Journal of Agriculture and Rural Development in the Tropics and Subtropics
Vol. 113 No. 2 (2012) 165–174

urn:nbn:de:hebis:34-2012092441842 ISSN: 1612-9830 – journal online: www.jarts.info

Strategies for coping with feed scarcity among urban and peri-urban livestock farmers in Kampala, Uganda

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Abstract

Livestock keeping is increasingly becoming more popular in Kampala, the capital city of Uganda. However, lack of feed is a real challenge. Inadequate feed supply in urban areas is due to many interacting factors, which include among others land shortage, high cost of feeds, climate risks and poor quality of feeds. The objective of this study was to identify and examine the effectiveness of the strategies adopted by livestock farmers in urban and peri-urban areas of Kampala, Uganda to cope with feed scarcity. A total of 120 livestock farmers from Kampala were interviewed using a structured questionnaire. Dairy cattle (48.3 %) and chickens (37.5 %) were the most common species, followed by pigs (34.2 %), goats (26.7 %) and sheep (3.3 %). Farm size was generally small both in terms of herd size and total landholding. Cattle and pig farmers in urban and peri-urban areas of Kampala ranked feed scarcity as their first major constraint, while chicken farmers had high cost of feeds. These farmers have adopted several strategies for coping with feed scarcity. Among the major coping strategies adopted were: changing of feed resources based on availability and cost (37.5 %), purchasing of feed ingredients in bulk (29.7 %), using crop/food wastes (26.6 %), harvesting of forages growing naturally in open access lands (23.4 %) and reducing herd size (17.2 %). However, most of the coping strategies adopted were largely aimed at dealing with the perennial challenge of feed scarcity on a day-by-day basis rather than dealing with it using sustainable and long-term strategies.

Keywords: feed scarcity, coping strategies, urban livestock, Kampala, Uganda

1 Introduction

Livestock keeping is increasingly becoming popular in Kampala, the capital city of Uganda. According to Ishagi *et al.* (2002), it is an entrepreneurial response to the income growth of the city coupled with the rapid human population growth and urbanization, which have seen an increase in the consumer demand for livestock products (Nyapendi *et al.*, 2004; Thornton, 2010). Additionally, the growing urban poverty, lack of formal employment and the proximity to market have also lured many into pursuing livestock production within and around Kampala city. According to Van Veenhuizen (2006), proximity to markets is one of the special opportunities that a city provides for farmers. If there is ready market for farm products, more households will go into production to meet the market demand, hence, the visible increasing trend in livestock keeping in urban and peri-urban areas of Kampala. The changing policy environment towards urban agriculture also explains this increasing trend. Currently, there is official recognition and support to urban agriculture in the city from Kampala Capital City Authority and government's programmes of poverty alleviation. The city has a section known as the Urban Agriculture Unit (under the Department of Production and Marketing) whose broad responsibility is to support and guide urban farmers.

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However, feed scarcity is a major limiting factor (Ishagi *et al.*, 2002; Katongole, 2009; Katongole *et al.*, 2011). The cultivation of fodder is almost impossible given the limitation of space (Ishagi *et al.*, 2002), while agro-industrial by-products and concentrate feeds are expensive and therefore not an option for resource-poor households. Even the crop/food wastes generated in the various markets, hotels, restaurants, schools and homesteads as well as forages growing naturally on open access lands (roadsides, undeveloped plots, wetlands/swamps etc.) have become a commercial item, with enterprising people collecting and selling them to farmers (Ishagi *et al.*, 2002; Katongole *et al.*, 2011). Under such circumstances, farmers are forced to develop or adopt coping strategies. The objective of this study was to identify and examine the effectiveness of the strategies adopted by livestock farmers in urban and peri-urban areas of Kampala to cope with feed scarcity.

2 Materials and methods

The data examined in this paper were part of a large questionnaire survey on farmers' indigenous knowledge on the nutritional quality of livestock feed resources in urban and peri-urban areas of Kampala. The study population consisted of households rearing livestock in these areas. According to the Local Government administrative system in Uganda, the lowest administrative unit is a Village/Cell/Zone, several villages/cells/zones constitute a Parish/Ward and several parishes/wards constitute a Sub-county or City division for districts with a city status such as Kampala. A total of 120 households were interviewed, 34 from Makindye division, 32 from Kawempe division, 30 from Rubaga division and 24 from Nakawa division. Kampala city is located 45 km north of the Equator at 0°19'6"N and 32°34'60"E (Figure 1).

For sample selection purposes, all the parishes in each of the four divisions were classified into four groups according to size of total landholding by the majority of households (above 0.25 acres; between 0.125 and 0.25 acres; between 0.0625 and 0.125 acres; and 0.0625 acres or less). From each group one parish was purposively selected based on the existence of livestock production activities. This resulted into a total of 16 parishes with four from each division. Local authorities (parish chiefs/administrative assistants) were asked to provide lists of all households rearing livestock (cattle, goats/sheep, pigs and chickens) in their parishes of jurisdiction. Based on these lists, the interviewed households were selected randomly. The selected households were contacted in advance on whether they were willing to participate in this study. Those who were not willing to be interviewed were replaced by other households, which were also picked randomly from the provided lists.

