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## Fit for human consumption? A descriptive study of Wambizzi pig abattoir, Kampala, Uganda



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# Fit for human consumption? A descriptive study of Wambizzi pig abattoir, Kampala, Uganda

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December 2016

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Editing by Tezira Lore

Design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Kristina Roesel

ISBN 92-9146-495-3

Citation: Roesel, K., Holmes, K. and Grace D. 2016. *Fit for human consumption? A descriptive study of Wambizzi pig abattoir, Kampala, Uganda*. ILRI/A4NH Discussion Paper 1. Nairobi, Kenya: ILRI

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# Acronyms

BMZ	Federal Ministry for Economic Cooperation and Development, Germany
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GIZ	Society for International Cooperation, Germany
ILRI	International Livestock Research Institute
KCCA	Kampala Capital City Authority
Lnn	Lymph nodes
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
UBOS	Uganda Bureau of Statistics
UGX	Uganda shilling(s)
USD	United States dollar(s)

# Acknowledgements

The authors would like to thank the Federal Ministry for Economic Cooperation and Development, Germany and the Society for International Cooperation for funding this study through the Safe Food, Fair Food project. We are deeply grateful to the management of Wambizzi Cooperative Society Limited—Simon Lubega, Paul Sserubiri, Justine Nabukeera, Thomas Kasule, Fredrick Kibuuka and Richard Sekasanvu—for inviting us to conduct this study at the cooperative's abattoir.

We are honoured to have worked with the Kampala Capital City Authority meat inspectors Jane Lwanira and David Walabyeki; thank you for your valuable insights and facilitation at each step of the study. We are greatly indebted to the abattoir workers who learned to tolerate having scientists around asking very many questions over the three years of the study. We are thankful to Joseph Kungu who facilitated a focus group discussion in the local language. Lastly, we would like to thank the International Livestock Research Institute scientists, Danilo Pezo, Emily Ouma and Michel Dione, for their valuable inputs on the draft report.

The first author would also like to express her gratitude to her university supervisors at Freie Universität Berlin, Peter-Henning Clausen, Reinhard Fries and Max Baumann, for their permission to conduct the study when the opportunity arose and for supporting the possible practical interventions as a logical consequence of the study.

# Introduction

Since 1986, the number of pigs in Uganda has at least quadrupled (MAAIF and UBOS 2009; FAOSTAT 2014) and more than 2 million pigs are currently kept by 1.1 million households (MAAIF and UBOS 2009). The majority of pigs are kept in smallholder households as part of a large informal subsector with limited access to technology, information and services. Up to 70% of all pork sold in Uganda is consumed in urban and peri-urban areas (ILRI 2011) and marketed mainly through informal road-side butcheries and 'pork joints'. At the time of Uganda's independence in 1962, annual per capita consumption of pork was only 0.14 kg while in 2011, the country had the highest annual per capita consumption of pork in East Africa at 3.4 kg (FAOSTAT 2014).

In early 2012, the International Livestock Research Institute (ILRI) led two collaborative research-for-development projects focusing on smallholder pig value chains in Uganda. The first project, *Catalysing the emerging smallholder pig value chains in Uganda to increase rural incomes and assets*, funded by the International Fund for Agricultural Development, characterized the value chain and identified entry points to improve the productivity of smallholder pig systems and the efficiency of the marketing channels from supply providers to consumers.

The second project, *Safe Food, Fair Food*, covered food safety aspects in those value chains and was funded by the Federal Ministry for Economic Cooperation and Development, Germany (BMZ) and the Society for International Cooperation (GIZ). The ultimate goal of the project was the improvement of livelihoods of poor producers and consumers by reducing the health risks and increasing the livelihood benefits associated with meat, milk and fish value chains. The project aimed at furthering research into the practical application of risk analysis and economic and social methods by food safety stakeholders and value chain actors, as well as improving food safety and market participation of the poor in informal markets for livestock products in sub-Saharan Africa. At the level of meat, milk and fish value chains, the project pioneered, tested and communicated participatory risk-based approaches to food safety management to enhance smallholder market access.

The present exploratory survey was conducted at Wambizzi abattoir in Kampala, which is currently the only formally registered pig abattoir in Uganda. ILRI was approached by the abattoir management and invited to visit the site in June 2012. A tour of the facilities showed neither a structured slaughter process nor a transparent product flow. However, being a registered abattoir, the meat is inspected and stamped 'fit for human consumption'. The management team was well aware of this problem and had submitted a proposal to the Kampala Capital City Authority (KCCA) in 2009 which included floor plans to modernize the abattoir. To date, the decision is still pending. Products and by-products supply both formal and informal markets in Kampala. The pigs slaughtered and marketed at these facilities are supplied mostly by rural farmers throughout the country, mainly from the central region. Therefore, the pig abattoir represents a link to the market for ILRI's target group: the smallholder farmers.

The aim of the study was to describe how a formal pig abattoir in Uganda operates, identify critical control points in the slaughter process and suggest potential interventions to improve the slaughter process and hygiene.

Specific objectives of the study were to:

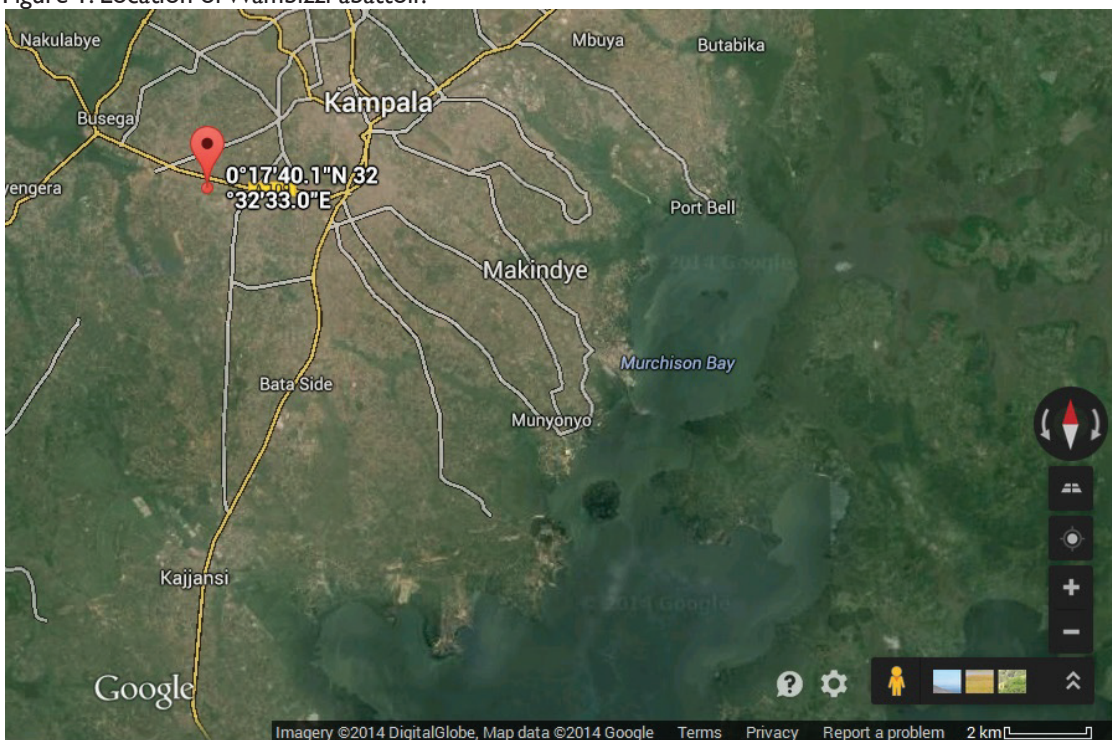
- assess the annual supply of pigs, seasonality and influencing factors
- identify the regional distribution of suppliers
- identify potential pig farmers and traders to enable mapping of the supply chain
- assess the setup of the facilities (separation of clean and dirty areas, hygiene facilities such as toilets, water sources, electricity supply, location of the premises and boundaries)
- describe the slaughter process, product flow, products, by-products and disposal management
- identify allocation of work force to certain tasks and relationships among slaughter men, traders, vendors and other abattoir stakeholders
- identify the stakeholders' knowledge and attitudes regarding meat hygiene
- assess risk factors compromising the health of abattoir workers as well as consumers
- assess knowledge, attitude and perception of responsibility for hygiene of abattoir management and workers

