and rising unemployment, war and natural disasters disrupts rural feed production and supply lines to the growing cities. (Egziabher, 1994)

Agriculture in urban areas is associated with several problems like lack of land for farming and the issue about land ownership and land use, as modern systems of land registration clash with traditional inheritance patterns. Further, the attitude from the governments towards urban agriculture is another issue. Urban agriculture is also said to have negative impacts on health, for example that malarial mosquitoes breed in maize crops grown in East African towns causing more malaria, which is a myth. Even if animals left to wander can spread diseases and cause problems, the benefits of urban agriculture are considered higher. (Egziabher, 1994)

Urban and peri-urban agriculture can reduce shortage of food in several ways: growing food at home or via a cooperative reduces the cost burden of acquiring food for the poor, puts more food within their reach, and reduces seasonal gaps in fresh produce (FAO, 2005a). Sales of surplus produce can generate income that can be used to buy more food or for other household expenses. Also, by increasing the diversity of food consumed, it can significantly improve the quality of urban diets. Many studies show that the primary motive for urban farming is food for household consumption and that the urban farmers are mostly women. (Maxwell, 1995)

General facts about Uganda

Uganda is a country located at the equator with a total area of 241,040 km^2, measuring 650 km from north to south and 500 km from east to west. The country is landlocked and borders Sudan to the north, Kenya to the east, Tanzania and Rwanda to the south, and DR Congo to the west (Figure 1). The average altitude is 1,200 m, with most parts situated 900 metres above sea level. Uganda has an equatorial climate with small regional variations in annual temperature and humidity. Mean annual rainfall is 1,180 mm. The southern and the northern part have two rain periods per year, while the area around Lake Victoria receives a high rainfall all the year around. There is, however, a moisture deficit during the periods December-February and June-September. The relative humidity is high, ranging between 70 and 100%. The mean annual temperature ranges from 18 to 35°C in most parts of the country. (FAO,

2005c) Uganda has a population of 27.8 million people with an annual population growth of 3.7%. The population is expected to be 41.9 million in year 2015. Foreign aid is very important for the budget of Uganda since 17% of the GDP[1] consists of aid. The adult literacy is two thirds of the population. The life expectancy is 48.4 years and 6.7% of the population between 15 and 49 years of age is living with HIV/AIDS. (SIDA, 2007) Uganda is ranked as number 145 out of 177 countries in the Human Development Report (2006) (Sweden is ranked as number 5). The proportion of people living in households with consumption or income per person below the poverty line is 82.6% (SIDA, 2007) and 88% of the population lives in rural areas (Uganda Bureau of Statistics, 2002).

Figure 1. Map of Uganda (Gorta, 2008)

General facts about Kampala

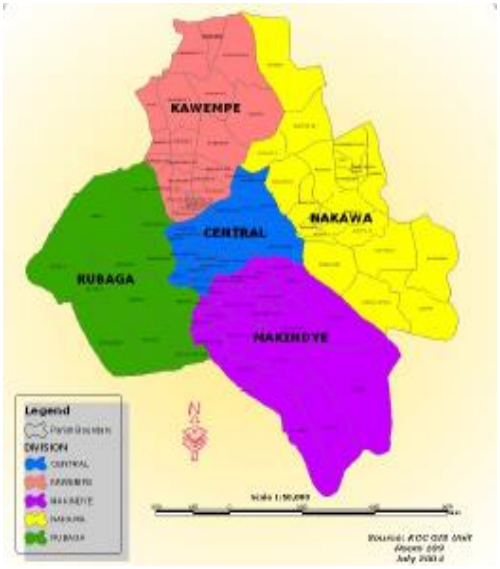


Figure 2. Divisions of Kampala (Mc Gill, 2006)

Kampala is the capital city of Uganda, with a population of 1.2 millions year 2002. The population density per km^2 is very high at 7,378 persons per km^2 of land. (KCC, 2007) (The Stockholm region has a population density of 287 persons per km^2 of land according to the Nordic Major City Statistics, 2006). Kampala city is divided into five divisions (Figure 2) each undertaking their own planning and budgeting. The five divisions consist of 99 parishes and 802 villages. (KCC, 2007) A parish refers to an administrative unit consisting of several villages. A village is the lowest administrative unit, which is commonly referred to as "Local Council 1" (LC 1). (Atukunda *et al.*, 2003)

According to Atukunda *et al.* (2003) there are four different farming-styles of Kampala City Council (KCC), which include: peri-urban, peri-urban to transition, urban-new and urban-old. These farming styles are greatly based on how much land that is available for agriculture, with the peri-urban area having the biggest area and the Urban-old category having the least (Table 1). Urban old have the highest population density and periurban the lowest.