The data examined included questions related to: respondent and farm characteristics; constraints to livestock keeping; coping strategies to feed scarcity as well as feeds used and feeding practices. The respondent characteristics included gender, age, marital status, years of residing at the current home, education level and whether one has ever undergone any livestock keeping training. Size of total landholding, herd characteristics (species composition, size and breeds) and homestead ownership (whether one owns or rents) were the farm characteristics recorded. From each selected household, the key person involved in the daily feeding of the livestock was interviewed. The data were analyzed using the SPSS 12.0 statistical package (2003). The analysis included descriptive statistics (percentages and means), cross-tabulations and Pearson Chi-square tests of association. Indices were calculated to obtain ranking for production constraints and coping strategies to feed scarcity.

Fig. 1: *Source: http://www.getamap.net/maps/uganda/kampala/kampaladistrict*

3 Results

3.1 Respondent characteristics

Of the 120 respondents interviewed, 63.3 % were females. The respondents included household heads (47.5 %), spouses (33.9 %), relatives to the husband or wife (16.1 %) and hired labourers (2.5 %). The average respondent age was 46 years, with about 64 % of the respondents being 40 years or older. Of the entire sample, 62.2 % were married, 20.2 % were single, 13.4 % were widowed, and 4.2 % were divorced. The majority of respondents (74.9 %) had attained senior secondary education and/or above. It was also observed that 55.0 % of the respondents had ever attended some kind of training in livestock keeping. The majority (76.3 %) of respondents had been residing at their current homesteads for more than 10 years.

3.2 Farm characteristics

Most of the respondents (89.9 %) owned the homesteads on which their farms were located. Dairy cattle (48.3 %) and chickens (37.5 %) were the most commonly reared livestock species followed by pigs (34.2 %), goats (26.7 %) and sheep (3.3 %). The proportion of respondents with at least two livestock species was 38.3 %. Farm size was generally small when measured either by size of total landholding or herd size: 63.3 % of the respondents operated on 0.125 acres or less. Of the farmers interviewed, 87.3 % kept between one and five heads of cattle (with an average of 2.3); 76.9 % kept between 5 and 80 local chickens (with an average of 36.7); 73.2 % kept between 30 and 500 exotic chickens (with an average of 283.8); 76.9 % kept between 1 and 22 pigs (with an average of 8.8); and 77.5 % kept between 2 and 10 goats (with an average of 4.4). Dairy cattle herds were mostly composed of Friesians crossed with undefined breeds (53.6 %), pure Friesians (25 %) and indigenous cattle breeds (14.3 %), particularly Ankole and Nganda. Dominant breeds in the pig herds were Landrace (22.5 %), crosses between Landrace and undefined breeds (47.5 %), and indigenous breeds (10 %). The goat breeds kept were either indigenous breeds (56 %) or crosses between indigenous and undefined exotic breeds (48 %). Most of the respondents (78.8 %) reared exotic chicken breeds, out of which 18.2 % reared both exotic and local breeds. The cattle were primarily kept under four rearing systems: stall feeding/zero-grazing (69.6 %), tethering (30.4 %), communal herding (16.1 %) and free-roaming (3.6 %).

3.3 Constraints to livestock production

Respondents were asked to identify and rank (1st, 2nd, 3rd and 4th) four major constraints to cattle, pig and chicken production in urban and peri-urban areas of Kampala. Several constraints were mentioned (Tables 1, 2 and 3) of which feed scarcity, diseases, high cost of feeds, high cost of veterinary drugs and space limitation were the top ranked constraints. Pearson Chi-square tests of association indicated that there was a significant relationship ($\chi^2 = 44.76$; $P = 0.013$) between what farmers ranked as the first major constraint and type of livestock species reared. Cattle and pig farmers ranked feed scarcity as their first major constraint (Tables 1 and 2), while chicken farmers ranked it fourth with high cost of feeds as their first major constraint (Tables 3).

3.4 Coping strategies to feed scarcity

Respondents were asked to identify and rank (1st, 2nd and 3rd) three major coping strategies to the constraint of feed scarcity in urban and peri-urban areas of Kampala. Pearson Chi-square tests of association indicated that there was a significant relationship ($\chi^2 = 50.76$; $P < 0.001$) between what farmers ranked as their first major coping strategy and type of livestock species reared. The first major coping strategy for cattle and pig farmers was changing feed resources based on availability and cost, while chicken farmers had purchasing of feed ingredients in bulk as their first major coping strategy (Tables 4).