## Methods

### Study area

Wambizzi abattoir is located in the southwestern part of Uganda's capital city, Kampala, approximately 10 km from the shores of Lake Victoria at N 0.294484°, E 32.542500° (Figure 1). Approximately 16% (31 km<sup>2</sup>) of Kampala's surface is covered by wetlands (Mafabi et al. 1998). By definition, a wetland is a land area that is saturated with water, either permanently or seasonally. The abattoir is located in the seasonal wetland area of Nalukolongo.

Figure 1: Location of Wambizzi abattoir.



Source: <https://goo.gl/maps/CdVtv>

### Participatory epidemiology

Participatory epidemiology is an emerging branch of veterinary epidemiology based on the principles and methods of participatory rural appraisal. In some contexts, participatory epidemiology is used in a very similar way to participatory rural appraisal but focuses on animal health rather than taking a broad view of problems in a given community (Catley 2005). The concept of 'stakeholders in a given community discussing a problem' has proved to be effective in veterinary public health too, where it provides a fast and relatively cheap way of identifying zoonotic and foodborne risks to public health, as in the Safe Food, Fair Food project.

A wide range of participatory epidemiology methods are available. They can be categorized into three main groups: informal interviews, visualization methods and ranking and scoring methods. In the present survey, these methods were used with three groups of key informants. We conducted one focus group discussion with four members of management, one in-depth interview with two permanent meat inspectors and one focus group discussion with 10 abattoir workers.

These methods were complemented by secondary literature, sales records and direct observation using a structured checklist. This process of comparison and cross-checking is called triangulation and is similar to the process of making a diagnosis in animals or humans which involves comparing information from different sources, taking into consideration the case history, physical examination, laboratory tests, research findings and textbook knowledge. All this information is mentally combined to provide a provisional or final diagnosis (Catley 2005).

## Participatory epidemiology tools used

### Mapping of the premises

This activity was conducted with the abattoir management to draw conclusions on the setup of the facilities (location of the premises on land suitable for running an abattoir, strict separation of clean and dirty areas, water sources, electricity supply and hygiene facilities such as toilets and hand washing basins).

### Seasonal calendar

Temporal variations in supply and demand are a common phenomenon in marketing of animal-source food products in sub-Saharan Africa, for instance, milk surplus during the rainy season or high demand for mutton at the end of the Muslim fasting season of Ramadan. This can result in discrepancies of price development and hence sometimes paradox losses and benefits for the smallholder farmers. The abattoir management used a seasonal calendar to map the seasonal supply of pigs, generating information on factors influencing pig marketing and possible constraints to suppliers (farmers and traders) as well as marketers and consumers.

### Geographical mapping of supply and demand

With the help of a drawn map showing the regions and districts of Uganda, the abattoir management visualized the spatial distribution of animal supply, mainly from smallholder farmers. Complemented by incidence data of signs in pigs at the abattoir, this allowed the identification of potential high-risk areas for further research.

### Mapping of the slaughter process

Tracing live pigs from the point of arrival to the point when the slaughtered animals leave the abattoir allowed the identification of allocation of work force to certain tasks and relationships between slaughter men, traders, vendors and other abattoir stakeholders. This exercise was complemented by filling in an observation checklist to identify practices that contribute to or compromise the hygiene of the pork as well as the health of the workers handling the animals and the meat.

### Mapping of the product and cash flow

The focus group discussion with the abattoir workers aimed at assessing the flow of products and by-products of the slaughtered pigs as well as the prices of these products and who sold and bought them. This not only helped identify marketing channels and thus beneficiaries from the sale of pork and its by-products, but also allowed the identification of groups of people at risk of contracting diseases due to handling or consuming certain pig products and by-products.

## Proportional piling

This method was used with the abattoir workers to identify the proportion of live or slaughtered pigs showing signs of diseases. A circle was drawn on a flipchart to represent the abattoir. A pile of beans was put in the circle to represent all the pigs arriving at the abattoir. The workers divided the pile of beans into two, indicating the proportion of animals that arrived dead or alive. They further divided the pile of those that arrived alive into those showing and not showing signs of diseases, slaughtered and not slaughtered, and with and without signs of diseases in the slaughtered pigs.

## Structured interviews

Interviews were conducted with the two meat inspectors who were permanently based at the abattoir, to assess the knowledge, attitudes and practices that increase or mitigate risks associated with the pork that was eventually stamped and declared fit for human consumption. Complemented by the findings from discussions with all three groups of key informants, the interviews gave an insight into the prerequisites and working conditions.

# Results

## Presentation of findings

Data were collected during a focus group discussion with the abattoir management (1 August 2012), through an in-depth interview with the two meat inspectors (6 August 2012) and a structured observation checklist and a group discussion with the abattoir workers (8 August 2012). The results, however, are not presented by activity but by topic and refer to the specific objectives including risk factors that contribute to the exposure of staff and clients to zoonotic diseases.

## The organization of the abattoir

Wambizzi Cooperative Society Limited was set up in 1971 as a livestock cooperative under the Cooperative Act. It was organized by farmers running piggeries who were having difficulties selling their products. Consequently, these farmers organized the abattoir services and transport of pigs from farms to the abattoir. Before the civil war of 1981–86, the cooperative also ran a shop near Nkrumah Road in Kampala that sold feed supplies and veterinary drugs as well as a supermarket for selling the products after slaughter. According to the management, the supermarket was equipped with freezers. Initially, the abattoir received funding from the government; this changed with the liberalization of trade in 1987. The losses incurred during the civil war, coupled with the cut in public funds, contributed to the collapse of the enterprise.

