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Participatory assessment of animal health and husbandry practices in smallholder pig production systems in three high poverty districts in Uganda

Michel M. Dione[a,*], Emily A. Ouma[a], Kristina Roesel[a,b], Joseph Kungu[a,c], Peter Lule[a,d], Danilo Pezo[a]

[a] International Livestock Research Institute, P.O. Box 24384, Kampala, Uganda
[b] Institute for Parasitology and Tropical Veterinary Medicine, Freie Universitaet Berlin, Robert-von-Ostertag-Str. 7-13, 14163 Berlin, Germany
[c] Department of Biosecurity, Ecosystem & Public Health, College of Veterinary Medicine, Animal Resources & Biosecurity, Makerere University, P.O. Box 7062, Kampala, Uganda
[d] Department of Agribusiness and Natural Resources Economics, Makerere University, P.O. Box 7062, Kampala, Uganda

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ABSTRACT

While animal health constraints have been identified as a major limiting factor in smallholder pig production in Uganda, researchers and policy makers lack information on the relative incidence of diseases and their impacts on pig production. This study aimed to assess animal health and management practices, constraints and opportunities for intervention in smallholder pig value chains in three high poverty districts of Uganda. Semi-qualitative interview checklists through Focus Group Discussions (FGDs) were administered to 340 pig farmers in 35 villages in Masaka, Kamuli and Mukono districts. Quantitative data was obtained during the exercise through group consensus. Results of FGDs were further triangulated with secondary data and information obtained from key informant interviews. Findings show that pig keeping systems are dominated by tethering and scavenging in rural areas. In peri-urban and urban areas, intensive production systems are more practiced, with pigs confined in pens. The main constraints identified by farmers include high disease burden such as African swine fever (ASF) and parasites, poor housing and feeding practices, poor veterinary services, ineffective drugs and a general lack of knowledge on piggery management. According to farmers, ASF is the primary cause of pig mortality with epidemics occurring mainly during the dry season. Worms and ectoparasites namely; mange, lice and flies are endemic leading to stunted growth which reduces the market value of pigs. Diarrhoea and malnutrition are common in piglets. Ninety-three percent of farmers say they practice deworming, 37% practice ectoparasite spraying and 77% castrate their boars. Indigenous curative treatments include the application of human urine and concoctions of local herbs for ASF control and use of old engine oil or tobacco extracts to control ectoparasites. There is a need for better technical services to assist farmers with these problems.

* Corresponding author at: International Livestock Research Institute, c/ o Bioversity International, P.O. Box 24384, Kampala, Uganda. Tel.: +256 312 266250/53; fax: +256 312266253.
E-mail address: M.Dione@cgiar.org (M.M. Dione).

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1. Introduction

Pork has become increasingly important in Uganda. Whereas in the 1960s it accounted for only 1–2% of the 11–12 kg annual per capita meat consumption, it now contributes at least a third of the current 10 kg of meat consumed by Ugandans each year (FAOSTAT, 2010). Beyond meat, pigs help rural and urban households to improve their livelihoods and they frequently serve as a source of cash in times of need.

Exploiting the full potential of pig production is however constrained by many pig diseases and ailments (Waiswa et al., 2007; Muhanguzi et al., 2012; Muwonge et al., 2012). Addressing these is in turn constrained by limited information on the relative incidence of the different diseases and their impacts on production.

To identify 'best-bet' interventions to improve the pig value chains, this study set out to draw on farmers' practices and knowledge to discover their perceptions on prevailing diseases and their role in constraining production.

2. Material and methods

2.1. Site selection

This study was conducted between November 2012 and March 2013 in 3 of 112 administrative districts in Uganda, namely Masaka, Mukono and Kamuli. These districts were selected as study sites for the Smallholder Pig Value Chain Development Project (SPVCD) implemented by the International Livestock Research Institute (ILRI) in Uganda (Pezo et al., 2014).

The selection of study sites followed several steps:

Geographical targeting (step 1) was done using GIS characterization and existing spatial data. Data on pig population density, human poverty levels and market access were used to depict differences in the districts and variations in value chain domains (Ouma et al., 2014). Time taken to reach nearest urban centres was used to proxy market access and served an important role in classifying the districts into the different target value chain domains: rural production for rural consumption (R–R), rural production for urban consumption (R–U) and peri-urban/urban production for urban consumption (U–U). Data on pig population density was derived from the 2008 livestock census (UBOS, 2009). Poverty levels, based on head count ratios were derived from human population census data, gridded population maps and the national poverty lines. The GIS process identified 10 potential districts with high pig population density and high human poverty levels.

Stakeholder involvement (step 2) was done through a site selection workshop to validate the GIS characterization results and to identify other 'soft' criteria not covered in the spatial analysis. These additional criteria identified by the stakeholders included the (1) potential for partnerships with on-going complementary projects, (2) districts having a high disease burden in pigs especially African swine fever, (3) current input market linkages especially access to input service providers and (4) year round access to the site.

Final decision (step 3) was taken after a process to score the 10 GIS identified potential districts by stakeholders against the stakeholder "soft" criteria. For the scoring, a matrix was constructed with the list of selected districts based on GIS criteria against the four "soft" criteria generated by the project's stakeholders. Each individual was given four cards to score against the districts based on their perception and knowledge about prevailing soft criteria. After the scoring, three districts – Masaka, Mukono and Kamuli were ranked top based on the scores and selected for project work (Ouma et al., 2014).

2.2. Village's selection

To identify specific site locations within the selected districts, a further assessment was done using pig population data at sub-county level from the livestock census data of 2008 (UBOS, 2009). In each district, 3–6 sub-counties with high pig population were selected for further scrutiny through site scoping surveys to identify their associated value chain domain type. Within each selected sub-county, 2–4 villages were randomly selected among all villages using excel random selection formula. The selected villages were considered for the pig value chain activities. In the end, 35 villages were selected for the value chain assessment exercise (Table 1).