Table 1: *Constraints to cattle production in urban and peri-urban areas of Kampala.*

	Rank (no. of responses)				
Constraint	*1st*	*2nd*	*3rd*	*4th*	*Index **
Feed scarcity	9	5	2	2	0.213
Diseases	6	5	1	2	0.160
High cost of veterinary drugs	3	5	2	0	0.116
Conflicts with neighbours	5	0	1	2	0.090
Scarce and expensive labour	2	2	3	1	0.078
High cost of animal feeds	2	1	3	0	0.063
Manure handling/disposal	2	2	1	0	0.060
Climate risks/Adverse weather	1	2	2	0	0.052
Animal thefts	1	3	0	0	0.049
Space limitation	1	3	0	0	0.049
Lack of veterinarians	0	1	1	1	0.022
High cost of veterinarians	0	1	0	0	0.011
Others **	1	0	3	0	0.037
Total	33	30	19	8	1

* Index = (4 × Number of responses for 1st rank + 3 × Number of responses for 2nd rank + 2 × Number of responses for 3rd rank + 1 × Number of responses for 4th) ÷ (4 × Total responses for 1st rank + 3 × Total responses for 2nd rank + 2 × Total responses for 3rd rank + 1 × Total responses for 4th rank)

** Harassment by city authority officials, dishonest labourers, over-speeding vehicles, water shortage

Table 2: *Constraints to pig production in urban and peri-urban areas of Kampala.*

	Rank (no. of responses)				
Constraint	*1st*	*2nd*	*3rd*	*4th*	*Index **
Feed scarcity	8	7	4	0	0.367
Diseases	3	3	0	3	0.145
High cost of animal feeds	3	1	0	0	0.090
High cost of veterinary drugs	0	2	4	0	0.084
Space limitation	3	0	0	0	0.072
High cost of veterinarians	0	0	2	0	0.024
Nuisance smells	0	1	0	0	0.018
Lack of veterinarians	0	0	1	1	0.018
Animal thefts	0	0	0	1	0.006
Counterfeit veterinary drugs	0	0	0	1	0.006
Others **	3	4	2	0	0.169
Total	20	18	13	6	1

* Index = (4 × Number of responses for 1st rank + 3 × Number of responses for 2nd rank + 2 × Number of responses for 3rd rank + 1 × Number of responses for 4th) ÷ (4 × Total responses for 1st rank + 3 × Total responses for 2nd rank + 2 × Total responses for 3rd rank + 1 × Total responses for 4th rank)

** Inadequate housing structures, stray dogs, poor breeds, limited income

Table 3: *Constraints to chicken production in urban and peri-urban areas of Kampala.*

	Rank (no. of responses)				
Constraint	*1st*	*2nd*	*3rd*	*4th*	*Index **
High cost of animal feeds	8	4	5	0	0.247
Diseases	6	6	4	0	0.228
Poor quality of animal feeds	2	3	3	1	0.110
Feed scarcity	4	2	0	1	0.105
Low output prices	3	1	0	1	0.073
High cost of veterinary drugs	0	3	1	2	0.059
Animal thefts	0	1	2	0	0.032
Space limitation	0	1	1	0	0.023
Scarce and expensive labour	1	0	0	0	0.018
High cost of veterinarians	0	1	0	0	0.014
Others **	2	3	1	1	0.091
Total	25	16	11	4	1

* Index = (4 × Number of responses for 1st rank + 3 × Number of responses for 2nd rank + 2 × Number of responses for 3rd rank + 1 × Number of responses for 4th) ÷ (4 × Total responses for 1st rank + 3 × Total responses for 2nd rank + 2 × Total responses for 3rd rank + 1 × Total responses for 4th rank)

** Flooding, water shortage, high transportation costs, limited income

Table 4: *Coping strategies to feed scarcity in urban and peri-urban areas of Kampala.*

	Rank (no. of responses)			
Coping strategy	*1st*	*2nd*	*3rd*	*Index **
Cattle farmers:				
Change feed resources based on availability and cost	9	6	0	0.262
Harvest natural forages **	8	5	0	0.228
Grow forage/fodder on the available space on the farm	8	0	0	0.161
Use crop/food wastes ***	5	2	1	0.134
Reduce herd size	3	2	1	0.094
Rent land and grow fodder	1	2	0	0.047
Purchase forage	1	1	0	0.034
Conserve forage	0	0	3	0.020
Resort to free-roaming	0	1	0	0.013
Resort to communal herding	0	0	1	0.007
Total	35	19	6	1
Pig farmers:				
Change feed resources based on availability and cost	11	0	0	0.388
Use crop/food wastes ***	6	2	1	0.271
Reduce herd size	3	2	0	0.153
Purchase concentrate feeds in bulk	0	3	1	0.082
Harvest natural forages **	1	1	0	0.058
Grow fodder/forage on the available space on the farm	0	2	0	0.047
Total	21	10	2	1
Chicken farmers:				
Purchase concentrate feeds in bulk	15	2	0	0.500
Reduce herd size	4	1	0	0.143
Change feed resources based on availability and cost	2	1	2	0.102
Resort to free-roaming	3	0	0	0.092
Use crop/food wastes ***	1	2	1	0.082
Harvest natural forages **	0	2	0	0.041
Grow green forages on the available space on the farm	1	0	0	0.031
Avoid feed wastage	0	0	1	0.010
Total	26	8	4	1

* Index = (3 × Number of responses for 1st rank + 2 × Number of responses for 2nd rank + 1 × Number of responses for 3rd rank) ÷ (3 × Total responses for 1st rank + 2 × Total responses for 2nd rank + 1 × Total responses for 3rd rank)

** Grasses, legumes, weeds and shrubs obtained from cropping areas and open access lands (roadsides, undeveloped plots, wetlands/swamps etc.)