Since its inception, only farmers were eligible for membership of the cooperative. From 1989, the constitution allows new members to join by paying an entrance fee of 20,000 Uganda shillings (UGX) (UGX 2500 = USD 1.00 at 30 August 2012) and buying 10 shares worth UGX 20,000 each. Using an average inflation rate of 12.2% (International Monetary Fund/Haver Analytics)<sup>1</sup>, UGX 20,000 in 1989 were worth UGX 282,401 (approximately USD 112) in August 2012.

At the time of the survey, the cooperative had 96 members (compared to 250 in the 1970s) and there were no members being recruited. The abattoir management assumed that membership was declining because farmers opted to join other businesses which generated money more quickly. Animal diseases such as swine fever and high cost of feeds and drugs discouraged farmers from keeping pigs. Moreover, prices for pork were said to be the same in both urban and rural areas, therefore, farmers found an easy market within close proximity. According to the constitution, members had to be pig farmers and use the cooperative's channels to sell their pigs and related by-products. In return, the members could make use of the abattoir facilities. However, the cooperative could no longer facilitate transport of pigs to the abattoir because the lorry was looted during the civil war and had never been replaced. Individual traders and farmers brought their animals to the abattoir for slaughter, meat inspection and sale.

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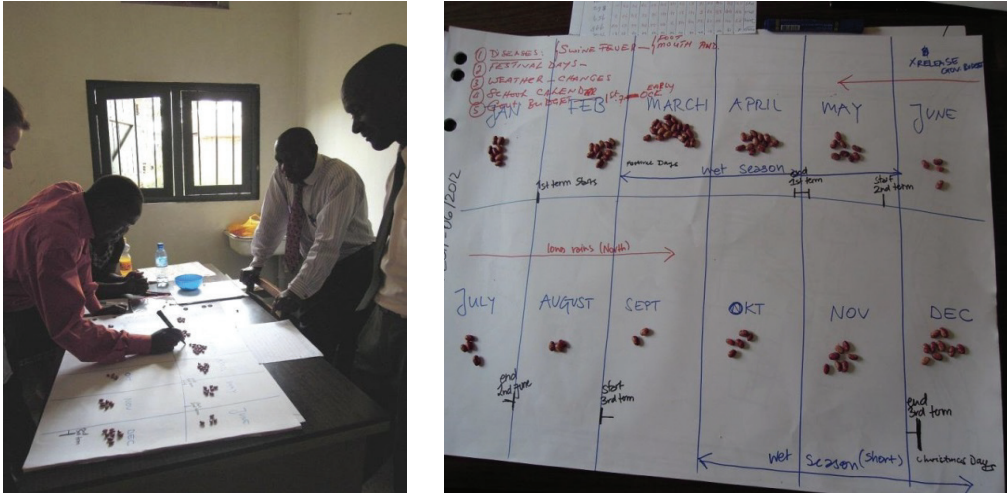
1.  $PV(1+i)^n$  where PV is the value of money in 1989, 'i' is the average interest rate or inflation rate (12.2%) and 'n' is the number of years used in the compounding (23).



## Seasonal variation in supply of live pigs

During the group discussion with the management, a seasonal calendar was drawn to show the variation in the supply of pigs during the 2011–12 fiscal year (July 2011 to June 2012) and 92 beans allocated proportionally (Figure 2). Factors influencing the variation in supply were identified. To validate the information on the seasonal calendar, the numbers indicated on the calendar were compared to data from the written sales records at the abattoir (Table 1).

Figure 2: Drawing a seasonal calendar to show the variation in supply of pigs during the 2011–12 fiscal year and factors influencing supply.



Photos: ILRI/Kristina Roesel.

During the 2011–12 fiscal year, the highest supply of pigs was in March, followed by April, February and December while September had the lowest supply (Table 1 and Figure 3). The variation in supply of pigs was attributed to annually recurrent factors and factors specifically linked to circumstances in the previous fiscal year. In general, supply fluctuated as a result of pig disease outbreaks, festivities, weather changes, the school calendar and the release of the government budget.

Table 1: Number of pigs supplied at the abattoir from July 2011 to June 2012

Source of data	2011						2012						Total
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Seasonal calendar	4 (4.35)	3 (3.26)	2 (2.17)	5 (5.43)	7 (7.61)	9 (9.78)	8 (8.70)	10 (10.87)	20 (21.74)	12 (13.04)	8 (8.70)	4 (4.35)	92 (100)
Abattoir records	998 (5.25)	956 (5.03)	852 (4.48)	1392 (7.32)	1726 (9.07)	1874 (9.85)	1819 (9.56)	1889 (9.93)	2160 (11.36)	1920 (10.09)	1800 (9.46)	1635 (8.60)	19,021 (100)

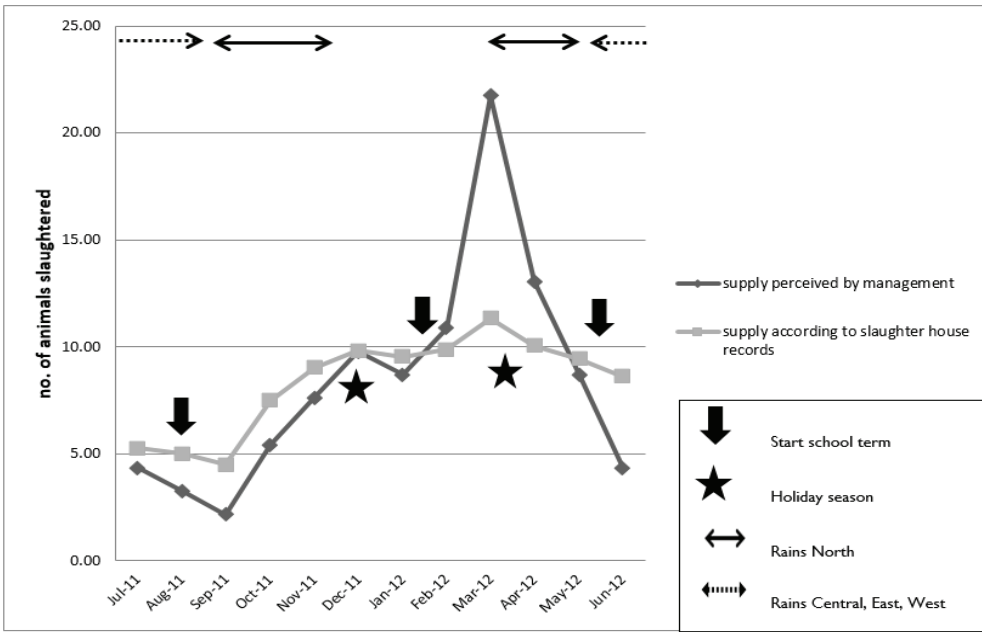
Percentages in parentheses.

The high supply of pigs in March, April and December was attributed to the Christmas (24–26 December 2011) and Easter (6–9 April 2012) holiday seasons. Moreover, the supply largely depended on seasonal rainfall. In the central, western and eastern regions of the country, there is usually a three-month season with intermittent rains between October and December and a season with heavy rains from March to May. In the northern region, there is only one rainy season from May to mid-September. However, in the period under study, the rainy season was not associated with an increased number of pigs from the North to the abattoir because there was a ban on movement of animals due to outbreaks of African swine fever and foot-and-mouth disease just before the third school term which started in September. The abattoir management had observed an increase in the number of pigs supplied one to two weeks before the start of each school term; term 3, 2011 started on 5 September 2011<sup>2</sup>; term 1, 2012 started on 30 January 2012<sup>3</sup> and term 2, 2012 started on 14 May 2012.

