academicJournals

Vol. 6(1), pp 1-7 January 2015
DOI: 10.5897/IJLP2014.0223
Article Number: A91374249996
ISSN 2141-2448

http://www.academicjournals.org/IJLP

International Journal of Livestock Production

Full Length Research Paper

Analysis of performance, management practices and challenges to intensive pig farming in peri-urban Kampala, Uganda

Okello, Emmanuel[1,2,3], Amonya, Collins[3,4], Okwee-Acai, James[3], Erume, Joseph[3] and De Greve, Henri[1,2]*

[1]Structural and Molecular Microbiology, Structural Biology Research Center, VIB, Pleinlaan 2, 1050 Brussels, Belgium.
[2]Structural Biology Brussels, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium.
[3]College of Veterinary Medicine, Animal Resources and Bio-security, Makerere University, P.O. Box 7062, Kampala, Uganda.
[4]National Agricultural Advisory Services, Tororo District, P. O. Box 25235, Kampala, Uganda.

Received 11 August, 2014; Accepted 12 January, 2015

Uganda is currently among the largest per capita consumers of pork in sub Saharan Africa. Most of this pork is consumed in "pork joints" in Kampala and other major urban centers in the country. However, the current productivity is low and cannot meet the soaring demand for pork. No information was previously available on the performance productivity of intensive piggeries in Uganda. This study was aimed at assessing the performance, factors affecting productivity and challenges to intensive pig farming in peri-urban Kampala. Production parameters were captured from purposively selected 332 sows and 521 grower pigs. Information on management practices, challenges and prospects of the industry was gathered through questionnaires administered to farmers, key informant interviews and stakeholder's focus group discussions. Results showed most farms had good level of management but the breeding practices were uniformly erratic in all the farms, and different breeds were crossed anyhow. Furthermore both reproduction and performance parameters were suboptimal. Analysis of management practices revealed that breed had a significant effect on growth performance ($p < 0.001$) and litter size ($p < 0.005$). Feeding had significant effects on litter size ($p < 0.001$), number weaned ($p < 0.01$), weight:age ratio ($p < 0.05$) and weaning to service interval ($p < 0.05$). The major constraints found were high feed costs, diseases and competition for land with the upcoming residential estates. The performance indices varied greatly between farms, indicating great potential for improved productivity. We recommend improved housing, breeding practices, feeding and biosecurity measures so as to improve on performance and productivity of peri-urban pig farming.

Key words: Peri-urban farming, pig production, performance indices, management systems, challenges.

INTRODUCTION

Peri-urban agriculture is an important economic activity in many sub-Saharan cities of Africa contributing significantly to the urban food supply, and is a source of livelihood for many households (Olufunke et al., 2003; Foeken and Owuor, 2008). In Uganda, peri-urban agriculture has become part of the development agenda and currently contributes up to half of total food consumed in Kampala (Makita 2009).

Poultry and pigs are the two main livestock species kept, followed by small ruminants and cattle (Maxwell, 1995; Makita 2009). The last livestock census report by UBOS (2009) estimated the domestic pig population in Uganda at 3.2 million heads, and the highest pig density was shown to be in peri-urban Kampala. In Africa, Uganda was ranked the third highest pig producer after South Africa and Nigeria, with estimated total annual production of 115000 tones of pork (FAOSTAT, 2012). In parallel, Uganda is also among the largest consumers of pig meat in sub-Saharan Africa with estimated per capita consumption of 3.4 kg/person/year (FAOSTAT, 2012). Most of this pork is consumed in "pork joints" in Kampala and other major urban centers in the country. However, the current production level is still low and the demand for pork and its products exceeds supply. This deficit is currently covered by imports majorly from Kenya and South Africa (FAOSTAT, 2011).

Productivity in piggery is measured by reproduction and growth performance, and these are influenced by genetic factors (Te Pas et al., 1999; Rehfeldt and Kuhn, 2006), feeding (Clawson et al., 1962; Wondra et al., 1995), environmental conditions (Prunier et al., 1997; Turner et al., 2000) and management practices such as lactation length (Xue et al., 1993), weaning age (Main et al., 2004) and parasite burden (Sykes, 1994). Productivity in breeding herds is measured by piglets weaned per female per year (PWFY), and is determined by indices such as litters per female per year (LFY), farrowing rate (FRATE), culling rate (CULLR), inter-farrowing interval (IFI), weaning-to-service interval (WTSI), number of piglets born alive (PBA) and pre-weaning piglet mortality (PWM) as defined by Stein et al. (1990). In finishing herds however, average daily weight gain (DWG) and weight:age ratio (WT/AGE) are the most important measures of productivity. These indices are influenced by a complex interplay of managerial, environmental and genetic factors (Tantasuparuk et al., 2000; De Grau et al., 2005; Kennedy and Moxley, 2010).