*** By-products generated during crop/food production, processing/preparation, marketing/distribution and consumption

Pearson Chi-square tests of association showed that there was no significant relationship ($P > 0.05$) between the coping strategies adopted by livestock farmers in urban and peri-urban areas of Kampala and respondent characteristics (gender, age, marital status, education level, whether one has ever undergone any form of livestock keeping training and years of residing at the current home) or farm characteristics (farming experience, whether one owns or rents the homestead, herd size and size of total landholding). Some of the coping strategies were short-term, while others were long-term, and the use of unconventional feed resources was a key component. Various unconventional feed resources were cited, of which banana peels, sweet potato vines and food leftovers were the most commonly used (Table 5).

Table 5: *Major unconventional feed resources in urban and peri-urban areas of Kampala.*

	Percentage of responses			
Feed resource	*Dairy cattle*	*Pigs*	*Chickens*	*Overall*
Banana peels	100.0	86.8	23.4	82.5
Sweet potato vines	34.5	39.5	2.1	29.2
Food leftovers	0.0	67.5	4.3	25.0
Sweet potato peels	13.8	26.3	0.0	15.8
Cassava peels	18.8	18.4	0.0	14.2
Local brew (Malwa) wastes	1.7	31.6	6.4	13.3
Brewer's waste	20.7	2.6	0.0	10.8
Cocoyam leaves *	0.0	9.3	5.4	6.7
Jackfruit wastes	8.6	5.3	0.0	5.8

* Both *Colocasia esculenta* and *Xanthosoma sagittifolium*

4 Discussion

The majority of the respondents were females. This result is in accordance with earlier studies (Muwanga, 2001; Nabulo *et al.*, 2004; Katongole *et al.*, 2011) on urban agriculture in Kampala. Muwanga (2001) estimated that 75 % of the persons involved in urban agriculture in Kampala are women. Cattle and pig farmers perceived feed scarcity as their first major constraint, while chicken farmers had high cost of feeds as their first major constraint. Feed scarcity was instead perceived as the fourth major constraint by chicken farmers. This is not surprising because chicken production largely depends on concentrate feeds, which are of high cost. In comparison, cattle and pig farmers, and cattle farmers in particular have a wider choice in terms of unconventional feed resources, which are relatively cheap. Farmers perceived disease as the second major constraint to the production of all the three livestock species (cattle, pigs and chickens). Thus, the present study has demonstrated that there is need to intensify animal disease control strategies in urban and peri-urban areas of Kampala.

Feed cost is often a major limiting factor in chicken production compared to the other livestock species. According to Walker & Gordon (2003), feed alone accounts for over 70 % of the variable costs of poultry production. This situation is accompanied by an increased competition between humans and chickens for the primary feed ingredients (especially maize, soybeans and fish), which makes them to be more scarce and expensive. Consequently, this has led to many of the chicken farmers in urban and peri-urban areas of Kampala to adopt feed cost-saving mechanisms, particularly own-feed formulation and mixing. Own-mixed feeds cost less than the commercial compound feeds, because feed manufacturers raise the price of their feeds in order to be able to pay their workers, maintain the feed mill and also make a profit, which is not the case when farmers mix their own feeds (Apantaku *et al.*, 2006). However, these own-mixed feeds have been reported to be nutritionally inadequate (Kasule, 2012), hence, resulting into decreased production efficiencies. Major reasons for the poor nutritional quality are the use of improper feed formulae (Ferris & Laker-Ojok, 2006; Nabukeera, 2011) and adulterated feed ingredients (MAAIF, 2005; UNBS, 2012). Much as a National Animal Feeds Policy exists, which aims at ensuring quality animal feeds on the market (MAAIF, 2005), it has never been implemented. The Animal Feeds Bill, which is supposed to operationalize the policy has never been passed. This is one of the major factors responsible for the poor and variable quality of animal feeds in Uganda. Strict policy interventions are necessary to protect farmers.

The practice of feeding animals on whatever feed resource that is locally available rather than relying solely on any particular feed resource/ingredient was found to be a very important strategy for coping with feed scarcity among farmers in urban and peri-urban areas of Kampala. As evidence of its importance, cattle and pig farmers ranked it as their first major coping strategy. In doing so, farmers did not restrict themselves to conventional animal feeds, but made the most of any locally available unconventional feed resource. Most of these unconventional feed resources may apparently be poor in supplying the nutrients required for production, but they are the only feed resources available. When smallholder farmers in developing countries are faced with limited resource availability for feeding livestock they use whatever is locally available to them, at either no or low cost (Jayasuriya, 2002). They do not select the basal diet according to the nutrient requirements (Chermiti *et al.*, 1996).