2. <http://www.monitor.co.ug/Magazines/PeoplePower/-/689844/1229640/-/13xdjuaz/-/index.html>

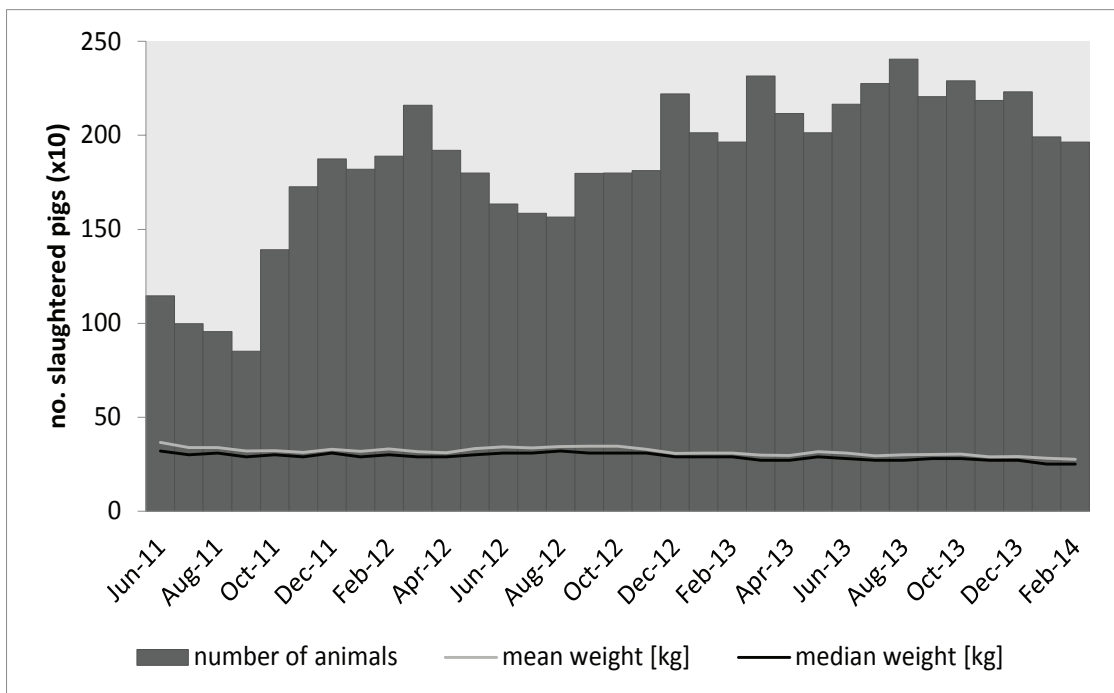
3. [http://www.edulinksuganda.com/index.php?option=com\\_content&task=view&id=362&Itemid=134](http://www.edulinksuganda.com/index.php?option=com_content&task=view&id=362&Itemid=134)

Figure 3: Perception of abattoir management triangulated against abattoir records.



The observed low supply of pigs between May and September was because most animals had been sold during the holidays and the others were kept until the new school term started. This pattern had been confirmed by one of the meat inspectors during the initial visit in June 2012. Moreover, he supported the promotion of pig keeping in Uganda due to rising demand for pork (FAOSTAT 2014). When he started working at the abattoir in 1996, no slaughtering was carried out between April and September. A review of the abattoir records revealed that in the period under study, there were only seven days when no slaughtering took place: Sunday 10 July 2011, Sunday 7 August 2011, Monday 8 August 2011, Friday 12 August 2011, Thursday 1 September 2011, Tuesday 6 September 2011 and Thursday 8 September 2011. The number of pigs slaughtered at the abattoir between June 2011 and February 2014 increased over time with a slight decrease in the mean and median weights recorded (Figure 4).

Figure 4: Average number of pigs slaughtered at Wambizzi abattoir from June 2011 to February 2014.



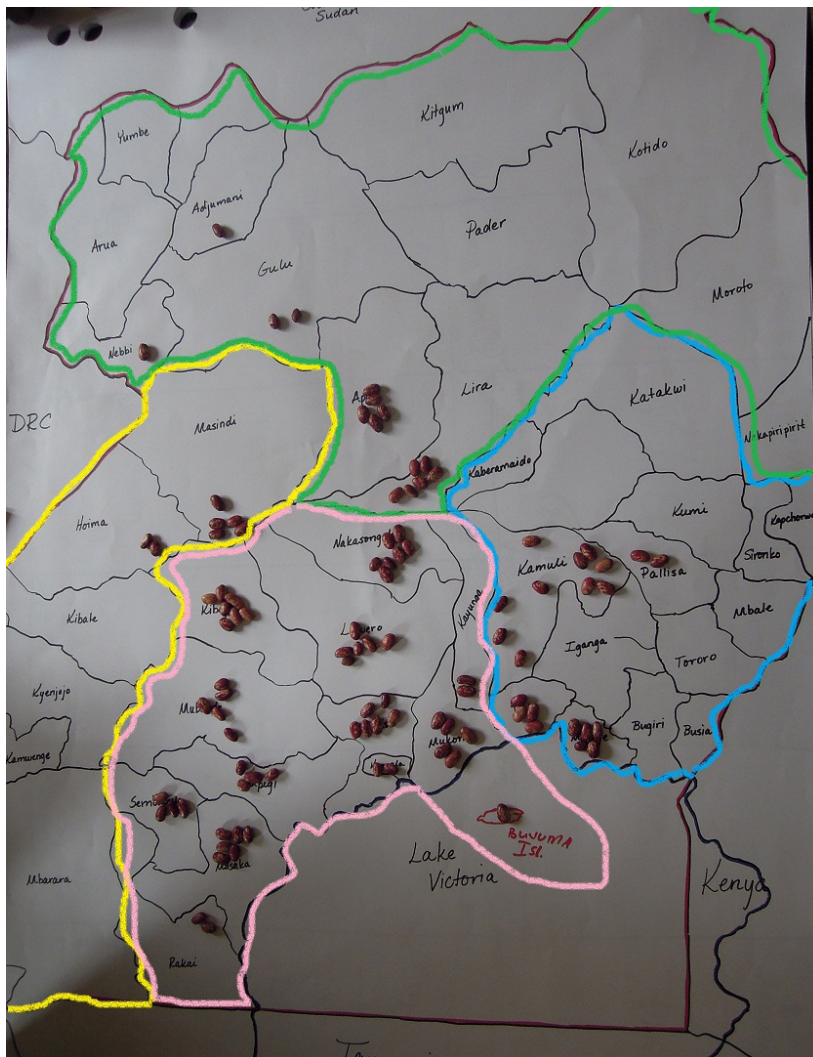
Another factor that influenced the supply of pigs to the abattoir was the timing of the release of the government budget which occurs in early June every year. Subsequently, there are three months of parliamentary discussions on how to allocate the budget and during this period, the demand is very low because the private sector restricts its spending in general (speculative behaviour). Private and public investment temporarily stagnates until the funds are released in early October and spending can be profitably aligned to the government agenda again.