[1] GDP= Gross Domestic Product. The total final output of goods and services produced by the country's economy (Wikipedia, 2008)

Table 1. Description of KCC Urban Classification system (Atukunda *et al.*, 2003)

Criteria	**Urban, old**	**Urban, new**	**Peri-urban to Urban transition**	**Periurban**
Prevalence of crop production	Low	Low	Medium	High
Prevalence of local livestock	Medium	High	High	Low
Prevalence of improved livestock	Medium	High	High	Low
Land availability	Limited	Limited	Moderate	Very good

Kawempe and Lubaga divisions

This study was carried out in Kawempe and Lubaga (also spelled Rubaga) divisions (Figure 2) in Kampala during September and October 2007. Kawempe is located in the north of Kampala and connects the city with major roads to the northern, eastern and western part of the country. Kawempe has one of the busiest day-life in Kampala with around 270,000 people and a number of industries and many traders crowding the areas of for example the big market Kalerwe. (KCC, 2007) With an estimated population of 300,000, Lubaga is one of the city's most densely populated areas; 8,938 persons per km^2. HIV/AIDS have had a great impact in the division resulting in many orphans. Most residents earn less than a dollar a day and suffer from poor living conditions, poor health, and lack of access to basic social services. (Watercan, 2007; KCC, 2007) Both divisions include parishes in each of the four farming styles.

Livestock production in Uganda

Uganda is a low-income agricultural economy with livestock contributing to over 9% of the total GDP. The area under arable land, permanent crops and permanent pastures is about 52% of the total land area. (FAO, 2005b) Of the working population, 71% of the men and 82% of the women are engaged in agriculture (Uganda Bureau of Statistics, 2002). Over the last two decades livestock production has been increasing, but has not kept pace with the population growth. The productivity per animal has remained the same. Mixed farming small holders and pastoralists own over 90% of the cattle and almost 100% of goats, sheep and poultry. (FAO, 2005b) In year 2005, the numbers of livestock in Uganda were around 8.1 millions goats, 7.5 million cattle, 1.7 million pigs, 1.2 million sheep and 23.5 million households were keeping chickens (Ministry of Agriculture Uganda, 2005/2006).

Urban and peri-urban agriculture in Uganda

After the Amin[2] years in the seventies, the economy in Uganda was severely damaged. The urban economy was further damaged by a guerrilla war in the outskirts of Kampala in the beginning of the eighties. (Maxwell, 1995) As a result of a worsening urban poverty, urban agriculture is widely practiced within the urban and peri-urban areas of Kampala. Crop cultivation, livestock rearing and fish farming are the main activities characterizing urban agriculture in Kampala. (Atukunda *et al.*, 2003) Half of the land in Kampala is used for farming by 30% of the population. (Egziabher, 1994) According to a survey by Maxwell (1995), 9.5% of the population are keeping livestock in the periurban/urban areas of Kampala, 2.6% are livestock keepers in the most densely populated study areas and 20% in the less densely populated areas.

Urban agriculture is an essential source of livelihood for many, particularly the vulnerable groups such as female-headed households, widows, the elderly and those living with HIV/AIDS. They engage in agricultural activities not only for economical benefits, but also to contribute substantially to their food security. (Katongole, 2007. Personal communication) Surveys from Save the Children and UNICEF indicate that children from poor households that produce food have a significantly better nutritional status than households that are not farmers (Egziabher, 1994).

One limiting factor for urban agriculture is the lack of land. The problem is even greater for those rearing animals. There is not enough land to grow animal fodder, yet the livestock keepers lack the financial means to buy commercial feeds, and they can not produce enough household wastes, which they would otherwise use to feed their animals. Therefore, farmers in urban areas are relying on roadside forages (which they cut and carry home), household wastes from their own household and neighbours as well as crop wastes generated from the different markets in Kampala. (Katongole, 2007. Personal communication)

Market crop wastes in Kampala

Many crops in developing countries are handled in their raw form, generating a lot of wastes. More than 18 000 million tons of crop wastes are generated from the markets in Kampala each year. (Ekere, Cited in; Katongole *et al*., 2007) These wastes are to some extent used as animal feed or as green manure, collected by city authorities and dumped or left in the markets causing environmental and health problems (Sendawula *et al.*, 1997). The three important staple foods: banana (*Musa acuminata*), sweet potato (*Ipomoea batatas*) and *Solanum aethiopicum* (a vegetable grown for its leaves, and traditionally known as nakati) generate the highest volume of wastes. Kalerwe market alone is responsible for over 25% of the wastes generated in Kampala. (Ekere, cited in; Katongole *et al*., 2007)

[2] Idi Amin took power in Uganda in a military coup in January 1971. His rule was characterized by human rights abuses, political repression, ethnic persecution, extra-judicial killings and the expulsion of Indians from Uganda. His regime killed from 80,000 to 500,000 people (estimation). The Uganda-Tanzania War became the fall of his regime in 1979. (Wikipedia, 2008)

OBJECTIVES

The objectives of this study were;

- To identify the market crop wastes (MCW) used as animal feed in the urban and peri-urban areas of Kampala.
- To determine the constraints that could hinder the use of MCW as animal feed.
- To determine dry matter (DM), crude protein (CP) and neutral detergent fiber (NDF) compositions of the most common MCW used as animal feed in the urban and peri-urban areas of Kampala.
- To determine the feed-treatments carried out on the MCW before they are fed to the animals.
- To determine the relationship between using MCW as animal feed and household socio-economic characteristics.

MATERIAL AND METHODS

The study was conducted together with Karin Alvåsen, student in Animal Science and Constantine Katongole, PhD student. The study included interviews with farmers as well as chemical analysis of the most commonly used MCW. The survey was carried out following a structured questionnaire (see Appendix 1). The questionnaire focused on the following aspects: socio-economic factors, types of feed given to livestock (with a focus on market crop wastes), feed treatments and constraints related to the use of market crop wastes.