Selling was the major form of herd reduction reported by farmers in urban and peri-urban areas of Kampala. The other forms of herd reduction mentioned were relocating animals to the countryside and slaughtering for family consumption. When livestock survival is threatened by different stress factors (climate risks, feed scarcity, ill health etc.) destocking is the obvious first action (Salem & Smith, 2008). However, destocking may represent an economic stress, particularly when farmers are forced to sell off young and productive animals (Bailey *et al.*, 1999). Consequently, farmers should always destock profitably (Rothauge, 2000). Farmers should not wait until the animals lose condition to sell them off. The best practice would be to sell off the stock in good time (as soon as the farmer notices any indicators of any stress factor) when the animals are still in a better marketable condition and can fetch a fair price.

Secondly, when farmers hold on to their livestock for too long they end up selling at a time when every farmer is selling. The market gets saturated, which makes it much more difficult for farmers to get a fair price (Campbell *et al.*, 2000). The farmers interviewed in this study, still clearly recalled what happened at the beginning of 2011 when Uganda was hit by a shortage of maize bran (a major feed ingredient in chicken rations). Besides being scarce, maize bran prices were reported to have increased by 200 % (Nantaba, 2011). The scarcity of maize bran was attributed to the exportation of unprocessed maize to neighbouring countries, particularly Kenya and South Sudan. Many farmers were forced to sell off their chickens (including immature ones) to stave off losses. Oversupply forced the chicken market to hit record low prices, which made farmers suffer huge losses. Several respondents told us that this was the main reason why many of their fellow chicken farmers were still out of business (they hadn't restocked) at the time of this study.

Each time chicken farmers predict a period of feed shortage; they purchase feed ingredients in bulk and stock them for use during periods of scarcity. This practice was ranked as the first major strategy for coping with feed scarcity by chicken farmers in urban and peri-urban areas of Kampala. Pig farmers ranked it as their fourth major strategy for coping with feed scarcity. However, the strategy of purchasing feeds in bulk has financial implications, hence, can only be adopted by farmers who are financially strong. Nevertheless, buying in bulk saves money. Another major limitation to this coping strategy is the lack of adequate storage facilities.

Although not among the top ranked coping strategies, purchasing of forage plays a role in ensuring feed supply to dairy cattle in urban and peri-urban areas of Kampala. The bulk of the purchased forage was from some enterprising people who harvest natural forages from open access lands (roadsides, undeveloped plots, wetlands/swamps etc.) and sell to farmers. However, there are concerns over the safety of forages harvested from open access lands. They are associated with the risk of tick-borne diseases and parasites (Okuthe & Buyu, 2006; Rubaire-Akiiki *et al.*, 2006). It is also a common practice for dairy cattle farmers in urban and peri-urban areas of Kampala to purchase brewer's waste as a strategy for coping with feed scarcity. However, the use of brewer's waste is restricted by its high demand and transport. According to Urio (1987), it is only the farmers with transport and "contacts" that are able to use brewer's waste for feeding their dairy cattle.

The practice of harvesting natural forages from open access lands (roadsides, undeveloped plots, wetlands/swamps etc.) is an important strategy for coping with feed scarcity among dairy cattle farmers in urban and peri-urban areas of Kampala. Dairy cattle farmers ranked it as their second major coping strategy. However, as was discussed earlier, such forages harvested from open access lands have been associated with the risk of tick-borne diseases and parasites. For the reason that there is free and open access to these forages, herdsmen also graze their cattle from there. Hence, the tick challenge on these lands is high. When farmers harvest the forages, ticks are transported unintentionally together with the harvested forages and introduced to their farms. It is chiefly because of this risk that some farmers don't use forages harvested from such open access lands.

Additionally, some enterprising people in and around Kampala claim the ownership of these naturally growing forages and sell them to livestock farmers, which would otherwise be obtained for free. Besides having to pay a fee for such forages, this practice has both labour and transport cost implications (Lukuyu *et al.*, 2011). These forages are not fed to the animals at the point of collection, but they are cut and carried to the animals, hence the need for labour and transport. The other challenge to the use of such forages is that their availability is continuing to decline. The major reason for their declining availability is that lots of open access lands in urban and peri-urban areas of Kampala are undergoing infrastructural development (Lwasa, 2004).

The practice of feeding animals on crop/food wastes was found to be a very important strategy for coping with feed scarcity, particularly among pig and dairy cattle farmers in urban and peri-urban areas of Kampala. However, most of these crop/food wastes are not obtained for free; some enterprising people (waste pickers) collect and sell them to livestock farmers (Katongole *et al.*, 2011). These wastes are composed of by-products generated during crop/food production

(agricultural residues after harvesting crops), processing/preparation (peelings, leaves and stalks), marketing/distribution (market crop wastes) and consumption (food leftovers). Chicken farmers dilute compound feeds with banana peels, as a cost saving strategy. However, nutritional concerns (low palatability due to tannins and high fibre content) limit the inclusion of banana peels at high levels in poultry diets (Sonaiya, 1995). The predominance of banana peels is attributed to their abundant supply. Banana is a basic staple food for many people in Kampala.