## Spatial distribution of the source of live pigs

In 2012, the cooperative had about 20 regular pig suppliers, dealing mainly in local (black) pigs, followed by Landrace and Large White crossbreeds. The suppliers were actually traders who collected the pigs through intermediary agents throughout the country. The agents worked for the traders and, from the perspective of the cooperative's management, it was impossible to trace back the animals to individual farms. The abattoir was also irregularly supplied by farmers and private individuals (non-members) who brought one or more pigs for slaughtering against a fee of UGX 6500 per pig (approximately USD 2.60).

In a mapping exercise, the management team was given 100 beans and a pre-drawn sketch of a map of Uganda. They placed the beans on the map to show the locations from where the suppliers collected the pigs to bring to the abattoir (Figure 5). Most of the pigs are sourced from throughout the central region (57%) followed by the eastern (21%), northern (15%) and western (7%) regions. Because the supply of pigs from the North was negligible due to restrictions on animal movement during 2011, the team indicated the usual sources on the map.

Figure 5: Spatial distribution of the source of pigs slaughtered at Wambizzi abattoir.



An attempt to triangulate these findings with written records was unsuccessful because only a small proportion of the pigs that were brought to the abattoir were accompanied by movement permits indicating the place of origin (Table 2). According to the management, no permits are required for movement of animals to the abattoir from within Kampala or the adjacent Wakiso and Mukono districts. In some cases, the intermediary traders were unable to trace the veterinary officers in the areas where the pigs came from and in other instances, the traders chose not to disclose the source of the animals and refused to hand over the permits.

Table 2: Number and proportion of pigs arriving at the abattoir with a movement permit

	2011						2012						Total
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Slaughtered	1004	956	862	1431	1726	1875	1820	1889	2166	1922	1801	1648	19,100
With movement permit (%)	76 (7.6)	100 (10.5)	193 (22.4)	245 (17.1)	185 (10.7)	269 (14.4)	168 (9.2)	526 (27.9)	292 (13.5)	348 (18.1)	No data	No data	2402 (12.6)

Contrary to the spatial distribution of supply of pigs, demand was concentrated in Kampala and its environs. The four members of management were asked to name and rank their main customers. The ranking exercise revealed that the main customers were pubs and ‘pork joints’ in town (Table 3). A pork joint is a place where customers can buy raw pork or eat fried/roasted pork served with a vegetable accompaniment. These places are also for socializing where one can meet friends, sit down for a meal and a drink and sometimes watch television, play pool or listen to music.

Table 3: Ranking of the top six customers sourcing pork from the abattoir

Rank	Ultimate customer
1	Pubs (4x <i>Hakuna Matata</i> in town) and pork joints
2	Quality Cuts/Fresh Cuts
3	Butchers
4	Supermarkets
5	Hotels
6	Private organizations (non-governmental organizations, missions and private individuals)

## Setup of the abattoir premises

The first activity in the survey was a group discussion with the abattoir management. The four members of management were asked to draw a map of the abattoir premises. The map had to include features such as buildings, boundaries, elevation, neighbourhood (other companies, streams, swamps and roads), operational water sources, power sources, security posts, toilets, hand washing facilities, drainage system, marketing outlets and waste disposal facilities. The abattoir’s project coordinator took a lead role in drawing the initial sketch which was subsequently built upon through the contributions of the other group members (Figure 6). The map was reviewed to gather more information about its details. It was later compared to findings from direct observations, structured interviews with the meat inspectors and a group discussion with the abattoir workers. Based on these additional findings, a cleaned map was produced (Figure 7).

Figure 6: Map of the abattoir premises, drawn by the participants.

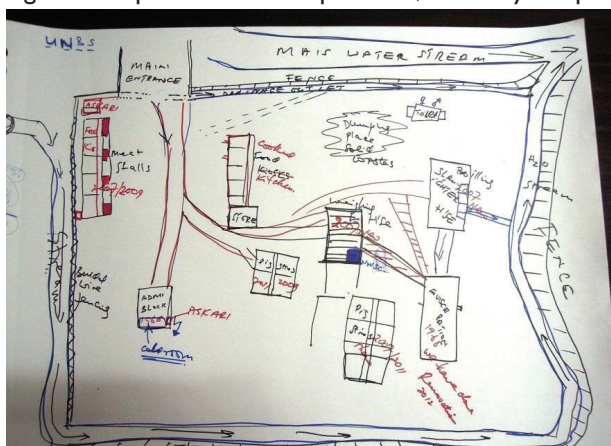
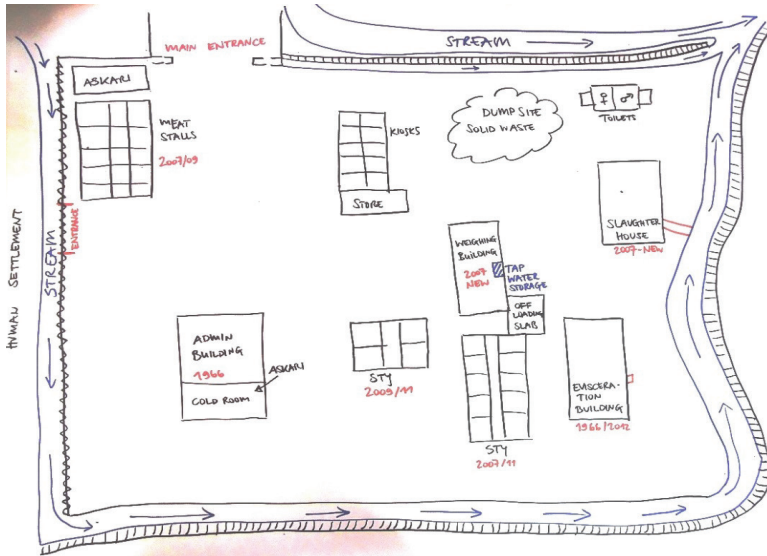


Figure 7: Map of the abattoir premises, cleaned by the authors.



The original abattoir comprised the following buildings erected in 1966 and funded by the Government of the Buganda<sup>4</sup> Kingdom:

1. Administration building
2. Cold room
3. Hair removal house, including the scalding tank (last refurbished in 2007)
4. Meat stalls/canteen building (last refurbished in 2009–11)
5. Kiosks building
6. Holding pens (last refurbished in 2007–11)
7. Pit latrine
8. Evisceration/inspection building (built in 1965 and renovated in 2007)
9. Weighing/sales building (added in 2007)
10. Boiler unit (added during Commonwealth Heads of State meeting in 2007)

In the 1970s, the Government of Uganda supported cooperatives but government funding was stopped in the course of the following years. Therefore, all additional constructions and refurbishments were paid for through the cooperative's fund-raising efforts. The current evisceration building and the weighing/sales building were refurbished after the Commonwealth Heads of State meeting in Uganda in 2007. The cold room was looted and destroyed during the 1981–86 civil war together with the cooperative's lorry, which has never been replaced.