Table 2. Number of respondents in each parish

Division	Parish	Respondents
Kawempe	Komamboga	15
	Kikaaya	17
	Kyebando	15
	Mpererwe	17
Lubaga	Lubya	15
	Nakulabye	17
	Lubaga	14
	Kabowa	15

One parish from each farming-style was selected by the local leader in each division, resulting in a sample size of 4 parishes per division, a total of 8 parishes for the two divisions (Table 2). Lists of all households with livestock in each selected parish were compiled by the local leaders. In each parish, the contact person for the farmers gathered the farmers for a meeting where we made the farmers aware of the subject, confirmed willingness to participate in the study and booked appointments for interviews. In some cases the interviews were done directly after the meeting. An interpreter, familiar with the local language Luganda, was always present during the interviews. 14 to 17 persons per parish were interviewed, giving a total number of 125 interviews.

From the questionnaire, descriptive statistics were generated by using the Statistical Package for Social Sciences (SPSS) version 16. Based on the survey results, samples

of the six most common crop wastes used to feed livestock were collected from Kalerwe, one of the major markets. The samples were oven dried at 60ºC for 24 hours for DM analysis and ground to pass through a 1-mm screen. The samples were then analyzed in duplicates/triplicates in the university laboratory for crude protein (CP) according to AOAC (1990) and neutral detergent fiber (NDF) by the method of Van Soest and Robertson (1985). Means and standard deviations for the chemical composition were generated using Excel.

RESULTS

Interview study

Socioeconomic characteristics

The average age of the participating farmers was 44 years; the youngest was 16 and the oldest was 80 years. A majority, 72% of the respondents, was females and almost 25% of the females were widows. The men were either married or single, none was a widower. Two thirds of the women and 57% of the men were married. Some of the men, who answered single, were probably widowers and some of the widowers were probably remarried.

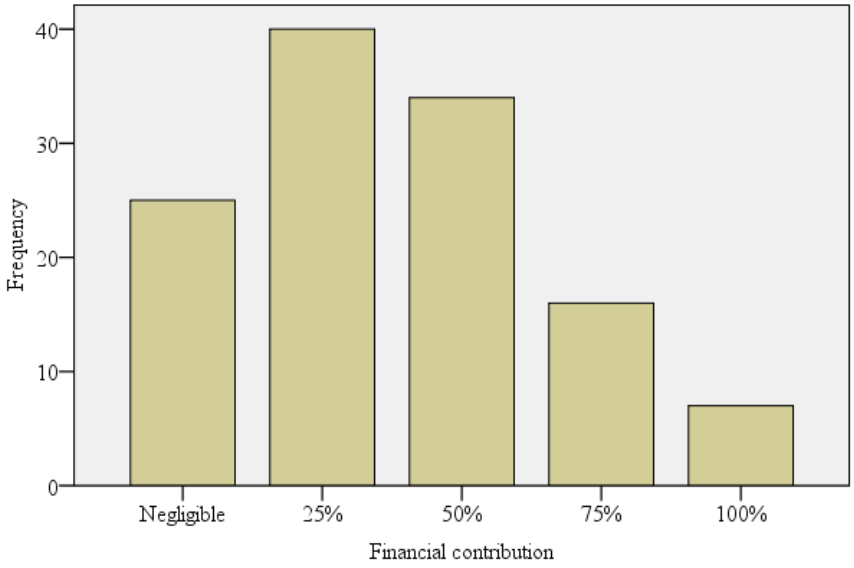
Less than 2% of the respondents were lacking formal education, while 30% had studied to Junior 1 and 34% to Junior 2[3]. The level of education was the same for both men and women. Around half of the farmers had undergone some kind of livestock training, the majority in the form of a short course at the university, by an institution, a workshop or a NGO.

Opinions about keeping livestock in urban/periurban areas

Of the respondents, 37% answered that the most important reason why they are farmers is because it raises income to the household. It is also an important food source. Many of the households needed the money from livestock production to pay for example school fees for the children. Other positive things were that the demand for products was higher in the city compared to the rural areas, meaning that they can sell the products for higher prices. The distance to markets was also shorter. According to almost every respondent, the most negative thing about being a farmer in the urban/periurban areas of Kampala was the lack of land, for pasture and for feed production. Another major constraint was conflicts with neighbours concerning smell and destruction by free ranging animals

[3] Primary Education: From Primary1 to Primary7 (P1-P7), equivalent to Junior one (J1) in the old system. Secondary Education: Includes two levels. Ordinary: from Secondary/Senior1to Secondary/Senior4 (S1-S4), equivalent to Junior2 (J2) in the old system. Advanced: from Secondary/Senior5 to Secondary/Senior6 (S5-S6), equivalent to Junior3 (J3). (Katongole, 2008. Personal Communication)

Chart 1. Financial contribution from livestock to household economy



Livestock keeping

Livestock was an important source of income for many of the respondents, for the majority, livestock contributed with 25-50% to the households' economy (Chart 1). Poultry was kept by most of the households, followed by cattle (Chart 2). According to the respondents, there is a high demand for eggs and chicken meat. The respondents also thought that poultry are easy to keep, the investment costs are low, they need little space and if the flock is small, they can be kept on free range. Further, poultry have a short generation interval, which makes it easy to plan the production, for example to sell many chickens when the school fees have to be paid. Exotic breeds were popular, especially among farmers that kept high numbers of poultry.