2.3. Sampling strategy

Farmers selected to participate in the group discussions were drawn from lists of pig farmers prepared by village leaders with staff of the National Agricultural Advisory Services (NAADS) or local government staff working in each sub-county. A random sample of 40 pig farmers was drawn from the lists for each of the 35 villages. The percentage of men and women in each group was representative of their proportions in the population. Selected farmers were invited for a meeting in a local school or church in each of the sampled villages. In each village, the group of 40 farmers were randomly divided into four groups of 10 individuals using hand count to discuss four subject domains including feeds/breeds, animal health/husbandry practices, value chain mapping/marketing, and food safety/nutrition, with all four sessions held in concurrently. Up to 350 farmers participated in each thematic session. A few farmers did not attend the meetings for unknown reasons. For the animal health and husbandry practices sessions, to which this study refers to, 340 of the initially targeted 350 farmers actually participated in the FGDs.

2.4. Assessment design

Surveys tools to assess the animal health and husbandry practices included proportional piling, listing, sample ranking, scoring, seasonal calendar, matrix/pair-wise comparison and problem-opportunity matrix as described by Catley et al. (2011). These tools were semi-qualitative in nature and covered different topics including housing systems, husbandry practices, disease burden, and constraints and opportunities of smallholder pig production. Some

Table 1
Selected sub-counties and value chain domains in Masaka, Mukono and Kamuli districts.

District	County	Sub-county	Dominant value chain domain	Number of villages sampled
Masaka	Bukoto	Kkingo	Rural–rural	3
	Bukoto	Kyanamukaka	Rural–rural	3
	Bukoto	Kabonera	Rural–urban	3
	Masaka Municipality	Kimanya-Kyabakuza	Urban–urban	2
	Masaka Municipality	Katwe-Butego	Urban–urban	2
	Masaka Municipality	Nyendo-Ssenyange	Urban–urban	2
Kamuli	Bugabula	Kitayunjwa	Rural–rural	2
	Bugabula	Namwendwa	Rural–rural	2
	Buzaaya	Bugulumbya	Rural–rural	4
Mukono	Mukono	Mukono town council	Urban–urban	2
	Mukono	Goma	Urban–urban	2
	Mukono	Kyampisi	Rural–urban	4
	Mukono	Ntenjeru	Rural–rural	4

quantitative data were obtained through group consensus. Two facilitators were appointed for each thematic session: one facilitator for leading the group discussion and one facilitator for note taking. To avoid inconsistency in the methodology and eventually in the results, the same facilitators were used to run group discussions in all 35 villages. The latter, who were graduates in subjects related to animal or veterinary sciences, were contracted and trained in use of the survey tools. After training, the facilitators pretested the tools for comprehension and timing to produce workable timetables for the sessions. The facilitators used predominant local languages such as Luganda in Masaka and Mukono and Lusoga in Kamuli.

2.5. Data recording and analysis

Although the tools were semi-qualitative in nature, all data were recorded in data entry sheets by the note-takers and entered into a database for clean-up using Microsoft Access 2010 version 14.0, July 15, 2010. Data analysis was performed using excel and Stata (http://www.stata.com/stata13).

3. Results

3.1. Herd dynamics

During a one-year production period, the most common sources of pig additions to the herd in U–U value chain domains (such as Kimanya–Kyabakuza, Nyendo Ssenyange and Goma sub-counties) were births (38–50%). This compares to R–R value chains where births were lower (11–34%), except for Ntenjeru (46%). Additions through purchase were common in the R–R value chain domain (34–52%), especially in Kkingo, Kitayunjwa and Namwendwa sub-counties. Rented-in pigs were more common in the R–R and R–U value chains (10–17%) than in U–U chains (2–5%). Rented-in is where a sow is given to a relative or neighbour and the resulting piglets or cash from piglet sales are shared. Receipt of piglets as gifts during social events or through programmes implemented by non-governmental organizations (NGOs) or NAADS was also an important source of pig addition to the herd in most sub-counties, with Mukono Town Council having the highest proportion (22%). Pig addition through in-kind payments in the form of piglets in exchange for the provision of boar services was relatively high in the rural areas (Table 2).

Pigs exiting the herd in the course of one year were largely through sales and deaths, accounting for 38–65% and 16–31% respectively. Up to 10% of exits were through slaughter for home consumption, especially during festive seasons. Piglet theft was relatively common in all sub-counties and varied between 5 and 20% of all exits. According to farmer, theft was most common where piglets were left to scavenge for themselves (Table 3).

The main cause of herd exits through death was disease (45–90%) except in Kitayunjwa in Kamuli district where heat stress appeared to be the most common cause of death (34%). Cases of death at farrowing troughs, cannibalism of piglets by sows and accidents were also reported. Malnutrition was reported as the second major cause of death in most sub-counties, accounting for up to 20% of deaths. Death through malicious killing accounted for up to 13% of all deaths, with the highest proportions being reported in R–R value chain domains (Table 4).

3.2. Pig keeping systems

Three major types of pig keeping systems exist in the sites. The common types in the R–R and R–U value chain domains were tethering and free range/scavenging, while confinement in corrals with either raised or non-raised floors was most common in U–U value chain domains (Table 5).

3.2.1. Free range/scavenging (extensive system)

This management type is seasonal and corresponds to low input systems. Animals are left to scavenge during the day and confined either in pens, in other simple constructions, or tethered during the night. Scavenging occurs mostly during the dry season. Piglets are often left to scavenge since they are considered to be less harmful to crops and are also difficult to tether given their small size. This system relieves farmers from the need to collect or purchase feeds as they think their pigs find adequate food and sufficient nutrients through scavenging. However, some

Table 2
Reasons for pig addition to the herd in the course of one year according to farmers.