The performance of the local, exotic and crossbred pigs under the intensive system of production in peri-urban Kampala had not been previously reported. In this study, we assessed the performance of pig enterprises in peri-urban Kampala and identified key factors affecting productivity. The results of the study provide valuable information in understanding the sector and will guide in designing strategies for improved productivity.

MATERIALS AND METHODS

Study area

The study was carried out on intensive pig farms in peri-urban Kampala, the capital city of Uganda. Intensive pig farming was defined as a management system where pigs were kept in total confinement in pigpens and feeding was majorly based on commercial feedstuff. Kampala is an independent administrative district located on the northern shores of Lake Victoria, Central Uganda. Peri-urban Kampala referred to the rural-urban transition zone adjoining the capital district. The detailed spatial distribution and socio-economic characterization of this area was previously described by Makita et al. (2010). Both crop and livestock faming are integral part of the economic activities in the area.

Study design

In this study, a cross-sectional field survey on intensive pig farms was conducted by stratified purposive sampling method. In the first stage, four town councils within peri-urban Kampala with the highest number of pig farms were selected. All the town councils were within a distance of 5 to 20 km from the borders of the city. A sample population of 346 intensive pig farms in the four town councils was established from available council records with the help of veterinary extension workers, from which 90 farms were sampled. Sample size determination was based on the table proposed by Bartlett et al. (2001) for continuous data (t=1.96, alpha=0.5, margin of error=0.03). Distribution of the farms among the town councils was as follows; Wakiso 18, Nangabo 20, Nansana 14 and 38 from Kira town council. The number of farms per town council was calculated based on sample population proportions. All sampled farms met the following criteria; farm had ≥5 sows, kept records and the farmer was willing to participate in the survey. Selected farms that did not meet the criteria were replaced. From each farm, information on husbandry practices, production indices, herd health/other challenges, and demographic characteristics of the respondents was collected using a semi-structured questionnaire. The questionnaires were pre-tested on 10 intensive pig farmers in Tororo District of Uganda that is located outside peri-urban Kampala. Since most farmers kept only partial records, a data capture form was designed to record information on breed, parity, age of sows, litter size, number born alive, number born dead, preweaning mortality, interfarrowing interval, weaning to service interval and age at weaning. Pre-weaning mortality was calculated from the percent ratio of piglets dead preweaning to piglets born alive. Breed types were determined from records and physical examination for characteristic features. Growth performance was estimated from a maximum of 15 randomly selected grower pigs per farm by taking weights and information on their ages from existing records or verbal history. Fifteen grower pigs were estimated as 30% of the average minimum number of grower pigs per sampled farm. Weighing was performed using sacs attached to a calibrated spring balance. Additional information on management practices such as feeding and parasite control, and challenges to production were collected through questionnaires, physical farm inspection, key informant (extension workers) interviews, and stakeholders' focus group discussions. The parasite control was categorized as: (a) Routinely every 3 months; (b) Every 6 months or (c) Seldom, when done after more than one year.

Data analysis

Data was coded and entered into excel spreadsheets and descriptive statistics were performed. Additional analysis was

*Corresponding author. E-mail: hdegreve@vub.ac.be. Tel: +32 26291929. Fax: +32 2 6291981

performed using SPSS 22.0 software. The effects of management practices on the production parameters (indices) were determined using ANOVA statistics. P-values <0.05 were considered significant.

RESULTS

Characteristics of pig farming in peri-urban Kampala

Intensive pig farming in peri-urban Kampala was found to be a secondary activity for most respondents, and 46.7% (n=42) were civil servants. Only 27.8% (n=25) of the respondents were engaged in farming as primary activity. The majority of the farmers (78.9%, n=71) mentioned income generation as the reason for keeping pigs, while 15.6% (n=14) kept pigs for security and 5.6% (n=5) for traditional/cultural reasons. The sampled population comprised of 4 different types of farm enterprises: Farrow to weaner, 28.9% (n=26); farrow to finisher, 18.9% (n=17); weaner to finisher, 6.7% (n=6); and mixed enterprises (two or three previous types), 45.6% (n=41). The herd sizes and breeds kept by farmers were as summarized in Table 1. The majority of the farms (46.7%) had small herd sizes of less than 50 pigs, and Large White was the predominant breed reared on 40% of the sampled farms.