The use of food leftovers as pig feed is popular in urban and peri-urban areas of Kampala. Food leftovers are obtained from homesteads, markets, restaurants/hotels, schools, food processing plants, waste dumpsites etc. However, there are concerns about the risks of physical (plastic, metallic, glass and ceramic objects) and microbial contaminants. Food leftovers require that they are safely treated (sorted and heated) prior to being fed to the pigs. Besides reducing the risk of foreign animal diseases (hog cholera, foot and mouth disease, African swine fever etc.), heating helps to eliminate any other harmful pathogens (salmonella, campylobacter etc.), which can even be spread to humans. It is for such health and safety reasons that some countries have banned the feeding of food wastes to pigs (Myer *et al.*, 1999). Additionally, many such food wastes are not stable because of high moisture content and contain high levels of soluble organic compounds that contribute to the growth of undesirable micro-organisms with concomitant production of noxious odours (Peterson *et al.*, 2004). The other issue of concern about food leftovers is the fact that most of the food wastes are collected off the farms. This practice has cost implications in terms of acquisition, transportation (depending on distance) and labour involved. Additionally, when these wastes are delivered to the farms they are not subjected to proper storage, which results in their further deterioration in quality.

The growing of forage/fodder (grasses, legumes and multipurpose tree species) is an important strategy for coping with feed scarcity among dairy cattle farmers in urban and peri-urban areas of Kampala. They ranked it as their third major strategy for coping with feed scarcity. Although this strategy is well known to have several advantages, small landholding sizes limit its adoption. The dairy cattle farmers who had planted forage/fodder on their farms were mostly those who operated on relatively larger landholdings (above 0.25 acres). However, some dairy cattle farmers rented land to grow forage/fodder. Additionally, the high population increase in Kampala has resulted into an increased demand for housing (Nyakaana *et al.*, 2007). Hence, the small land areas available are taken away from the planting of forage/fodder in favour of constructing rental houses for better income generation. Besides, the small available lands are preferably used for food crops rather than forage/fodder growing.

The growing of forage was also an important strategy for coping with feed scarcity among pig farmers in urban and peri-urban areas of Kampala with sweet potato and cocoyam (*Colocasia esculenta*) as the most commonly grown forage crops. Pig farmers planted sweet potatoes in the backyard for both tuber and forage purposes. Sweet potato is a well known feed crop with a high yield of both tuber and vines, and with good nutritional properties (An *et al.*, 2003).

Whereas forage conservation in form of either silage or hay is a well known, convenient and economical way of ensuring regular feed availability, only three respondents reported having adopted silage making as a strategy for coping with feed scarcity. No respondent mentioned hay making. The main reason farmers cited for not conserving forage was the lack of knowledge. It was interesting to note that the concept of feed conservation seemed entirely new to most of the farmers. This presents an area for further research.

Sometimes farmers let their animals roam free as a strategy for coping with feed scarcity. This was an important strategy among chicken farmers, particularly those rearing cockerel broilers and local chickens. During day time the birds are allowed to roam freely close to the homestead and they are confined during the night. The birds scavenge food leftovers, insects, worms, crop residues, green forages and grains. One advantage with this system is that there is a general preference for chicken products kept under free-range conditions, particularly eggs due to their dark yellow yolks (Abdelqader *et al.*, 2007). However, under free-roaming conditions, chickens are exposed to various threats ranging from predation, theft, diseases and cold or heat stress (Muchadeyi *et al.*, 2004; Abdelqader *et al.*, 2007).

A few dairy cattle farmers in urban and peri-urban areas of Kampala resort to communal herding when faced with feed scarcity. Under this system a herder is paid (either on a daily or monthly basis) to graze several herds on open access lands (roadsides, undeveloped plots, wetlands/swamps etc.). In urban and peri-urban areas, there are less communal herding lands compared to the rural areas, implying that all the cattle in a given locality have access to the same grazing field. This makes close interaction between the herds very common, which promotes tick infestation between individual animals and herds especially where relatively poor tick control is practiced (Nansen *et al.*, 1990; Okuthe & Buyu, 2006). In systems where cattle are grazed on common land, cattle owners are discouraged from regularly treating their cattle against ticks when they know

that their cattle will come into contact with other cattle that have not been treated (Pearson & Krecek, 2006).

Additionally, due to rapid urbanization lots of open access lands in Kampala are being exchanged for infrastructural development (Lwasa, 2004), implying that the size of communal herding areas in Kampala is diminishing from time to time. Besides, the Local Governments (Kampala City) (Livestock and Companion Animals) Ordinance of 2006 prohibits grazing of any animal in road reserves, public parks and gazetted greenbelts. Quite often, Kampala Capital City Authority (KCCA) officials enforce this Ordinance and impound all communally herded cattle in the city. A fee is levied upon the owner of each impounded animal. However, majority of the urban livestock farmers are not aware of this Ordinance they instead complain of harassment by KCCA officials.