Chart 2. Number of households keeping each type of livestock

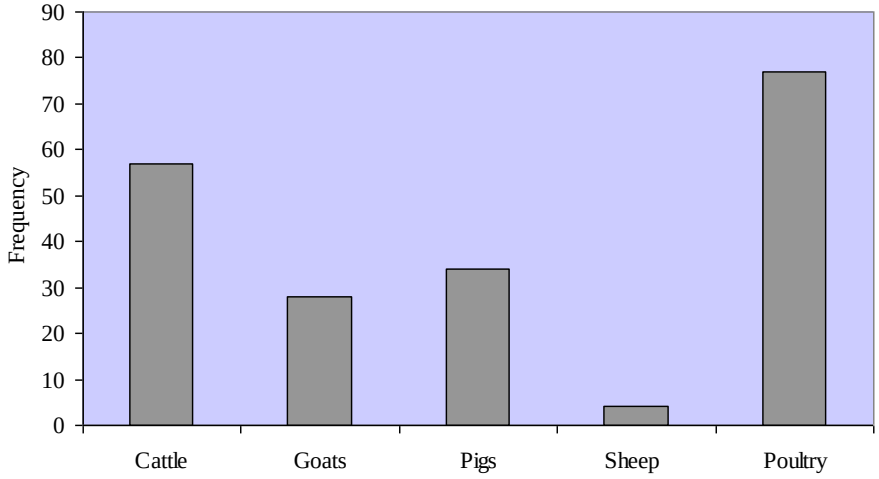
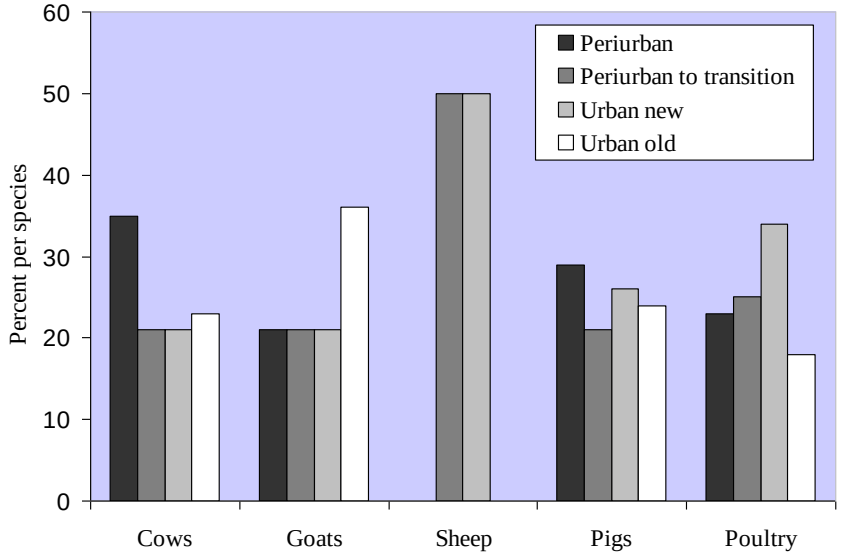


Table 3. Number of animals per household and total number of animals in the study.

	Mean	Min	Max	Total no. of animals
Cattle	2.6	1	11	162
Goats	5.6	1	20	156
Sheep	7	5	9	28
Pigs	10.6	2	47	359
Poultry	241	1	3000	18550
Rabbits	-	-	-	0

Many households kept one or two cows while the mean number was 2.6 cows, the mean number of goats was higher, 5.6 goats. Around two thirds of the cows and goats were mainly kept to sell the products. One difference between cow and goat keepers was that one third of the farmers with cows kept them mainly for home consumption, while 20 % of the goat keepers kept goats mainly for hobby or cultural reasons. Only a few households were keeping sheep, probably because people in Kampala prefer goat meat before mutton. None of the respondents were keeping rabbits (Table 3).

Chart 3. Distribution of animals in each farming style per species

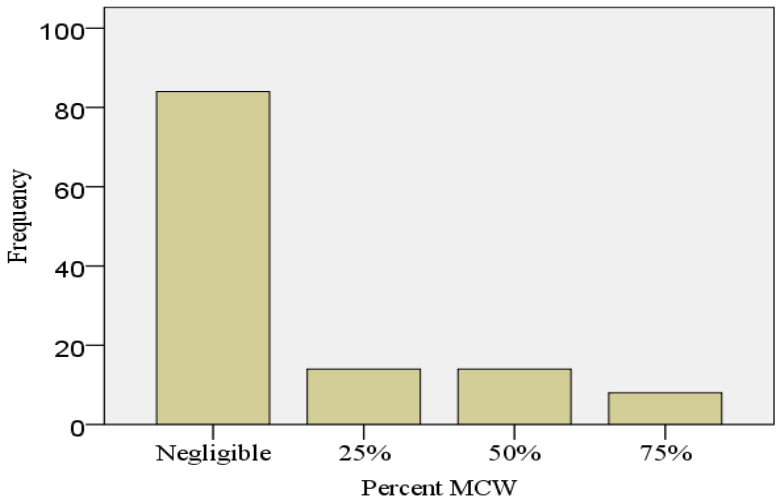


Of the four farming styles, most goats were kept in urban old areas (36%), Pigs were most popular in periurban areas, poultry in urban new, cattle in periurban (35%) and sheep were kept in periurban to transition (50%) and urban new (50%) (Chart 3).