Table 1. Pig herd sizes and breeds kept by farmers in peri-urban Kampala.

Property	Frequency (Farms)	Percentage
Herd size		
< 50	42	46.7
51-100	25	27.7
101-200	14	15.5
201-300	6	6.7
> 300	3	3.3
Breeds		
Large White	36	40.0
Landrace	1	1.1
Camborough	14	15.6
Crosses[a]	30	33.3
Local breeds	9	10.0

[a]Crosses were offsprings from parents of different breeds listed.

Management types

The level of management on different farms was classified into 3 categories (above average, average and below average) based on the feeding systems, housing types and herd health practices. Under above average management, the pigs were housed in leak proof, hygienic (highly clean) and well ventilated houses with concrete or wooden floor above ground level and was cleaned daily. Feed types included commercial feeds, farm by-products and crop residues, and the pigs were dewormed routinely every three months. In average management, the pigs were housed in leak proof, well ventilated houses with moderate hygienic conditions, concrete floor or wooden floor above ground level and cleaned occassionally. Pigs were fed on variety of feeds including maize bran, rice bran, brewers waste and crop residues. Pigs under average management were also exposed to deworming routine of 6 months interval and ectoparasites were only occassionally controlled. In the below average management category, the pigs were housed in poor hygienic sheds with leaking roofs, poor ventilation and seldom cleaned. Feeds were provided erratically and comprised of locally available feed stuffs such as rice bran and crop market wastes comprised majorly of banana peelings, cabbage leaves and sweet potatoes vines. Under this system, ecto and endo parasite control was seldomly practiced. The majority of the farms kept pigs under average level of management conditions (46.6%, n=42), this was followed by farms that kept pigs under above average management conditions (34.4%, n=31), while 18.8% farms were under below average management.

Table 2. Breeding methods practiced by farmers in peri-urban Kampala.

Method	Frequency (Farms)	Percentage
Criss-crossing[a]	44	48.9
Terminal crossing[a]	12	13.3
Random breeding[a]	34	37.8
Total	90	100.0

[a]Criss-crossing refers crossing of two or more breeds and alternately mating the F1 females with males of the parent breeds. In terminal crossing, specialized damn and sire parent breed are mated to produce F1 slaughter progeny. In random mating, no specific breeding scheme is followed.

Breeding practices

Criss-crossing, the alternate reciprocal mating of F1 generation with the parent breeds, was the most widespread breeding scheme adopted by 48.9% of the farmers, followed by random breeding (37.8%) and terminal crossing was least practiced (Table 2). Criss-crossing involved crossing Large White with either Camborough or Landrace and alternate mating of the crossbred female with the parent breed. Breeding boars were kept on a farm for either 1-2 years (24.4%), 3-4 years (46.7%) or until they were unable to serve (28.8%). Average life span of a breeding sow was 5-8 years on most farms, and age at first service ranged from ≤ 10 months (61.1%), 10-12 months (27.8%) or >12 months in

Table 3. Mean reproductive performance indices (with standard deviations in parentheses) of the different pig breeds on farms in peri-urban Kampala (n=90 farms).

Breeds	Reproductive indices										
	Litter size	Litter number	Parity	Number born alive	Number born dead	Number weaned	Pre-weaning mortality	Farrowing index	Weaning to service interval (Days)	Inter-farrowing interval (Days)	Age at weaning (Days)
Large White	10.6(4.1)	258	3.1(2.1)	9.9(3.7)	0.7(1.3)	8.2(2.9)	1.7(1.5)	1.8(0.2)	47.1(4.3)	214.2(29.8)	53.4(8.6)
Landrace	11.5(3.0)	6	2.5(0.8)	10.7(3.01)	0.8(1.6)	8.8(1.8)	1.8(2.1)	1.8(0.2)	38.3(19)	199.8(17.1)	50(6.3)
Camborough	11.7(3.3)	94	2.27(1.3)	10.9(2.8)	0.8(1.1)	9.0(2.4)	1.9(1.5)	1.8(0.2)	53(34.2)	222.2(32.6)	57.5(9.3)
Crosses	9.4(3.1)	190	1.5(0.9)	8.9(2.6)	0.5(1.1)	7.3(2.6)	1.6(1.7)	1.8(0.2)	56.2(27.3)	223.2(32.2)	53.9(8.9)
Local breeds	8.1(4.1)	29	1.9(1.1)	8(2.3)	0.7(0.3)	6.8(1.8)	1.2(1.2)	1.7(0.1)	54.8(19.8)	226.9(23.5)	60.1(11.6)
Average	10.5(3.9)	na	2.6(1.9)	9.8(3.4)	0.7(1.2)	8.2(2.8)	1.7(1.5)	1.8(0.2)	49.9(26.9)	217.5(30.6)	54.5(9.1)
Benchmark indices	>11.5[a]	na	na	11-12[a]	<0.2[a]	>9.5[a]	<1.4[a]	2.4[a]	<7[a]	144	28[a]