A small stream and tributary to the main Nalukolongo channel formed the natural boundary of the abattoir premises. Behind the stream on three sides of the plot was a brick wall separating the adjacent industrial premises (including a coffee processor). The entire industrial area was located in the Nalukolongo wetlands and as a result, the premises were frequently flooded after heavy rain. The abattoir management reported that neighbouring companies had adopted a strategy of heaping soil to elevate individual premises but the abattoir had not. A brick gate was built at the main entrance to drain the water into a ditch and lead the water into a stream away from the abattoir grounds. The abattoir management was very concerned about the amounts of mud present after the rains.

4. Buganda Kingdom is one of the seven prevailing kingdoms in Uganda and is located in today's Central region.

A barbed wire fence forms the remaining boundary behind the so-called meat stalls. However, this fence is not continuous; there is a non-lockable, non-secured entrance accessible to anybody from outside. The abattoir staff employs two security guards who work in two shifts (night and day). Contrary to what the drawing suggests, there is no guard post near the gate, although there are plans to have one because drug addicts keep coming into the premises at night. Currently, the security guards have their post behind the administration building. Free movement of people into and out of the premises was observed during visits to the abattoir.

From the main (tarmac) road, the abattoir was accessible through a dirt road passing through an industrial area, with most of the neighbouring companies having main gates in place. The abattoir was located at the end of this industrial area where it sat in the transit area to a human settlement. People from this settlement were seen collecting by-products from the abattoir and carrying them through the gap in the fence behind the meat stalls.

Located in the weighing building was one permanent water source that provided tap water. However, there were no connecting pipes in place so the abattoir workers were forced to carry water in jerry cans or buckets to the slaughter and processing areas. The workers perceived this as a big disadvantage. At the time of the study in 2012, it was reported that the slaughter men sometimes did not want to walk all the way to the tap and so drew water from the stream for use in meat processing. Also, the water in the jerry cans was used for anything—cleaning the animal, washing hands and knives and even drinking.

There was no source of electricity on the premises. The administration building was wired but not connected to the grid. This connection was also destroyed during the civil war. The other operational buildings were not wired. It was observed that slaughtering, meat inspection and processing took place in the dark morning hours. The sun rose at around 0700 hours but slaughtering started much earlier. The meat inspectors and some workers used torches.

There were two permanent toilets on the premises, so called port-a-potties, latrines which were emptied once a month by the leasing company. There was one for men and one for women and they were also used by the communities living in the surrounding areas. In the past, basins and soap for hand washing were provided at the toilets. There was no running water but tap water was provided in a jerry can. However, this was stopped after the jerry cans, basins and soap were repeatedly stolen as soon as they were placed by the toilets. It was observed that the toilets seemed not to have been used in the recent past and were highly infested with maggots because they were due for emptying.

There were two drainage systems in place: one drained water out of the evisceration house and off the premises into the stream while the other was installed in the abattoir to collect and dispose blood into the stream. This system consisted of three pits in the abattoir constructed like a three-changer septic tank but with an outlet at the bottom leading to the stream. It was supposed to be filled with the blood running off into the first pit (over an inclining floor). When the first pit was filled, the second filled up through spill-over flowing through a pipe on top of the pit. At the end of the day, the blood was diluted with water and then drained into the stream by means of a pipe at the bottom of the tanks. The management said they mixed disinfectant into the water to dilute the blood. However, when they were asked to show the disinfectant, it turned out to be soap. The pit was not always used for collecting blood. Sometimes, live pigs were held there while other pigs were slaughtered, bled and scalded.

The 10 meat stalls were owned by the cooperative. According to the management, the vendors paid the cooperative a monthly rental fee of UGX 20,000 (USD 8) and a daily fee of UGX 1000 directly to the cleaner, a casual worker who was not employed by the cooperative, to clean the stalls at the end of the day. At these stalls, the vendors sold offal, heads, feet and ready-to-eat foods. The management explained that compliance with hygiene rules was supervised when the management walked the premises after 0800 hours.

Wheelbarrows were used to transport the dung from the holding pens to the waste disposal area. Farmers could come and take the dung to use as manure/fertilizer. What was not taken was left there and the pile was burned once a month. For condemned carcasses, a hole was dug at the waste disposal area where the carcass was covered with paraffin and burned. Carcasses with cysts were covered with paraffin and buried. Low-grade carcasses without signs of zoonoses were given to dogs.

## Slaughter process

The slaughter process was described by the management as well as by the workers during their respective group sessions to visualize the movement of animals from their arrival to the point where the carcasses leave the abattoir.

This descriptive activity was complemented by information obtained through a structured observation checklist and by following individual pigs. The purpose of the activity was to identify:

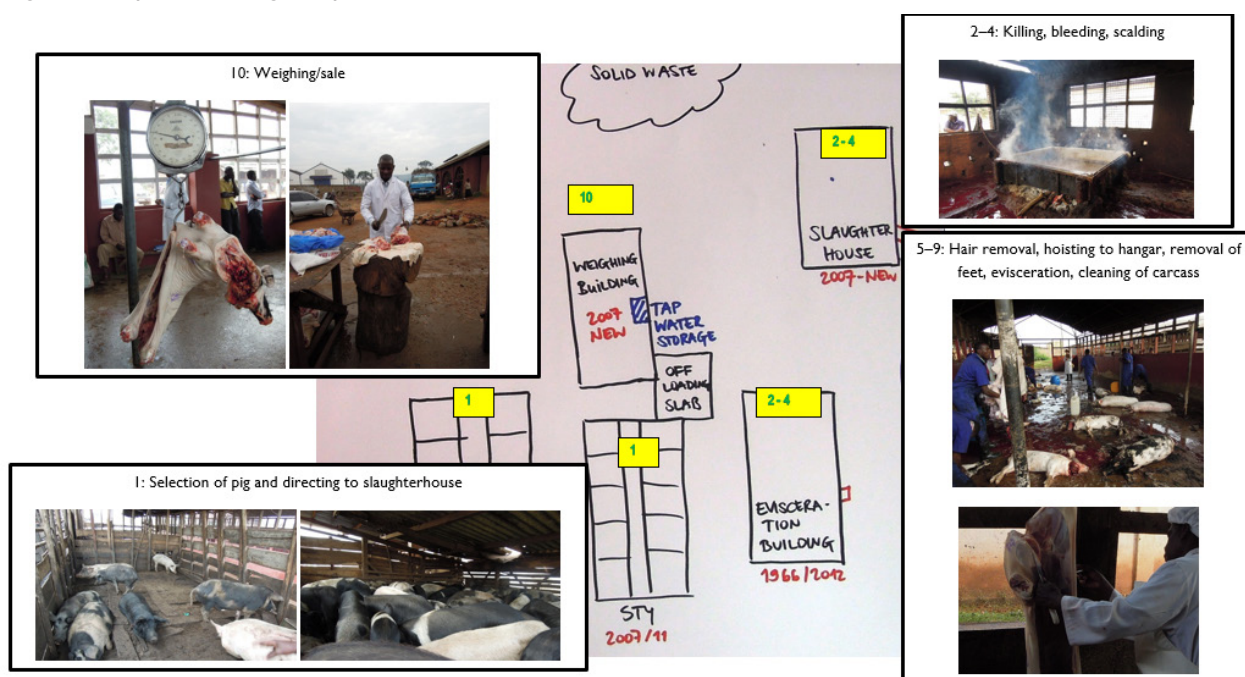
- the flow of products, by-products and cash as well as disposal management
- factors compromising meat hygiene and thus the health of consumers
- risk factors for those handling the meat (occupational disease)
- allocation of work force to certain tasks and relationships between slaughter men, traders, vendors and other abattoir stakeholders

The research team mapped the slaughter process by following two pigs from the holding sties to the weighing house from where the trader sold the meat (Figure 8). Times between the different activities were recorded for the two pigs.