Value chain domain	Sub-county (*N*)	Proportions of respondents (%)					Total
		Purchase	Birth on farm	Piglet as payment from breeding service	Gift from fellow farmer or NGO	Rented in	
Rural–rural	Kkingo (30)	52	11	17	5	15	100
	Kyanamukaka (29)	42	30	13	4	11	100
	Kitayunjwa (19)	45	13	7	18	17	100
	Namwendwa (16)	45	13	7	18	17	100
	Bugulumbya (39)	34	34	3	13	16	100
	Ntenjeru (37)	37	46	0	7	10	100
Rural–urban	Kabonera 30)	44	24	10	7	15	100
	Kyampisi (40)	30	42	0	13	15	100
Urban–urban	Kimanya-Kyabakuza (20)	28	50	5	17	0	100
	Katwe-Butego (20)	27	39	18	16	0	100
	Nyendo-Ssenyange (20)	39	47	1	10	3	100
	Mukono town council (20)	35	38	0	22	5	100
	Goma (20)	38	45	0	15	2	100

Note:
– *N*: number of respondents (farmers).
– Rural–rural: rural production for rural consumption value chain domain.
– Rural–urban: rural production for peri-urban/urban consumption value chain domain.
– Urban–urban: urban production for urban consumption value chain domain.

farmers provide supplements at night when the pigs are put in pens.

This practice also allows sows to access roaming breeding boars and is popular with farmers who do not have their own boar or enough money to pay for breeding services. Most farmers using free range/scavenging practice justify doing it because they lack funds to construct proper housing for their pigs or to buy feeds. Under the free range system, risks of accidents, predation and theft increase because pigs are exposed to external factors and are often not under any direct control of their owner. The main disadvantage of this system, according to farmers, is the potential for crop destruction by pigs which may lead to conflict with crop producing neighbours. This management system was mainly practiced in rural settings by 17% and 18% of farmers in R–R and R–U value chains respectively. In rural areas, space is more available and animals are less exposed to accidents caused by vehicles. In urban settings, only 1% of farmers practiced this system.

3.2.2. Confinement in corrals (intensive system)

Total confinement is common in U–U and R–U value chain domains, 86% and 42% respectively. It is a relatively high input system where pigs are fed and watered in confined pens. Pens consist of combinations of different materials to make the floor (cement, concrete with pieces of bricks, or the ground), the wall (timber, stems, bricks or planted trees) and the roof (iron sheets, grass, papyrus, polythene or left open). The floor can be elevated (off the ground) or not.

Farmers say that confining pigs in corrals has several advantages. Security is good because pigs are protected

Table 3
Reasons of pigs exit from the herd in the course of one year according to farmers.

Value chain domain	Sub-county (*N*)	Proportion of respondents (%)						Total
		Disease	Malnutrition	Malicious killing	Predation	Accident	Heat stress	
Rural–rural	Kkingo (30)	59	20	12	5	4	0	100
	Kyanamukaka (29)	63	13	7	3	11	3	100
	Kitayunjwa (19)	26	9	12	19	0	34	100
	Namwendwa (16)	54	18	9	9	9	1	100
	Bugulumbya (39)	67	11	11	3	3	5	100
	Ntenjeru (37)	53	14	13	2	8	10	100
Rural–urban	Kabonera (30)	55	14	5	12	7	7	100
	Kyampisi (40)	45	7	0	21	15	12	100
Urban–urban	Kimanya-Kyabakuza (20)	74	18	0	0	8	0	100
	Katwe-Butego (20)	65	19	7	7	1	1	100
	Nyendo-Ssenyange (20)	90	10	0	0	0	0	100
	Mukono town council (20)	49	2	0	17	21	11	100
	Goma (20)	54	15	9	15	6	1	100

Others: loss of pigs, piglet as payment for breeding service and gift from fellow farmers or development organization.

Table 4
Main causes of pig deaths according to farmers.

Value chain domain	Sub-county (*N*)	Proportion of respondents (%)						Total
		Disease	Malnutrition	Malicious killing	Predation	Accident	Heat stress	
Rural–rural	Kkingo (30)	59	20	12	5	4	0	100
	Kyanamukaka (29)	63	13	7	3	11	3	100
	Kitayunjwa (19)	26	9	12	19	0	34	100
	Namwendwa (16)	54	18	9	9	9	1	100
	Bugulumbya (39)	67	11	11	3	3	5	100
	Ntenjeru (37)	53	14	13	2	8	10	100
Rural–urban	Kabonera (30)	55	14	5	12	7	7	100
	Kyampisi (40)	45	7	0	21	15	12	100
Urban–urban	Kimanya-Kyabakuza (20)	74	18	0	0	8	0	100
	Katwe-Butego (20)	65	19	7	7	1	1	100
	Nyendo-Ssenyange (20)	90	10	0	0	0	0	100
	Mukono town council (20)	49	2	0	17	21	11	100
	Goma (20)	54	15	9	15	6	1	100

Note: These proportions refer to what farmers consider as main cause of death for their pigs.

against predators including wild animals, dogs and thieves. The spread of disease is reduced due to restricted animal movements; conflict with neighbours over crop damage is avoided; manure can be easily collected, improving hygiene; while feed wastage is reduced because feeders are placed inside the pen. Most farmers with improved breeds practice this system because, they say, these breeds are more susceptible to disease and environmental stress and they are more valuable (in monetary terms). Overall, this confined system is considered to be labour-intensive since feeds and water are collected and brought to the pigs in the pens.

Two types of house construction exist, those with raised floors and those without.

3.2.2.1. Raised floor. The floor is elevated and constructed from timber or small diameter wood. This is considered by farmers to be very hygienic because urine is eliminated easily, keeping the pigs clean. However, again according to the farmers, growth is slower in these corrals as pigs suffer stress associated with living on the elevated floors.

3.2.2.2. Non-raised floor. The floor is on the earth. It can concreted or with bare earth and some covered with straws. In these corrals, pigs are also clean and stress due to elevated floors is avoided. Manure is easily collected and the floor can easily be cleaned. When the floor is not cemented, pigs can get very dirty because of their direct contact with the soil. Such housing structures can be expensive depending on the building materials used. Farmers who can afford such housing are usually those with higher numbers of animals (usually more than five sows) who can afford the investment. In corrals with non-cemented floor (e.g., grass or bare soil), farmers tend to have more than one pen and they shift the pigs while cleaning.