[a]Althouse (2011). Litter number included repetitive measures for multiparous sows.

the rest of the farms. In all the farms, natural service was sole breeding method practiced.

Health management

The principle health management practices comprised of endo and ecto parasite control, and bio-security measures. Most farmers carried out ecto and endo parasite control at an interval of 2 weeks (34.4%) and 3 months (46.6%), respectively. However, a considerable number of respondent farms reported to have carried out ecto parasite control (27.8%) and endo parasite control (24.4%) only when they saw the parasites or when the pigs were sick.

Biosecurity measures were in place in 63.3% (n=57) of the respondent farms whereas the rest had not instituted any form of biosecurity practices. The most common biosecurity practice in use by farmers was restricted access to their farms, fencing and less frequently footbaths. It was also noted that replacement stock often came from a variety of sources of unknown health status with no quarantine before entry.

Pig production

Reproductive performance

The average reproductive performance was computed from the data from 332 sows that were distributed over the 90 farms. The computed indices are summarized in Table 3. Average litter size and number of piglets born alive were 10.53 ± 3.91 and 9.84 ± 3.39, respectively. Camborough had the highest number of piglets of (11.7 ± 3.3), followed by Landrace (11.5 ± 3.0), Large White (10.6 ± 4.1), crosses (9.4 ± 3.1) and lastly the local breeds (8.1 ± 4.1). The results also indicate that on average 8.19 ± 2.77 piglets were weaned per litter representing a 16.3% pre-weaning mortality. Farrowing index of 1.8 ± 0.2 was consistent among all breeds except for the local pigs which was slightly lower (1.7). Average weaning age was computed at 54.5 ± 9.1 days, with Landrace having lowest weaning age of 50 ± 6.3 closely followed by Large White (53.4 ± 8.6), crosses (53.9 ± 8.9), Camborough (57.5 ± 9.3) and the local pigs had the highest weaning age of 60.1 ± 11.6. The average weaning to service interval was 49.9 ± 26.9 days but varied widely among the different breeds being shortest in Landrace (38.3 ± 19), and longest among the crosses (56.2 ± 27.3). The average inter-farrowing interval (IFI) was 217.5 ± 30.64 days. Landrace had the shortest IFI (199.8 ± 17.73), followed by Large White (214.2), Camborough (222.16), crosses (223.18) and the local pigs (226.86).

Performance of the grower/fattener pigs

The growth performance indices (Table 4) were computed from randomly selected 521 grower pigs from the respondent farms. The overall recorded weight:age ratio was 6.4 ± 1.2. The results indicate that Camborough had the highest recorded weight:age ratio of 6.5 ± 1.0 meaning that on average, a grower/ fattener Camborough pig adds on 6.5 kg per month and this was closely followed by Large White at 6.4 kg per month, Landrace (5.5 kg/month) and lastly local breeds (5.1 kg/month).

Effect of management on performance indices

The effect of management on the performance

Table 4. Growth performance estimates of grower pigs (with standard deviations in parentheses) from peri-urban farms in Kampala-Uganda.

Breed	Growth performance indices(n=90 farms)		
	Average age (Mo.)	Average weight (Kg)	Weight:Age (Kg/Mo.)
Large White	6.4(2.4)	41.7(17.9)	6.4(1.2)
Landrace	4.5(0.2)	24.8(2.4)	5.5(0.3)
Camborough	6.7(3.4)	43.0(20.8)	6.5(1.0)
Crosses	5.3(1.4)	35.7(12.5)	6.7(1.0)
Local breeds	5.6(0.1)	28.2(3.3)	5.1(0.4)
Average	6.1(2.1)	39.6(17.1)	6.4(1.2)
Reference[a]	5.3	106	20

[a]Dunshea et al. (2003).