5 Conclusions and recommendations

This study shows that feed scarcity is a major challenge to livestock farmers in urban and peri-urban areas of Kampala. Livestock farmers have adopted several strategies for coping with feed scarcity with changing of feed resources based on availability and cost, purchasing of feed ingredients in bulk, using of crop/food wastes, reducing herd size and harvesting of forages growing naturally in open access lands as the major coping strategies. However, these coping strategies are largely aimed at dealing with the perennial challenge of feed scarcity on a day-by-day basis, and hence, not sustainable. In view of this, farmers should be encouraged to adopt coping strategies that can deal with the perennial challenge of feed scarcity more sustainably.

Acknowledgement

The authors gratefully acknowledge the Government of Sweden (through its Ministry of Foreign Affairs) for funding the study. We also acknowledge the farmers in Kampala for their participation.

References

Abdelqader, A., Wollny, C. B. A. & Gauly, M. (2007). Characterization of local chicken production systems and their potential under different levels of management practice in Jordan. *Tropical Animal Health and Production*, 39 (3), 155–164.

An, L. V., Frankow-Lindberg, B. E. & Lindberg, J. E. (2003). Effect of harvesting interval and defoliation on yield and chemical composition of leaves, stems and tubers of sweetpotato (*Ipomoea batatas* L. (Lam.)) plant parts. *Field Crops Research*, 82 (1), 49—58.

Apantaku, S. O., Oluwalana, E. O. A. & Adepegba, O. A. (2006). Poultry farmers' preference and use of commercial and self-compounded feeds in Oyo area of Oyo State, Nigeria. *Agriculture and Human Values*, 23, 245—252.

Bailey, D., Barrett, C. B., Little, P. D. & Chabari, F. (1999). Livestock markets and risk management among East African pastoralists: A review and research agenda. Available online. URL `http://papers.ssrn.com/sol3/papers.cfm?abstract_id=258370` last accessed September 2012.

Campbell, B. M., Dore, D., Luckert, M., Mukamuri, B. & Gambiza, J. (2000). Economic comparisons of livestock production in communal grazing lands in Zimbabwe. *Ecological Economics*, 33 (3), 413–438.

Chermiti, A., Nefzaoui, A., Teller, E., Vanbelle, M., Ferchichi, H. & Rokbani, N. (1996). Prediction of the voluntary intake of low quality roughages by sheep from chemical composition and ruminal degradation characteristics. *Animal Science*, 62, 57–62.

Ferris, S. & Laker-Ojok, R. (2006). Growth prospects for services within selected agricultural sectors in Uganda. CIAT Africa, Kampala, Uganda. Available online. URL `http://www.devas.dk/Uganda/Ugrowth/agribusiness/Agric-sector-growth-prospects-0906.pdf` last accessed November 2012.

Ishagi, N., Ossiya, S., Aliguma, L. & Aisu, C. (2002). Urban and Peri-urban livestock keeping in Kampala City. Ibaren Konsultants, Kampala, Uganda. Available online. URL `http://www.dfid.gov.uk/r4d/PDF/Outputs/ZC0201e.pdf` last accessed November 2012.

Jayasuriya, M. C. N. (2002). Principles of ration formulation for ruminants. In International Atomic Energy Agency IAEA (Ed.), *Development and field evaluation of animal feed supplementation packages. Proceedings of the final review meeting of an IAEA Technical Co-operation Regional AFRA Project organized by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and held in Cairo, Egypt, 25–29 November 2000. IAEA-TECDOC-1294* (pp. 9–14). International Atomic Energy Agency. Vienna, Austria. Last accessed November 2012.

Kasule, L. (2012). Nutritional properties of own-mixed chicken rations in urban/peri-urban areas of Kampala.

BSc. Agriculture – Special project report; Makerere University, Kampala, Uganda.

Katongole, C. B. (2009). *Developing rations for meat goats based on some urban market crop wastes*. Ph.D. thesis Makerere University, Kampala, Uganda.

Katongole, C. B., Sabiiti, E., Bareeba, F. & Ledin, I. (2011). Utilization of market crop wastes as animal feed in urban and peri-urban livestock production in Uganda. *Journal of Sustainable Agriculture*, 35 (3), 329–342.

Lukuyu, B., Franzel, S., Ongadi, P. M. & Duncan, A. J. (2011). Livestock feed resources: Current production and management practices in central and Northern Rift Valley provinces of Kenya. *Livestock Research for Rural Development*, 23 (5). Last accessed September 2012 URL `http://www.lrrd.org/lrrd23/5/luku23112.htm`.

Lwasa, S. (2004). Urban Expansion Processes of Kampala in Uganda: Perspectives on contrasts with cities of developed countries. Urban Expansion: The Environmental and Health Dimensions, Cyberseminar, Population-Environment Research Network (PERN).