Feeding and the use of MCW

Two thirds of the farmers were not using MCW as feed for their animals (Chart 4). One reason is that they have more or less access to other feed resources such as food peelings (91% of the respondents) and food waste (62%) from the household, neighbours and restaurants. Many farmers used commercial concentrate (79%) and cut grass and fodder (86%), but the sources of especially grass are scarce and commercial concentrate is too expensive for many.

Chart 4. Use of MCW as percent of the households' total feed requirement



Another reason for not using MCW was lack of knowledge about the feeding values of the MCW and to which type of livestock it can be given. Many farmers with exotic breeds were negative to feeds such as MCW and food wastes, because they thought that the animals do not produce enough when using these feeds. Instead, many bought expensive concentrates, which made the profit lower. The use of MCW was around 10% more common among ruminant keepers than pig or poultry keepers.

The MCW mostly used as animal feed in Kawempe and Lubaga divisions were: banana (*Musa*) peels, sweet potato (*Ipomoea batatas*) peels, sweet potato vines, cassava (*Manihot esculenta*) peels, cassava leaves and cabbage (*Brassica oleracea*) leaves. A mixture of different fruit wastes was also very commonly used, but difficult to analyse due to the variation of fruits. Many farmers collected or bought a mixture of the crops mentioned, and the content then differed from time to time.

The most common treatments of the MCW before they were fed to animals were sorting and wilting/sun-drying, followed by washing and chopping. The treatments differed between households, and there was no clear linkage between a certain crop and a treatment. The reasons for these treatments were to remove dangerous objects like nails and plastic bags. Washing reduced mud and other contaminators and wilting reduced the moisture content, which was high, DM for the analysed wastes ranged from 11.9-32.4% (Table 4).

Constraints connected with MCW

The most important constraint when using MCW, according to the farmers, was contamination of the wastes. Some farmers had experienced diarrhoea or even death of animals eating MCW, often due to nails, plastic bags and other contaminators. These accidents have made some farmers stop using MCW, while others have started to sort the wastes better.

Several other factors hinder the use of MCW as animal feed, such as high prices due to high competition of the wastes in the market. One third of the respondents paid for the wastes, while the others got them for free. Even if they were free, many had to be in the markets very early to drive others out of competition, alternatively have good contacts in the market.

The distance to markets is another issue, which caused problems to transport the wastes to the households. The median transport distance was around 1.5 km (ranging from 100 meters to 20 km). Costs/difficulties transporting the wastes were one of the major reasons why farmers were not using MCW to a higher degree. The ways of transportation ranged from carrying the wastes, transport using wheel barrow, bicycle and motorbike to public minibus and own or rented van. The median transportation cost was 4000-5000 UGX[4] per week for those who had to pay for the transport.

Chemical composition of the wastes

Table 4. Chemical composition of the MCWs

	DM, g/kg	In g/kg DM	
		CP	NDF
Banana peels	161	48 (0.2)	753 (11.0)
Sweet potato peels	316	26 (0.0)	560 (9.2)
Sweet potato vines	163	132 (1.4)	453 (2.3)
Cassava peels	324	60 (0.8)	520 (8.5)
Cassava leaves	219	221 (1.1)	500 (7.2)
Cabbage leaves	119	121 (0.2)	280 (2.0)

Means and SD= standard deviation; DM=Dry matter; CP=Crude protein; NDF=Neutral Detergent Fibre

Of the six MCW, Cassava leaves had the highest content of CP, 22.1%, while the peels of sweet potato had the lowest protein content, 2.63%, followed by the peels of banana and cassava. The peels had the highest NDF contents, with banana peels having the highest content (75.3%). Cabbage leaves had the lowest content of NDF, 28%. Cassava peels had the highest DM, 32.4% and cabbage the lowest, 11.9%.

DISCUSSION AND CONCLUSIONS

Interview study

The results from this and many previous studies indicate how important urban farming is in the urban/periurban areas of Kampala, especially for families with children and single mothers, who need the income to provide their children with food and to pay for their education. Maxwell (1995) reported that many earlier studies

[4] 1000 UGX = 3.9 SEK (Gocurrency, 2008)

concluded that the primary reason for urban agriculture is for household consumption. This study showed that most households kept animals primary to sell the products. These results can depend on the rising urbanization since the 1990's and there may have been a development of the markets, since the farmers said that there is a high demand for animal products in the city.

Urban farming is not an ideal solution to fight poverty, since it is connected with several problems. Still, urban farming is not a choice for many citizens; it is a way of surviving and makes education for the children possible. Most farmers had some education, which correspond well to the population. According to Uganda Population and Housing Census (2002), 1% of the men and 2% of the women were lacking education. However, most farmers have a low level of education and the possibility to get an employment is low.