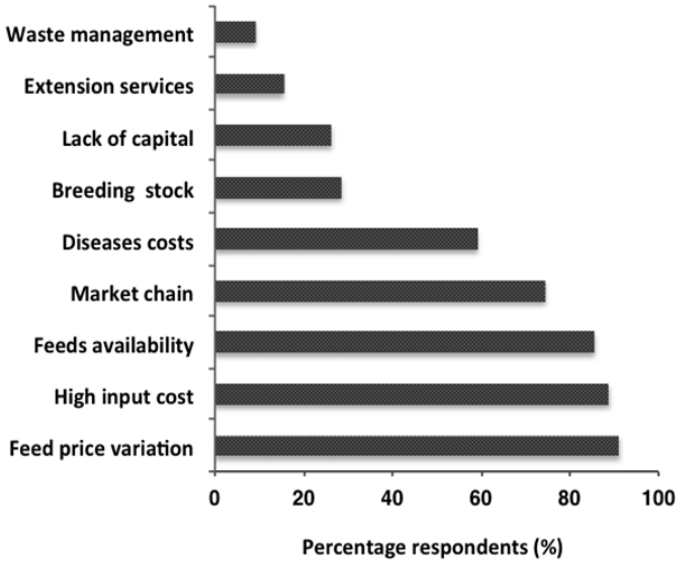

Figure 1. Constraints to pig farming in peri-urban Kampala, Uganda.

was determined using analysis of variance (ANOVA) at 5% significance level. The management practices considered were breed of the pigs, feed types and parasite control, while the production parameters included litter size, number weaned, farrowing index, weaning to service interval, interfarrowing interval, preweaning mortality and weight:age ratio. Breed had a significant effect on weight:age ratio ($F_{(4,536)}$ = 9.3, p < 0.001) and litter size ($F_{(4,327)}$ = 4.28, p < 0.005) but not on farrowing index ($F_{(4,327)}$ = 2.15, p > 0.05) and weaning to service interval ($F_{(4,327)}$ = 1.93, p > 0.05). Feeding had significant effects on litter size ($F_{(5,326)}$ = 1.06, p < 0.001), farrowing index ($F_{(5,326)}$ = 0.53, *ns*), number weaned ($F_{(5,326)}$ = 3.07, p < 0.01), weight:age ratio ($F_{(4,536)}$ = 8.7, p < 0.05) and weaning to service interval ($F_{(5,326)}$ = 3.83, p < 0.05), but was not significant on age at weaning ($F_{(5,326)}$ = 0.69, *ns*). Control of parasites had no significant effect on all the performance indices; Litter size ($F_{(4,327)}$ = 1.81, p > 0.05), weight:age ratio ($F_{(4,536)}$ = 0.61, *ns*), and number weaned ($F_{(4,327)}$ = 1.27, p > 0.05).

Constraints to pig farming in peri-urban Kampala

The major constraints to pig farming reported by the interviewed farmers (n=90) included feed price fluctuation (91.2%), high input costs (88.9%), seasonal availability of feeds (85.6%), poor and unorganised market chain (74.5%) and diseases (59.2%) (Figure 1). Other constraints reported were lack of quality breeding stock, lack of capital, poor extension services and challenge of manure disposal.

DISCUSSION

In peri-urban Kampala, the herd size of most piggeries were generally small (<100 pigs) probably because pig farming was a secondary activity for most farmers, and competition for land with the housing estates. The dominant breeds of pigs were Large White and crosses between Large White and Landrace. Farmers preferred Large White because of the perceived fast growth and larger litter sizes. The high percentage of crossbred pigs between Large White or Landrace and crosses was largely due to lack of a systematic breeding program. The average lifespan of the boars on the farms averaged 4 years and this is within recommended range for tropical regions (Huang et al., 2010). Sows, however, had a longer life span of 5-8 years, and this is above the minimum of 4 years or three parities required to achieve positive financial return (Stadler et al., 2003). Sows are removed for different reasons such as old age, reproductive disorders and low productivity (Engblom et al., 2007). The high average lifespan of sows on the studied farms indicate low removal rate, possibly due to attempt by farmers to achieve highest possible number of parity per sow over the entire lifetime given the low

farrowing index. Sow longevity has been argued to help farmers break even since financial return is projected to occur at the third farrowing (Stadler et al., 2003). In this situation, however, reducing the weaning age and the farrowing interval may be able to substantially improve profitability.