3.2.3. Tethering (semi-extensive/extensive system)

In this management type, pigs are tied with a rope under a tree or in a home garden. The animals are moved between positions to prevent over-grazing and to allow change of feeds, which are usually crop residues or grass. If the pig is tethered in the compound, food is provided. The ropes are changed from one leg to another to minimize injury, a very common occurrence in this system. It is a cheap technique and helps restrain the pigs if they have to be transported for breeding. This approach produces manure on site and it prevents pigs from damaging any crops. Tethered pigs are usually older than four months and mostly of local breeds. Farmers who practice this system usually keep a small number of animals (one to three adult pigs) which are easy to manage. They identified limited space for animals to scavenge and lack of funds to construct pig pens or to purchase feeds as constraints.

According to farmers, the major disadvantages associated with this system are rope injuries as well as exposure to predators like dogs because of their inability to escape when attacked. Many farmers, 62% and 40% in R–R and R–U value chain domains practiced this type of management.

3.3. Husbandry practices

Smallholder pig farmers apply many husbandry practices including castration, deworming, breeding using

Table 5
Proportion of pig keeping systems in smallholder farms in Masaka, Mukono and Kamuli districts.

Confinement type/value chain domains	Rural–rural ($n = 170$)	Rural–urban ($n = 70$)	Urban–urban ($n = 100$)
Tethering	62%	40%	13%
Housed with raised floor	5%	6%	25%
Housed without raised floor	16%	36%	61%
Free range/scavenging	17%	18%	1%

communal village boars, multi-vitamin and iron supplementation, ectoparasite spraying and teeth clipping. Deworming and castration were the most common practices across all value chains. Farmers typically monitor these practices themselves using other experienced farmers or veterinary paraprofessionals as the service providers.

3.3.1. Deworming

Ninety-three percent of farmers deworm their pigs at least once before they are sold or slaughtered. They believe that deworming results in faster growth. Most of the time, growers and fatteners deworm when a piglet is entering the farm and again a few days before pigs are sold. To get their pigs dewormed, most farmers get services from a veterinary paraprofessional or they buy drugs and administer them to their pigs by themselves. The cost of an injection varied between 1 and 1.8 USD; a pill costs between 0.2 and 0.8 USD for piglets and 0.8 and 1.2 USD for adult pigs. For drenching, the cost is higher and can go up to 8 USD. The most commonly used drugs for deworming are albendazole and ivermectin.

3.3.2. Spraying against external parasites

Thirty-seven percent of farmers spray their pigs to kill external parasites using acaricides. External parasites are dominated by mites, lice, flies (especially jiggers) and ticks. The cost varied between 2 and 6 USD per treatment.

3.3.3. Multi-vitamin supplementation

Multi-vitamin supplementation is usually combined with deworming when sows are around two months pregnant in order to boost their immunity. It is also administered to growers and fatteners to boost growth. The cost of one injection varied between 0.4 and 2 USD.

3.3.4. Castration

Castration is commonly practiced (by 77% of farmers). This is done either by a veterinary paraprofessional, by a skilled and experienced traditional farmer referred to as "village castrator" or in very rare cases by the farmer. This is mostly carried out when the pig is around two weeks of age and can cost up to 1.2 USD.

3.3.5. Breeding services

Farmers transport sows to a boar that belongs to a lead farmer usually called "communal village boar" or to a neighbour's boar for serving when heat is detected. Where the service is from a neighbour, the farmer often benefits from a free service or service at a reduced cost because the fellow farmer is often a relative. The cost of service using the "communal village boar" varies between 4 and 20 USD depending on the location, source of service, breed and the quality of the boar. Payment is either through cash or in-kind (in the form of a piglet).

3.3.6. Iron supplementation

Iron supplementation is done by injections. It is practiced by few farmers, and is more common in urban areas (39% of farmers). The cost per dose is between 0.4 and 1.4 USD and in most cases is provided by a veterinary paraprofessional. Most farmers who were unable to meet the cost of an iron injection released their pigs to scavenge; allowing them to ingest red soil.

3.3.7. Teeth clipping

This was not found to be a common practice as it requires good technical knowledge. Few farmers in urban areas apply this practice. According to farmers, most health service providers are not well equipped for this kind of technique which involved more advanced skills and sophisticated equipment.

3.4. Disease burden and impacts on production

African swine fever (ASF) and parasites, especially worms and mites, were the most reported diseases. ASF was reported as most fatal with a case fatality rate of 77.5%. Foot and Mouth disease (FMD) was mentioned in only two villages in Masaka district, while Diarrhoea is widely distributed affecting mainly piglets in all districts. Other ectoparasites, namely flies, jiggers (only mentioned in Kamuli district), lice and ticks were commonly reported. According to farmers, external parasites contribute to skin alteration and loss of weight. Heat stress and a few undiagnosed diseases for which clinical signs were related to sudden deaths were also reported (Table 6).

Table 7 summarizes the diseases mentioned, their local names in Luganda and the clinical signs described by farmers. The common term "*omusujja*" was used by farmers to describe swine fever in general, but according to some key informants and based on the clinical signs provided by farmers, it seems to be equivalent to ASF in most cases.

3.4.1. Seasonal calendar for disease and parasite occurrence

Several diseases were considered by farmers to be seasonal. Outbreaks of ASF were more reported during the dry season. Malnutrition was more reported during short droughts and in the dry season when maize bran is scarce and more expensive. Diarrhoea, together with worms, ticks and lice seem to occur throughout the year. However lice, mites and jiggers seems to be more reported during the dry season (Figs. 1 and 2).

3.4.2. Disease control and prevention strategies adopted by farmers

Farmers tend to treat diseases when they occur and they usually consider treatment to be effective. They treat their animals themselves with purchased drugs or they call in a veterinarian or a veterinary paraprofessional. When animals are suspected to have ASF, some farmers tend to treat them with concoctions made of local herbs (*kigagi*, *ekisula*, *ekifumufumu*, *omululuza*) or even human urine. Ivermectin seems to be the most used dewormer by farmers. According to them, this drug's administration route is very convenient and it has a broad-spectrum. To control external parasites, ivermectin and acaricides are commonly used. Extracts of tobacco and used engine oil are also smeared on the skin of pigs to prevent external parasites, especially lice and mange. Farmers believe that practices they consider cheap help to remove parasites from the pig's body. Other farmers scrub their animals with soap. Some dig shallow ponds

Table 6
Major diseases and their results as perceived by farmers in Masaka, Mukono and Kamuli districts.