More households kept cows than goats and the total number of cows was also higher in the study, even though goats are smaller and easier to feed than cows, and the total number of goats in Uganda is higher than the number of cows. One reason can be that a cow is a multipurpose animal, which gives milk every day and also meat, while the goats in Kampala are held for their meat only. Cows are more expensive both to buy and to feed compared to goats, which can also be a reason why many households keep low numbers compared to goats, and why many keep goats just for hobby. Cows and pigs were most common in areas with more access to land than the areas were poultry and goats were most common. One reason can be that cows and pigs need more space and that the trouble with smell from these species might be worse than from goats and poultry. Rabbits are suitable for urban farming, but none of the respondents were keeping them. It seems that there was no tradition to eat rabbit meat in Kampala.

The fact that MCW was more commonly given to ruminants can depend on breeds. Poultry and pigs were often of exotic breeds while especially goats were indigenous, and farmers tended to give the alternative feeds to indigenous breeds before exotic. Many of the farmers were of the opinion that exotic breeds only produce with commercial feeds, which are expensive, and grass which is scarce. Research including feeding trials with alternative feeds with both indigenous and exotic breeds is needed.

Half of the respondents had some kind of agricultural education, but many thinks they need more knowledge about livestock feeding and how to use alternative feeds such as food peelings, kitchen wastes and market crop wastes. Workshops and written information about feeding and the potentials of MCW as feeds could be a way to increase the knowledge among the farmers.

The transport issue is difficult to overcome, and limits the use of MCW among farmers living away from the markets. If more people had bicycles, the transportation costs could be reduced. Farmers living far from markets without the possibility to transport the wastes cheaply are better off choosing other alternative feeds such as food peelings and kitchen wastes.

The high competition of the MCW indicates that the feed resources are very scarce in the city. If it is possible to reduce the contamination of the MCW, more wastes could be used as feed. The wastes are also a serious problem for the city authorities. Cooperation between the authorities and the market vendors could be one way. One

idea is that the authorities place containers for each waste in the market. An inspector could receive the wastes and sort them as in a recycling station. The inspector could pay the vendor, depending on the level of contamination. The vendors would then see the wastes as products and handle them more carefully. In the morning or evening, the inspectors could distribute the wastes for free to the farmers. The wastes probably have to be free since most farmers get the wastes for free today. This system could benefit the farmers who would not need to sort and wash the wastes as much. If the wastes were sorted, it would be easier to give feeding recommendations to the farmers, based on the chemical composition of each waste. The problems with garbage collection in the markets would be reduced since less waste would need to be gathered and transported to the waste disposal sites. More wastes could be recycled as feed and finally manure that can be used as fertilizer. This system is probably more ecological and profitable for the farmers, if it is advantageous for the authority is unsure. Further research about the ways to reduce the contamination of the wastes in the markets is needed.

Chemical analysis

According to the literature (AFRIS), the DM content of banana peels is 18.4% and CP 9.1%, but in this study the CP of the banana peels was half of the values presented by AFRIS. This can be due to the variety of banana since in this study the bananas were of the type used for cooking. Earlier studies have found the DM of sweet potato vines to be between 8.7 and 19.7%, CP 11.2 and 21.9% and NDF 40.9 and 42% (Dung *et al*., 2002; Katongole *et al*., 2007; AFRIS). This corresponds to the values of the vines analysed in this study with the exception of NDF, which was higher in this study (45.3%). In view of the fact that the vines were mature one would expect the CP values to be in the lower range and the NDF values in the higher. According to AFRIS, the DM of cassava peels is 27.9% and CP 5.6%, which correspond well to the material analysed in this study. CP for cassava leaves are little lower in this study then the result presented by AFRIS and Gomez & Valdivieso (1984), 24-29%, DM is 14.5-18.5 according to AFRIS and 33% according to Gomez & Valdivieso (1984). According to Livingstone *et al*., (1980) the CP content of cabbage is 23%, which is twice as high as the results from this study. The peels had the poorest nutritional values of the wastes analysed, with very low CP and high NDF values. The DM of all wastes was low, especially for the leaves, which had a DM between 11.9-21.9%.

The peels may well be used for low producing ruminants, since the CP is very low and not suitable for high producing or growing animals. Ruminants can digest NDF to a much higher extent than the monogastrics. Cassava plants and tubers can contain varying proportions of two cyanogenetic glucosides, linamarin and lotaustralin which brake down to give hydrocyanic acid (HCN). HCN is toxic to animals but can be broken down by boiling before feeding (McDonald et al., 2002). The content of these glucosides in the varieties in Kampala is unknown. Sweet potato tubers can contain trypsin inhibitors, which lower the protein digestibility (McDonald et al., 2002). If the peels contain the inhibitor is not known, if they do, it will lower the already low content of CP. The vines of sweet potato have a lower carbohydrate content and higher fibre and protein content than the tubers. The principal nutritive value of the vines is as a source of vitamins and protein. The feeding value of vines is close to that of alfalfa, and a cow can eat up to 70 kg per day (AFRIS).

Ongoing research by the PhD student Mr Katongole will give more answers about the potentials of MCW as feed for goats. More research is needed on the feeding value of MCW for other livestock species.

The variation in nutrient contents in and between different earlier studies is high, which can depend on varieties, seasons and geography. Also most of the published results on e.g. sweet potato vines are from the field crop and not as wastes from the market. Therefore, it is difficult to compare the analysed wastes to previous studies. The sample size for each waste was 2 or 3 and they were taken only from one market, at one occasion and each waste was taken from only one vendor giving not very representative results. Another factor that could have affected the results could be our lack of experience in the lab in Kampala.