Overall, the performance indices were low compared to reference values (Althouse, 2011; Dunshea et al., 2003), mainly based on values from developed economies, but comparable to those of developing economies (Wabacha et al., 2004; Lemke et al., 2006). The low performance of pigs in tropical conditions was attributed to heat stress by Lutaaya et al. (2009), among other factors. Productivity can however be optimized by controlling the environmental conditions, feeding and selection. Litter size showed less deviation from the reference value in contrast to growth rate, although both traits are highly heritable (Kaplon et al., 1991). This difference could be explained by the extent of management effect on the two indices. Statistically, we could show that breed had significant effect on weight:age ratio ($F_{(4,536)}$ = 9.3, p < 0.001) and litter size ($F_{(4,327)}$ = 4.28, p < 0.005) but not on farrowing index ($F_{(4,327)}$ = 2.15, p > 0.05) and weaning to service interval ($F_{(4,327)}$ = 1.93, p > 0.05). The significant effect of breed type on the major production (weight:age ratio) and the reproduction (litter size) indices also explains the popularity of Landrace and Large White breeds that have high prolificacy and growth rate, traits with high heritability coefficients.

We found that the management system had a major influence on performance, and a majority of the farms had above average or average management system with hygienic housing, adequate feeding system, biosecurity measures and parasite control. This was in agreement with findings by Muhanguzi et al. (2012) from a related study within a limited subpopulation in this area. The good management could be attributed to extensive farmer training provided by extension workers through government initiatives and the ability of the farmers to meet capital and operational cost from alternative sources of income, since piggery was not the primary source of income for the majority of farmers. Feeding was a key management factor influencing performance (litter size (p = 0.001), farrowing index (p = 0.028), number weaned (0.009), weight:age ratio (p = 0.02) and weaning to service interval (p = 0.0458)). Most farmers were dependent on locally available feedstuff to reduce feed costs and cope with scarcity and seasonality. This feeding strategy is common in other tropical countries with comparable systems (Rekwot et al., 2005; Lemke et al., 2006; Kagira et al., 2010). These non-conventional feeds such as banana peelings, sweet potatoes vine and cabbage peelings (Drechsel and Dongus, 2010) have varied or unknown nutrient content and its use depends on seasonal availability (Katongole et al., 2011, 2013), making feed management a big challenge.

The major challenges to pig farming included feed availability and cost, market chain and diseases. Feeding is a major cost in piggery and affects both growth and reproductive performance. This is a common challenge in most developing economies as reported in previous studies (Morek and Mphinyane, 2011; Muhanguzi et al., 2012). During seasons of limited feed supply, there was an observable decline in body condition scores, and a similar scenario was reported in Zimbabwe by Chikwanha et al. (2011). Other minor challenges reported were waste management, lack of capital and extension services. Waste management is particularly a big challenge in peri-urban areas and most farms practiced composting to recycle organic waste. In recent years, however, the method has drawn attention due to concern over environment pollution.

In conclusion, this study revealed high variability in the performance indices of piggeries in peri-urban Kampala. These indices were suboptimal compared to the reference values (Althouse, 2011), but comparably similar to values from other developing economies. There is therefore a potential for increased productivity. Feeding was the main management factor affecting performance, with feed costs and seasonal availability reported as the main challenges. Fomunyam (1992) showed that incorporating banana peelings at maximum 30% in animal diet have economic benefits. Since these crops are common in the study area all year round, adopting this feeding strategy would reduce the cost of feeding especially during seasons of inadequate supply. However, more research should be done to develop standard feeding regimes based on affordable alternative feed resources. Other challenges included diseases, market chains and waste management. We recommend improved management system to increase farrowing index and stringent biosecurity measures to control diseases. To increase the farrowing index, the weaning age should be reduced from the reported average of 54.5 days to the recommended 28 days (Althouse, 2011). Additionally, early weaning at 4 weeks was also shown to improve health and growth performance of the piglets (De Grau et al, 2005). Finally, the reported endo-parasite control interval of 3 months should be reduced since it is longer than the recommended interval of 5 weeks that corresponds to the live cycle of *Ascaris suum,* the major endo-parasite of pigs (Roepstorff, 1997; Kanora, 2009).

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGMENTS

E.0. is a doctoral fellow supported by VLIR-UOS (Vlaamse Interuniversitaire Raad) through the Inter University Development Cooperation program (Belgium). C.A is a master fellow supported by BTC (Belgian Technical Cooperation) through the Royal Embassy of

Belgium, Uganda. The authors are grateful for the financial support.

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