Disease	Rural–rural (n = 170)			Rural–urban (n = 70)			Urban–urban (n = 100)		
	Morbidity (%)	Mortality (%)	Case fatality (%)	Morbidity (%)	Mortality (%)	Case fatality (%)	Morbidity (%)	Mortality (%)	Case fatality (%)
African swine fever	29.8	23.1	77.5	43.1	31.8	73.8	15.8	7.5	47.5
Worms	55.1	12	21.8	35	5	14.3	22.3	1.8	8.1
Mange	16.1	1.9	11.8	14.8	1.1	7.4	14	0.4	2.9
Lice	9.8	0.3	3.1	7.5	0	0.0	1.1	0	0.0
Flies	1.3	0	0.0	0.1	0	0.0	1.1	0	0.0
Diarrhoea	5.8	1.3	22.4	4.6	0.7	15.2	5.6	0.5	8.9
Malnutrition	2.4	0.1	4.2	3.6	0	0.0	4.3	0.1	2.3
Foot and mouth disease	0	0	0	0	0	0.0	1.5	0	0.0
Others[a]	0	0	0	3.8	0.2	5.3	0.3	0	0.0

[a] Swine erysipelas, anaemia, ticks, jiggers, heat stress, fever, undiagnosed diseases usually related to sudden death.

Table 7
List of diseases and their clinical signs according to farmers in Masaka, Mukono and Kamuli districts.

Disease name	Local name	Clinical signs	Seasonality	Main effect on pig
Swine fever	*Omusujja/Omusudha*	Anorexia (35), fever (23), shivering (26), vomiting (15), unsteady gait (27), cyanosis on ears (15), haemorrhage on skin (6), cough (3), dull eyes (1), standing hair (4), difficult breathing (3), lacrimation (2), bluish meat (1), sudden death (7), diarrhoea (10), swollen eyes (1), weakness (5), mucosal nasal discharge (2)	Dry season (22) Wet season (5) Unpredictable (7)	Death shortly after clinical signs (35)
Worms	*Enjoka/Ebiwuka*	Rough hair coat (24), swollen stomach (10), cough (38), coiled and dropping tail (7), pointed nose (1), anorexia (10), diarrhoea (17), sticky faecal material (1), worms can be seen in the faeces (8), stunted growth (8), pot belly (13), vomiting (1), restlessness (1), wounds on ear (1)	Year round (33)	Stunted growth and loss of weight (23), death especially of piglets (1)
Lice	*Ensekere/Nsekera*	Appearance of lice and eggs on the skin (9), wounds (2), scratching (3) restlessness (1), anaemia (1)	Year round (14)	Stunted growth (4), loss of weight (3)
Mange	*Lukuku/Olukulu*	Cracking skin (5), hair loss (31), scratching (15), itchy skin, rubs against walls (11), wounds on skin (14), lack of appetite (1)	Year round (26), mostly during dry season (4)	Stunted growth (26), loss of weight (6), restlessness, stress (2), wounds on skin (16), death (11)
Flies	*Kawawa*	Wound on skin, irritation	During wet season	Stunted growth, ear may be lost
Ticks	*Enkodho/Enkwa*	Physically visible (red, small size, spotted coat; large grey)	Year round, especially on wallowing pigs	Stunted growth
Jiggers	*Envunza*	Physically visible	Year round	Swollen feet, stunted growth
Diarrhoea	*Ekudukana*	Soiled hind quarters (6), watery faecal matters (11), dullness (3), anorexia (1), cough (3), weakness (1), pot belly (2), worms visible in faeces (2), pasted behind (3), straight tail (2)	Year round, more during wet season (10)	Stunted growth (4) Death especially of piglets (5)
Malnutrition	*Endya embi* *Enjjala* (*hunger*)	Emaciated (4), stunned, retarded grown (2), long neck (1), pointed mouth (1), weak, agalactia (2)	When bran is expensive or during dry season	Do not die, but reduced market value
Swine erysipelas	*Ebisent*	Wounds/scrubs (1)	Sporadic (once or twice a year) (1)	Emaciated (1)
FMD	*Kalusu*	Vesicules on hooves and udder (1)	Sporadic (once or twice a year)	Do not die, but reduced market value
Anaemia	*Anemiya*	Weak piglets and sow, death of piglets at birth (1)	Year round (1)	Death (1)

Note: (): number of farmers who declared having observed these clinical signs on their pigs. According to key informants, 'swine fever' refers to African swine fever which is the most endemic disease of pig causing high mortality in the area.

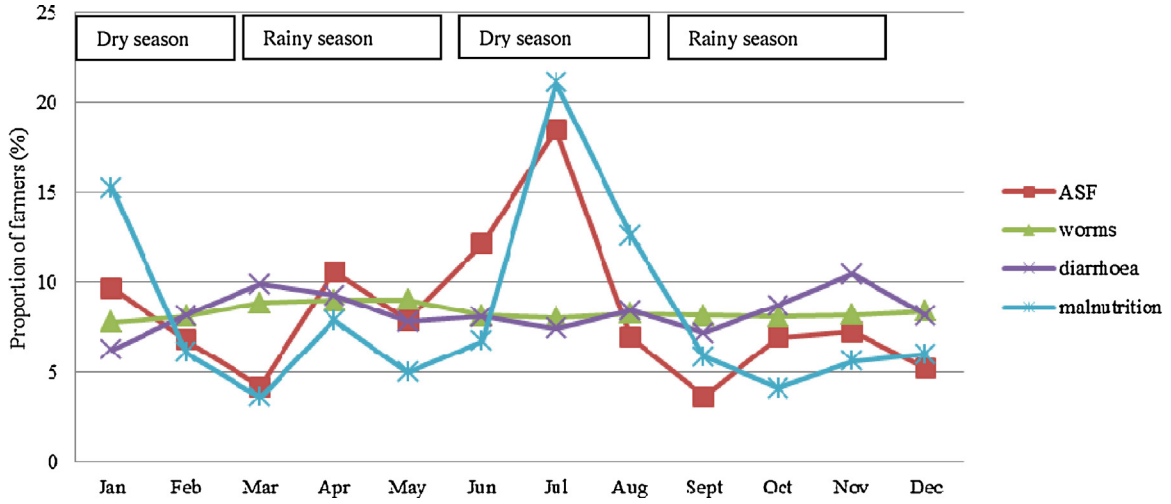

Fig. 1. Seasonal variation in the occurrence of pig diseases and symptoms in Masaka, Mukono and Kamuli districts according to farmers.

where pigs can wallow and they believe the mud that coats the pigs also kill external parasites. Most farmers in rural settings believe that external parasites are only present in pigs that do not wallow. Farmers consider the methods they use for parasite control to be effective.