1. **Selection of pig and directing to abattoir:** The trader either selected one pig to be slaughtered or told the slaughter men which size of an animal was needed to be slaughtered. The slaughter man then came to take the pig. He grabbed the pig by the tail or the ears and directed it around the weighing house towards the abattoir (about 30 to 40 metres away) by pulling its tail or pushing its back. Inside the slaughter building, the pig was moved forward between two raised concrete blocks and over to the pits. The slaughter man used his foot to shove the pig into the pit where it waited alone or along with other pigs. The pig did not attempt to get out of the pit. The slaughter man left and returned several minutes later. He jumped down into the pit and hit the pig repeatedly to force it to jump out of the pit. The pig was then moved to the area around the boiling tank.
2. **Killing:** The slaughter man lifted the pig and threw it down on its side. He grabbed the top forelimb and held it up so that the pig could not stand. He used one of his feet to step on the body of the pig to hold it down. He cut the pig's throat with a knife, using a sawing motion. He cut through the fat, carotid arteries, jugular veins, trachea and oesophagus and stopped when he reached the cervical vertebrae. The pig screamed until the knife reached the trachea and then there was a gurgling sound.
3. **Bleeding:** The pig thrashed on the floor for about one to four minutes, in its own blood and faeces and those of other pigs being slaughtered at the same time. There were five other pigs being bled on the floor.
4. **Scalding:** The pig was left on the floor for 9–30 minutes before being put into the boiling tank. There were five other pigs in the boiling tank. The pig remained in the boiling tank until one of the slaughter men determined that it was ready to come out by testing how easily its hair could be pulled. When the pig was ready, the slaughter man pulled it out using a grappling hook and dragged it through the blood and faeces on the floor of the slaughter building. He continued outside, pulling the pig on the ground through the walkway to the evisceration building. The pig was dragged over the steps and through the standing water and hair. The pig was left on the ground for about seven minutes with another carcass while the slaughter man went to get water in a bucket or jerry can.
5. **Hair removal:** The slaughter man returned with a bucket or jerry can containing water from the tap, as well as his metal cup, razor blade and knife. He dropped two of the grappling hooks into the water and then pulled out the metal cup. He used the metal cup to scrape the hair off and then to rinse the carcass. This part of the process was very rough on the carcass, perhaps damaging the skin and the meat. He rinsed his hands several times throughout the process of hair removal. When the large hairs had been removed, he used the razor blade to remove the finer hairs. Hair was removed everywhere except for the head and feet. When he had finished, the pig was rinsed once more. This process took up to 30 minutes.

6. **Hoisting to hangar:** The slaughter man took his knife from the water in the bucket and made an incision between the caudal aspect of the tibia and the common calcaneal tendon. The knife was then placed on the floor. He took one of the grappling hooks from the bucket and put it through this incision, then hoisted the pig up so that it was hanging from the railing in the evisceration building. When the pig was lifted, blood, hair and faeces remained on the carcass. The remaining hair was scraped off. The slaughter man rinsed the carcass while it was hanging and then dumped the remaining water in the bucket onto the floor.
7. **Removal of the feet:** The slaughter man picked up his knife and cut out the collar of the pig, which he threw into the bucket. He then dropped his knife on the floor and picked up a panga (local name for a machete knife) that was being shared with the other slaughter men. He used the panga to hack off three of the four feet, leaving the one that was suspending the pig from the rail. He dropped the panga on the floor and picked up his knife again.
8. **Evisceration:** The slaughter man used his knife to cut off the pig's tail, which he threw in the bucket. Then, using the knife, he opened the body cavities of the pig, cutting away the mammary tissue and associated fat as he did so. He threw this into the bucket. Then he cut around the anus and rectum and proceeded to remove the whole gastrointestinal tract, cutting along the mesentery which suspends the gastrointestinal tract from the dorsal wall of the abdominal cavity. The total time from the killing of the pig to removal of the gastrointestinal tract was 64 and 91 minutes in the case of the two pigs observed. He also pulled out the reproductive and urinary tracts. He threw all of these into a pile on the floor, with the exception of the kidneys, which he threw into a bucket or a plastic bag. He pulled out the spleen and the liver and after removing the gall bladder, he also put these into the bucket or plastic bag. He cut through the diaphragm and removed the lungs, heart and lower trachea, which all went into one bucket or plastic bag. Another slaughter man came by to pick up the gastrointestinal, reproductive and urinary tracts.
9. **Cleaning of carcass:** When all of the viscera had been removed, the slaughter man rinsed the body cavity with water from a yellow jerry can. He called the meat inspector, who inspected and stamped the carcass. The slaughter man then put the carcass over his shoulder and another slaughter man picked up the panga to hack off the remaining foot. The hooks and knives were put into the blue bucket with the organs.
10. **The slaughter man then carried the carcass to the weighing house.** The head was removed and thrown on the floor from where it was picked up by a woman. The carcass was then weighed (23 kg and approximately 30 kg in the case of the observed pigs). He brought the carcass back outside and put it down on the wooden tables behind the weighing house or on the concrete tables in the weighing house. He then left.

Figure 8: Map of the slaughter process.





# Activity clock

The timing of activities of the different groups working at the abattoir are presented in Table 4.

Table 4: Activities as perceived by the different groups working at the abattoir

Time	Slaughter men	Management			Meat inspectors
00:00					
00:30					
01:00					
01:30					
02:00	Arrival at abattoir				
02:30					
03:00					
03:30					
04:00					
04:30					
05:00	Picking 10 pigs for slaughter and cutting the throat				
05:30					
06:00	Scalding and hair removal				
06:30	Hanging, cleaning, dressing (10 minutes), taken for weighing (30 minutes)				
07:00					
07:30					
08:00	Weighing; customers come to the weighing room to buy; packaging/loading for customers				
08:30					Meat inspector(s) present
09:00					
09:30					
10:00					
10:30		Slaughter process			
11:00					
11:30					
12:00					
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The abattoir workers said that they ate before they came to the abattoir in the morning and had a tea break around 0800 hours when they were done with the slaughtering. On the day of the observations, the workers were seen eating at the vendors' stalls after 0900 hours when the slaughtering was finished. If they needed to go to the toilet, they had to get permission from the trader (whom they referred to as 'the boss') to leave the work place. For defecating they used the toilets and for urinating they went somewhere behind the building. They washed their hands at the tap (water storage) in the weighing house.