MAAIF (2005). The National Animal Feeds Policy. Ministry of Agriculture, Animal Industry and Fisheries, Entebbe, Uganda. URL `http://www.igad-data.org/index.php?option=com_docman&task=doc_download&gid=1341&Itemid=46` last accessed November 2012.

Muchadeyi, F. C., Sibanda, S., Kusina, N. T., Kusina, J. & Makuza, S. (2004). The village chicken production system in Rushinga District of Zimbabwe. *Livestock Research for Rural Development*, 16 (6). Last accessed September 2012 URL `http://www.lrrd.org/lrrd16/6/much16040.htm`.

Muwanga, J. (2001). *Informal food markets, household food provisioning and consumption pattern among the urban poor. A study of Nakawa Division, Kampala city*. Master's thesis Makerere University, Kampala, Uganda.

Myer, R. O., Brendemuhl, J. H. & Johnson, D. D. (1999). Evaluation of dehydrated restaurant food waste products as feedstuffs for finishing pigs. *Journal of Animal Science*, 77, 685–692.

Nabukeera, R. (2011). Benefits and risks of farm made feeds: a farm manager's experience. Presentation to the 'Fourth Annual Fish Farmers Symposium and Trade Fair', Kampala, Uganda.

Nabulo, G., Nasinyama, G., Lee-Smith, D. & D., C. (2004). Gender analysis of urban agriculture in Kampala, Uganda. *Urban Agriculture Magazine*, 12, 32–33.

Nansen, P., Steffan, P., Monrad, J., Grønvold, J. & Henriksen, S. A. (1990). Effects of separate and mixed grazing on trichostrongylosis in first- and second-season grazing calves. *Veterinary Parasitology*, 36 (3-4), 265–276.

Nantaba, E. (2011). Uganda poultry feeds prices drop. Business Week. URL `http://www.busiweek.com/index.php?option=com_content&view=article&id=1447` last accessed November 2012.

Nyakaana, J. B., Sengendo, H. & Lwasa, S. (2007). Population, urban development and the environment in Uganda: the case of Kampala city and its environs. Faculty of Arts, Makerere University, Kampala, Uganda.

Nyapendi, R., Kaganzi, R. & Best, R. (2004). Identifying market opportunities for Kampala's urban and peri-urban farmers. Centro Internacional de AgriculturaTropical (CIAT), Kampala, Uganda. CIAT in Africa, No. 12.

Okuthe, O. S. & Buyu, G. E. (2006). Prevalence and incidence of tick-borne diseases in smallholder farming systems in the western-Kenya highlands. *Veterinary Parastology*, 141, 307—312.

Pearson, R. A. & Krecek, R. C. (2006). Delivery of health and husbandry improvements to working animals in Africa. *Tropical Animal Health and Production*, 38 (2), 93—101.

Peterson, B. V., Hummerick, M., Roberts, M. S., Krumins, V., Kish, A. L., Garland, J. L., Maxwell, S. & Mills, A. (2004). Characterization of microbial and chemical composition of shuttle wet waste with permanent gas and volatile organic compound analyses. *Advances in Space Research*, 34 (7), 1470–1476.

Rothauge, A. (2000). New ecological perception of Arid Rangelands. *Agricola*, 11, 4–56.

Rubaire-Akiiki, C. M., Okello-Onen, J., Musunga, D., Kabagambe, E. K., Vaarst, M., Okello, D., Opolot, C., Bisagaya, A., Okori, C., Bisagati, C., Ongyera, S. & Mwayi, M. T. (2006). Effect of agro-ecological zone and grazing system on incidence of East Coast Fever in calves in Mbale and Sironko Districts of Eastern Uganda. *Preventive Veterinary Medicine*, 75, 251–266.

Salem, H. B. & Smith, T. (2008). Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Research*, 77, 174–194.

Sonaiya, E. B. (1995). Feed resources for smallholder poultry in Nigeria. *World animal review*, 82, 25–33.

Thornton, P. K. (2010). Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365, 2853–2867.

UNBS (2012). UNBS on drive to eliminate substandard poultry feeds on the Market. Uganda National Bu-

reau of Standards, Kampala, Uganda. URL http://www.unbs.go.ug/news.php?id=30 last accessed November 2012.

Urio, N. A. (1987). Feed resources for dairy farmers in Kilimanjaro, Tanzania. In J. A. Kategile, A. N. Said, & B. H. Dzowela (Eds.), *Animal Feed Resources for Small-scale Livestock Producers* (pp. 167–173). ILCA, Addis Ababa.

Van Veenhuizen, R. (2006). Cities farming for the future. Urban agriculture for green and productive cities. RUAF Foundation, IDRC, Ottawa. URL http://doc.abhatoo.net.ma/doc/img/pdf/Cities_Farming_for_the_Future.pdf last accessed November 2012.

Walker, A. & Gordon, S. (2003). Intake of nutrients from pasture by poultry. *Proceedings of the Nutrition Society*, 62, 253–256.