A range of antibiotics and multivitamins are used to treat most diseases and also for prophylaxis. However there is no control and uniformity in the administration schedule of these drugs. Some farmers believe that an antibiotic remaining in a pig's body will prevent diseases, thus they frequently administer antibiotics regardless of the animal's health status. Other farmers administer antibiotics only when they suspect that their animals are sick. One of the most referred clinical signs by farmers for antibiotic use is shivering, which is an indication of fever. In this case, antibiotics are automatically administered without any further veterinary diagnosis. Some farmers call a veterinary paraprofessional to inject one dose of antibiotic or multivitamin before the onset of an ASF outbreak season usually at the beginning of a dry season. Multivitamins are also commonly used to boost pig growth, so they are administered when a pig enters the farm and during the fattening period until the pig is sold.

3.5. Constraints to animal health

Lack of knowledge about management practices and feeding strategies, as well as limitations in the delivery of health services were commonly cited as animal health related constraints. Poor feeding, poor hygiene and absence of prophylaxis programmes were ranked highest. The other constrains mentioned include poor housing, lack of capital, high cost of feeds and poor quality of drugs (Fig. 3).

3.5.1. Lack of knowledge

Poor knowledge on good husbandry practices and management is a constraint frequently cited by farmers. Farmers often fail to get the assistance they need either because they cannot afford technical services or because there are limited veterinary services available to them. While NGOs, like Volunteer Efforts for Development Concerns (VEDCO) established in Kamuli district and Government institutions like National Agricultural Advisory Services (NAADS) provide technical advice in some subcounties, not all farmers have access to those services, and when available, they are often temporary because they rely on specific limited-duration projects.

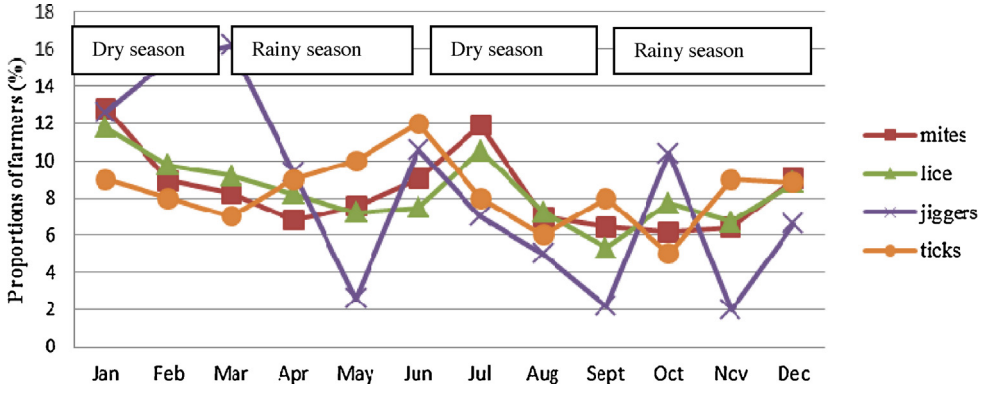

Fig. 2. Seasonal variation in the occurrence of ectoparasites in Masaka, Mukono and Kamuli districts.

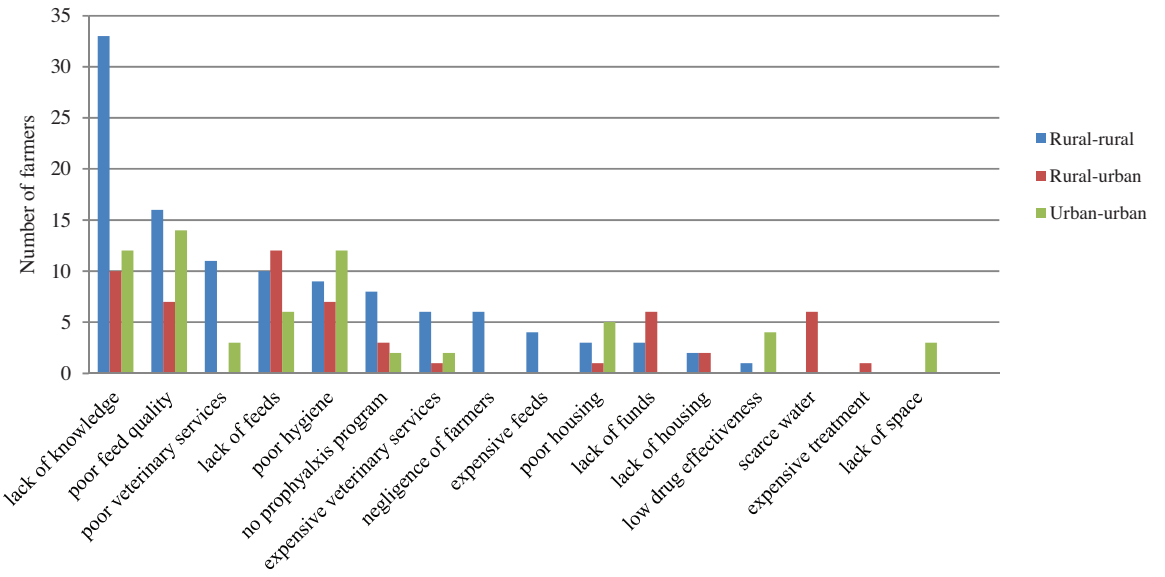

Fig. 3. Frequency of animal health and husbandry constraints listed by farmers in Masaka, Mukono and Kamuli districts.