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APPENDIX 1

QUESTIONNAIRE

A. HOUSEHOLD IDENTIFICATION

A1. Questionnaire number _____

A2. Date of Interview _____

A3. Interviewer's name _____

A4. Location of the Household

Division:

_____

Parish:

_____

LC1/Zone/Village:

_____

B. HOUSEHOLD SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

B1. Name _____

B2. Age _____

B3. Sex of the respondent □Male □Female

B4. For how long have you been residing at the current home? _____

B5. What is your marital status?

□Single □Married □Divorced/separated □Widowed □Other

B6. What is your position in the household?

□Household head □Spouse □Son/daughter
□Other relative □Household worker □Other

B7. What occupation takes the LARGEST PORTION of your time everyday?

□Salaried employment □Casual labour engagements
□Business/Trading □Managing the livestock enterprises
□House keeping □Managing the crop enterprises
□Other

If respondent is NOT the household head:

B8. What occupation takes the LARGEST PORTION of the Household Head's time everyday?)

□Salaried employment □Casual labour engagements
□Business/Trading □Managing the livestock enterprises
□Managing the crop enterprises □House keeping
□Other

B9. What is your stake in the livestock enterprises at the current homestead?

□Enterprise owner □Daughter/son to enterprise owner
□Hired labour for enterprise owner □Spouse to enterprise owner
□Other relative to enterprise owner

B10. What is your maximum level of education?

□Lower Primary (Primary1-Primary4) □No formal education
□Upper Primary (Primary5-Primary7) or Junior1 □College
□Lower secondary school (S1-S4) or J2 □University

□Upper secondary school (S5-S6) or J3

B11. Have you ever undergone any livestock training in your lifetime? □yes □no

B12. If yes, what?
□Training by government or private extension worker
□Short-course at University/Institution/Workshop or NGO
□Junior certificate in agriculture or veterinary
□Diploma or degree in agriculture or veterinary

B13. How many people stay permanently in the household for each age bracket?
Children < 6 years ___
Children 6<17 years ___
Adults 18-45 years ___
Adults 45-60 years ___
Elderly 60+ years ___

C. LIVESTOCK PRODUCTION SYSTEM
C1. For how long has the household been keeping each type of livestock at the current location?
Dairy cattle ___ Goats ___ Rabbits ___
Pigs ___ Sheep ___ Poultry ___

C2. How many animals (including young ones) do you have (at the current location) in each category?
Dairy cattle ___ Goats ___ Rabbits ___
Pigs ___ Sheep ___ Poultry ___

C3. What is the main reason for keeping each type of livestock? (TICK the appropriate box)

	Dairy cattle	Goats/ Sheep	Pigs	Poultry	Rabbits
Milk for sale					
Milk for home consumption					
Sale live animals to raise income					
Home consumption (Home slaughter)					
Hobby or cultural reasons					
Eggs for home consumption					
Eggs for sale					
Other					

C4. Who is responsible (1st and 2nd) for the specified activities for each type of animal?
1.Husband 2.Wife
3.Jointly by husband and wife 4.Jointly by all household members
5.Daughter/Son/Other relative 6.Hired labourer
7.Other

	Dairy cattle	Goats/ Sheep	Pigs	Poultry	Rabbits
Mobilising and collecting feed					
Processing feed (cooking, chopping, drying/wilting etc)					
Feeding the animals					
Cleaning the animal houses					
Repairing animal houses					
Contacting the Vet. when animals are sick					
Disposal of animal manure					
Finding buyers for products					
Negotiating with buyers the prices					
Handling cash from the sales					

C5. Which type would you say is more financially rewarding? Give reasons!

□ Dairy cattle _____
□ Goats _____
□ Sheep _____
□ Pigs _____
□ Poultry _____
□ Rabbits _____

C6. What would you estimate to be the financial contribution from livestock to the total household expenses?

□Negligible □25% □50% □75% □100%

C7. Indicate how frequently you give the following feed categories to your animals.

	Reason to never	Rarely (1-2 times per month)	Sometimes (1–2 times per week)	Regularly (4 - 7 times per week)
Commercial concentrates				
Kitchen/Plate food wastes				
Market crop wastes				
Cut grass and fodder				
Food peelings				
Slaughter wastes				
Brewery wastes				
Other (Specify)				

C8. Describe the availability of each feed type using a scale of 1 – 3:

(1) poor, (2) fair and (3) good

	Score	Reason for the score
Commercial concentrates		
Kitchen/Plate food wastes		
Market crop wastes		
Cut grass and fodder		
Food peelings		
Slaughter wastes		
Brewery wastes		
Other		

C9. Indicate the type of animals (Dairy cattle, Goats, Sheep, Pigs, Poultry and Rabbits) you mostly give each of the following feed types?

	1st choice	2nd choice
Commercial concentrates		
Kitchen/Plate food wastes		
Market crop wastes		
Cut grass and fodder		
Food peelings		
Slaughter wastes		
Brewery wastes		
Other (Specify)		

C10. What is the reason you give market crop wastes to the chosen animals?

_____
_____

D. UTILIZATION OF MARKET CROP WASTES FOR FEEDING ANIMALS

D1. What is the contribution of market crop wastes to your feed requirements in a week?

□Negligible □25% □50% □75% □100%

If negligible, go straight to D17

D2. List the types of market crop wastes that you mostly collect for your animals and where you regularly get them from?

Market crop waste	Source	Distance of source from household, km
1.		
2.		
3.		
4.		
5.		

D3. Under which terms do you get each of the market crop wastes mentioned above? (TICK the appropriate box)

Market crop waste	Given free	Cost is charged for specific unit	Token of appreciation given	Exchange for other services
1.				
2.				
3.				
4.				
5.				

D4. For each of the market crop waste you collect please indicate (YES or NO) to describe the way you find it at the source.

Market crop waste	Heaped	Sorted	Packed in sacks/any containers	Treated in any way (if YES, specify the treatment)
1.				
2.				
3.				
4.				
5.				

D5. What is the exact location where you get the market crop wastes at the source, and in case you have to pay for them, who do you give the money? (TICK the appropriate box)

	Exact source of wastes				Who do you pay			
Market crop waste	Waste heaps	Market vendors' stoles	Prior arrangements made	Middle men	Market vendors	Middle men	Market authorities	None
1.								
2.								
3.								
4.								
5.								

D6. How much do you pay for the wastes?

Market crop waste	UNIT measure of packing	COST per unit
1.		
2.		
3.		
4.		
5.		

D7. Indicate the method and frequency of collection for each market crop waste.

Market crop waste	Average NUMBER of units collected per week	METHOD of transport	Transportation COST per week
1.			
2.			
3.			
4.			
5.			

D8. How available are each of the market crop wastes? (TICK the appropriate box)

Market crop waste	Always get what needed and leave a lot behind	Always get enough but leave behind little/nothing	Sometimes enough, sometimes very little or nothing	Have to be there first to out-compete others for it
1.				
2.				
3.				
4.				
5.				

D9. Describe if its availability is stable throughout the 12 months of the year (TICK the appropriate box)

Market crop waste	Availability stable throughout the year	
	Yes	No
1.		
2.		
3.		
4.		
5.		

D10. Indicate which months of the year that each market crop waste is most and least available at the source.

Market crop waste	Months when MOST available	Months when LEAST available
1.		
2.		
3.		
4.		
5.		

D11. What constraints do you face with the market crop wastes that you use?

Market crop waste	1st	2nd
1.		
2.		
3.		
4.		
5.		

D12. What treatments or processing do you carry out on each market crop waste?

Market crop waste	Processing/treatment	Reasons for processing
1.		
2.		
3.		
4.		
5.		

D13. How do you normally store the market crop wastes between collection and feeding?

Market crop waste	Method of storage	Average days of storage
1.		
2.		
3.		
4.		
5.		

D14. List if your animals have had any problems from the consumption of the different market crop waste types.

Market crop waste	Observed problem	Type of animal
1.		
2.		
3.		
4.		
5.		

D15. Even if you have not observed any, what problems would you fear for your animals due to the consumption of the different market crop wastes?

Market crop waste	Fear (wellbeing or health)	Type of animal
1.		
2.		
3.		
4.		
5.		

D16. If you were to stop using market crop wastes for feeding your animals, what is the MOST important reason you would do so?

_____

If you are NOT USING market crop wastes for feeding your animals:
D17. What is the MOST important reason you are not doing so?

_____

E. MANAGEMENT OF MANURE/URINE

E1. Where do you put the manure/urine produced by each type of animal? (TICK the appropriate box)

	Dairy cows	Goats/ Sheep	Pigs	Poultry	Rabbits
Heaped in one place and disposed of later					
Daily disposed of in a public dumping area or facility					
Daily disposed of in any area found					
Dried and burnt for fuel					
Added to land as fertilizer for food production					
Added to land as fertilizer for fodder production					
Tipped in a pit at home					
Other (Specify)					

E2. In the case of the manure left heaped for later disposal, how many days or weeks does it take before its disposal? (TICK the appropriate box).

	Dairy cattle	Goats/ sheep	Pigs	Poultry	Rabbits
It stays there permanently					
Less than 7 days					
1-2 weeks					
2-3 weeks					
3-4 weeks					
1-3 months					
More than 3 months					

E3. How would you RANK (1st, 2nd, 3rd and 4th) the intensity of nuisance smells and flies associated with manure/urine produced by the 5 types of animals?

	Dairy cows	Goats/sheep	Pigs	Poultry	Rabbits
Score					

E4. Have you ever slaughtered a goat at the current home stead?

□ yes □no

E5. If yes, have you ever experienced contamination of the carcass by manure/urine smell?

□ yes □ no

E6. If no, how did you avoid it?

_____
_____

E7. What techniques do you use to control nuisance smells and flies associated with the manure/urine from each type? (TICK the appropriate box)

	Dairy cows	Goats	Pigs	Poultry	Rabbits
Do not do any thing specific					
Pour wood ash on the manure					
Put the manure under the sun					
Bury the manure in the ground					

E8. Which other methods are you aware of that could help control the smell and flies from the manure/urine?

_____
_____

E9. Highlight any key problems you have experienced with respect to handling and disposing manure/urine from each type of animal?

	Problems
Dairy cows	
Goats	
Pigs	
Poultry	
Rabbits	

E10. What are your opinions (positive and negative) about urban livestock keeping?

_____
_____
_____
_____