3.5.2. Poor housing and management

Most farmers who practice tethering methods mentioned lack of funds as the primary reason for not constructing proper housing for their pigs. Farmers who try to house their animals rely on local materials for construction. Animals are often exposed to poor hygiene because most pens do not include plans for manure collection or liquid drainage including urine.

3.5.3. Limited access to good quality health services

A major concern raised by farmers is the limited coverage and poor quality of the veterinary services they receive. There are several non-licensed practitioners providing poor quality veterinary services. There is no appropriate monitoring of pigs under treatment. Most of the time, drugs are given in a single dose and any booster doses depend on the availability of funds. As farmers lack knowledge about basic veterinary care, they often accept any treatment offered for their pigs. Some practitioners exploit this and misuse information to manipulate farmers. As an example, some practitioners were known to explain to farmers that a particular injection (given by them) is a vaccine against ASF, yet there is no vaccine for ASF. Besides this, limited access to drugs and high costs are also major issues.

4. Discussion

4.1. Pig keeping systems

Most studies conducted in Uganda show that pigs are kept in all three systems listed by farmers in this study, with more intensive systems in the peri-urban/urban compared to rural settings (Waiswa et al., 2007, 2009; Rutebarika and Ademun, 2011; Muhanguzi et al., 2012). A study in Nangabo district with a similar production system to the one observed in Mukono U–U value chain reported that most farmers keep their pigs in intensive or semi-intensive systems but allow their pigs to forage for 2–5 h per day (Muhanguzi et al., 2012). While each management system has its advantages and disadvantages, the most recommended management practice is total confinement for several reasons including high security, low exposure to diseases risk especially ASF whose main transmission route is through pig to pig contact. However, some farmers who cannot afford the cost of feeds and veterinary services throughout the confinement period switch back to scavenging allowing pigs to look for their own feeds while gaining some self-supplementation especially in iron through red soil ingestion during feeding which they think is iron-rich. Farmers assume that red soil contains natural iron which is good for the health of the pigs. Some farmers may add red soil in piglet food at one week of age to supplement for iron.

Total confinement can also help maximize weight gain and profit through good control of feeds and watering. However, the type of pen constructed varies from one farmer to another, and depends strongly on their financial capacity. Most smallholders keeping one to three pigs do not invest in housing because of lack of funds. Farmers who have improved housing structures are mainly medium to large-scale producers. On average, medium and large scales were defined as those that own 3–6 sows and more than 6 sows respectively for piglet producers; and 4–11 and more than 11 grown pigs for slaughter respectively for grower/fattener producers (Ouma et al., 2014). Poor housing can result in pig injury due to poor hygiene and heat stress. Poor management of manure and urine could also result from poor housing. Manure and stagnant urine from infected pigs may contain pathogens, which could represent a risk for the pigs and the farmers themselves.

Scavenging and tethering practices seems to be common in the rural areas where feeding is mainly based on crop residues and forage. These management types are a

major source of disease spread by pig to pig or pig to vector contact namely ticks and wild animals (Costard et al., 2009). It also exposes the pigs to feeding on uncontrolled materials which can contain contaminated products.

The main objective of keeping pigs is to generate funds for basic necessities such as school fees and food (Ouma et al., 2014). Given the low input production systems, farmers fail to save enough funds from their piggery in order to re-invest in good housing. Also there are other financial costs associated with total pig confinement. Among these, feeding is the main challenge.

4.2. Herd dynamics

The pig addition to the herd is mainly due to purchases or birth occurring in the farm. However, this may have to do with the type of system practiced: births in piglet producing systems (or farrowing units) and purchases for growing and fattening units. Rented-in is relatively more common in the R–R and R–U value chains compared to the U–U, possibly due to strong social networks among families in rural areas, or resulting from feed scarcity. It is a particularly useful practice for resource-constrained farmers or those unable to care for their animals.

Because of the high investment costs to maintain a breeding boar, most farmers in rural areas solicit the service of a communal village boar to serve their sows, and in exchange they usually pay in-kind in the form of piglets. In urban areas where investment in a piggery is often higher, some farmers have their own boar and do not solicit services from outside. Communal breeding as well as purchasing animals of unknown health status are risk factors to transmit diseases, between or within farms through direct pig to pig contact (Muhanguzi et al., 2012; Okoth et al., 2013). Results from a study in Wakiso in a peri-urban area indicate that newly obtained replacement animals are not isolated from the rest of the herd in 45% of the farms monitored in Nangabo sub-county, consequently there is a high risk for disease dissemination (Muhanguzi et al., 2012).

Sales are the major cause for pig exiting from the herds in all villages. This is understandable because farmers mainly keep pigs as an income generation strategy to cover family needs (Ouma et al., 2013). Sales happen year round depending on the farmer's needs. However, most sales target specific seasons such as religious festivities, school openings or other social events.

Mortality was considered the second most common cause of herd exit in the course of the year. The top two causes of death mentioned by farmers were ASF and parasite infestation, matching the findings of other studies in Uganda (Muhanguzi et al., 2012; Atuhaire et al., 2013). Other causes of death mentioned were malicious killings by unidentified persons. This is related to scavenging practices where pigs damaging crops may cause conflict with neighbours.

4.3. Husbandry practices

Farmers indicated that deworming is commonly practiced across all villages, probably recognizing that parasites are the leading cause of poor production in the three districts. However, in spite of this widely adopted practice, parasite infestation was ranked highest by farmers as far as morbidity is concerned across all villages. The persistent high parasite infestation in pig production systems could be attributed to the management types which are mainly tethering and scavenging systems. In these systems, the risks of re-infestation are high (Hale et al., 1986). Moreover, parasites might have also become persistent despite treatment because of the poor quality of drugs reported by farmers, as well as inappropriate dosage and deworming schedules which could be due to poor knowledge of treatment practices by farmers who administer drugs to their animal themselves or eventually low qualification of health service providers who are mainly village veterinarians and veterinary paraprofessional. Poor treatment could result in the development of resistance by parasites to common drugs (Kagira et al., 2003). Other common practices recommended to farmers by health service providers to boost growth include multivitamins, but this is less common because of the high costs. Castration is done to control mating especially under scavenging systems and to prevent boar taint in pork when consumed. Teeth clipping is the least-practiced activity since it requires good technical knowledge and, given the lack of qualified health workers and veterinarians, most farmers preferred not to do it.

4.4. Disease prevention and control

Diseases and parasites are among the most severe factors that impact livestock production and productivity. Animal diseases have great impact on food supplies, trade and commerce, and human health globally (Lamy et al., 2012). ASF and parasites are the main constraining diseases for pig production identified by our respondents in Uganda, and the same has been reported in other studies conducted in Africa (Costard et al., 2009; Roepstorff et al., 2011). Although ASF seems to be the disease that most farmers fear because of its high fatality rate, worm infections are also a major health problem because of their endemic status. Their negative impacts could become very important over time if control measurements are not in place. For ASF, there is no vaccine or treatment available hence strict biosecurity measures are recommended to prevent economic losses and the spread of the disease (FAO, 2010). The adoption of these recommended prevention strategies by farmers is very low, mainly due to the lack of accompanying measures such as compensation for animal losses during an outbreak (personal communication by Masaka District Veterinary Officer).

Furthermore, when an outbreak is confirmed, monitoring the disease and the enforcement of quarantine measures are very limited because, according to District Veterinary Officers, they lack transport and communication facilities to monitor the affected farms. However, when there is an ASF outbreak, farmers in fear of losing their pigs respond by depopulating their piggeries through massive sales at low prices. This is very common in countries where compensation schemes to eliminate animals in a controlled way do not exist (Muwonge et al., 2012). While the animals are sold, this approach often causes losses to the farmers because it floods the market and drastically reduces prices.

Moreover, since the sale of the meat is not restricted to communities where the outbreak occurred, pork is sold at the road side and may travel to other locations, transmitting the virus more widely (Tejler, 2012; Nsadha, 2013). The tendency for ASF outbreaks to occur in the dry season has been pointed out in previous studies in Uganda (Atuhaire et al., 2013), however the epidemiological basis of this seasonality has never been clearly understood.

Parasites occur frequently in domestic pigs all over the world and they are considered endemic in the pig system in Uganda (Waiswa et al., 2007). This means that much less attention is given to parasites as they often do not cause acute losses. Several practices are adopted by farmers to treat parasite infestations, ranging from traditional therapy using local herbs to conventional approaches using licensed drugs. With these treatments, parasites could be eliminated from the pig's body. However, if the pig-keeping environments are not kept clean, re-infestations can occur. Re-infestations can also occur when black pigs considered free of ectoparasites (because the colour makes visualization difficult) are not treated and then mixed with other pigs that have been treated.

Given the current status of management practices in most areas, the high incidence of diarrhoea in piglets could be associated with poor hygiene, diets or a combination of both. Considering these factors, episodes of diarrhoea can be reduced by simply improving management through good hygiene and feeding practices (Madec and Rose, 2003).

4.5. Constraints and farmers' self-help-initiatives

Farmers have developed strategies to minimize constraints faced by their enterprises. These include attempts to treat animals by themselves, identifying competent animal health workers, getting trained on pig husbandry, seeking advice from district veterinary services, visiting more experienced farmers, group forming to raise or borrow funds, use of locally-available feeds (banana peelings, sweet potato vines, cassava and yams leaves, and vegetables) and feed stocking for use during periods of feed scarcity.

Farmers who cannot access loans from microfinance institutions often sell pigs to raise funds to construct houses or to buy drugs for their pigs. Besides all these self-help initiatives, farmers also request more technical services and knowledge from NGOs and research/extension institutions in terms of training on husbandry practices, feeding strategies, and pig health management. There is a need for farmers to get better veterinary services and easy access to good quality drugs and feeds.

ASF, parasites and malnutrition emerge very prominently as the main causes of disease and death in pigs in Uganda according to farmers. Are these the priority issues to work on? They are certainly the ones that farmers can recognize based on their clinical signs. Since veterinary care is limited, proper diagnosis is hardly ever made in cases of disease or the death of a pig. It is likely that other porcine diseases are present and limit production but are not recognized by farmers. Also farmers tend to associate any kind of swine fever to ASF but it is unknown how much of the "swine fever" may be due ASF or other diseases that also cause fever especially classical swine fever (CSF) and other viral infections including porcine reproductive and respiratory syndrome (PRRS) and porcine circovirus (PCV).

Further studies targeting diseases that have not been listed by farmers could help establish a more exhaustive disease burden profile. Gaining a better understanding of the whole situation is also one of the reasons why a household cross-sectional disease prevalence survey in the same villages immediately followed this qualitative assessment.

5. Conclusion

The smallholder pig production systems in Uganda are characterized by low input which has resulted into poor management practices. ASF was reported by farmers to be the most deadly disease with outbreak occurring mostly during dry season. Most husbandry practices are related to parasite control because of their high burden throughout the year. The main constraints to animal health are lack of knowledge on management and husbandry practices, poor feeding and poor health service delivery systems. However, actions have already been attempted by farmers to solve these problems, but those are not enough. More collective action is needed involving government authorities, research and development institutions. Farmers claimed that group forming could help them get better access to training as well as to small funding to support their activities. Also, further more in-depth studies are needed to complement information provided by farmers on disease burden. It should help strengthen health information along the smallholder pig value chain in Uganda.

Finally, our study targeted poorest districts with highest pig population density. These districts are located in the Central (Masaka and Mukono) and Eastern (Kamuli) regions, which regions have the highest pig population in the country, with 41% and 22% respectively (UBOS, 2009). Because of this high pig population density in the studied districts, and also the fact that pig production systems characteristics in generally homogeneous across all districts in the country, our results can be extrapolated to other districts in the North and the West.

Conflict of interest

The authors declare that there are no conflicts of interest.

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