## Ante mortem examination and signs in live pigs

Live animals, which were kept in holding pens from the time of their arrival, were not routinely inspected before slaughter. The meat inspectors said that ante mortem examinations are performed when animals are in the lairage and if a pig shows signs of disease such as coughing or anorexia. They both noted that there was no legal obligation to perform an ante mortem examination. Moreover, there is a lack of qualified staff. According to one inspector, between the time the inspectors left the abattoir to return their offices (around noon) and the time they arrived the following morning, any pigs arriving at the abattoir did not undergo ante mortem physical examination. It was noted that in the morning, there were pigs that had been slaughtered and were ready for inspection before either of the inspectors arrived and, therefore, could not have undergone ante mortem physical examination. This was happening because the abattoir premises were never locked and easily accessible to anybody at night. According to the inspectors, the health status of live pigs ranged from fairly healthy to healthy. If sick animals were discovered, they could not be isolated from the other pigs because there was no isolation pen.

The inspectors were asked about the frequency of symptoms they observed in live pigs. They said that gastrointestinal signs, especially diarrhoea, were almost never seen because the traders would not buy animals presenting these symptoms from the farmers. Anorectic pigs were seen more than once per week due to the stress of transport. One inspector said that he heard coughing pigs at least three times per week, while the other said that coughing is very rare in the pigs, having last seen it in a pig that was found after slaughter to have had pulmonary tuberculosis. Mange and other skin conditions, including marks caused by the slaughter men, were observed once a week to twice a month. One inspector said that signs in live pigs consistent with African swine fever are seen once per week. Nervous and cardiovascular system conditions were not noted by either inspector. Urinary and reproductive tract abnormalities were not specified either, although one inspector said that at least one pregnant animal is slaughtered per day. According to the inspector, some farmers have their female animals serviced prior to sale to increase the animal's live weight.

During the group discussion with the abattoir workers, proportional piling was done to assess the proportion of healthy and diseased live pigs. The proportional piling did not work too well with the group; they were not able to conceptualize proportions so they were asked about frequencies (often, not so often, not at all) of observing signs in live pigs using 12 different picture cards (Annex 1). The results are presented in Table 5.

In general, the workers noted that sick pigs were usually observed during the dry season. About 10% of the animals arrive sick and 90% arrive healthy at the abattoir. Death may occur but only rarely (about two in 100 pigs), mainly due to heat and transit stress; the dead bodies were usually given to the dogs after certification by inspectors and management. According to the inspectors, the time the pig had been dead was also taken into consideration (only if the pig died just before arrival). During the rainy season, the pigs were usually healthy. However, even if live animals showed signs, they were all slaughtered. If the signs were cyanosis or skin lesions, the carcass was condemned. If an animal happened to die while in the holding pen, it still went through the slaughter process.

Table 5: Signs in live pigs as observed by meat inspectors and slaughter men

Frequency	Observed by slaughter men	Observed by meat inspectors	Remarks on signs observed by meat inspectors
Often	Dry season:	Pregnant animals	Every day: at least one pregnant sow
	Diarrhoea (card 2)	Respiratory signs	Every three days: coughing ('transit fever'); mange; deep markings (trader's marks)
	Bruising on back (card 9)	Skin problems	Daily: lack of appetite in pigs with African swine fever or stress; erythema of ears, ventral abdomen, and perianal region with African swine fever (only seen often during an outbreak)
	Nasal discharge/red ear tips/bleeding patches/diarrhoea (card 6)	Lack of appetite	Every two weeks: flaky, tough skin seen with mange
Not so often	Nasal discharge only (card 11)	Diarrhoea	If the pigs have diarrhoea when they are brought, the trader refuses to buy them
	Lice* all year round (card 13)	Lameness due to broken limbs	
		Cardiac arrest due to stress	
Not at all	Coughing (card 7)	Respiratory signs	Sometimes coughing when the pig has tuberculosis
	Hernia (card 8)		
	Vomiting (card 1)		
	Circular scabs (card 5)		

\* Card 13 showed pigs with small black dots. After this card was chosen, the inspectors and slaughter men were shown cards 14 and 15 which had pictures of flies, midges, fleas, lice and ticks and asked to choose which best represented the small black dots. They unanimously agreed that they saw lice only.

## Meat inspection and signs in slaughtered pigs

Slaughter of pigs at the abattoir began before sunrise and as the buildings at the abattoir did not have electricity, inspection of carcasses required the use of torches. Slaughtering started before the arrival of the inspectors between 0500 hours and 0600 hours; therefore, the inspectors had to catch up when they arrived by inspecting carcasses that had already been brought to the weighing building and lined up on the counter. As soon these carcasses were examined, the inspectors moved to the evisceration building where they inspected the carcasses just after the slaughter men finished evisceration.

Other than animals that were slaughtered before the arrival of the inspectors and examined in the weighing building, carcass inspection took place in the building where hair removal and evisceration were performed. Following hair removal, the carcasses were suspended by hooks from rails from which they were eviscerated. The inspectors described the meat inspection procedure while performing it, as follows:

1. Examination of the integument for abscesses and signs of fighting or biting.
2. Visual inspection of the internal organs. If there are any obvious abnormalities, the organs are palpated and sometimes incised.
3. Removal of a piece of the hypaxial muscles (beneath the spine) and sternal intercostal muscles (muscles around the breast bone and the ribs) including a portion of the rectus abdominis muscle (lower abdominal muscle) using a knife. These pieces are checked for *Taenia solium* cysts. If found, the masseter (chewing) and gracilis (thigh) muscles are incised to look for further cysts. If cysts are found, the affected parts are condemned.
4. Stamping the carcass 'fit for human consumption' using a stamp shared between the two inspectors and kept in the office when they are not present at the abattoir.

Detailed descriptive information on the process was obtained by in-depth questionnaires and a structured observation checklist (Table 6). There is no protocol in place for post mortem examination of pigs in Uganda. As a general guideline, the abattoir management and the meat inspectors consult the Draft Uganda Standard (DUS 734), first edition 2007 'Requirements for the design and operation of abattoirs and slaughterhouses'. However, these guidelines do not include standard operating procedures for ante mortem or post mortem inspection. Therefore, the European Union (EU) regulation no. 854/2004<sup>5</sup> was referred to in this study; it lays down specific rules for the organization of official controls on products of animal origin intended for human consumption. Section IV, Chapter IV on domestic swine was simplified and used as a checklist. If certain aspects were not considered during inspection (marked 'No'), it did not mean that the inspectors violated the Draft Uganda Standard. It only meant that post mortem examination of carcasses at the abattoir was not compliant with components of the EU regulation. For example, according to the EU regulation, lymph nodes (*Lnn.*) are a vital component of meat inspection. Lymph nodes are a part of the body's immune system and act as filters for foreign particles including pathogens. Lymph nodes may become enlarged or inflamed or show lesions if a certain organ system is affected by disease because their drainage tributaries are specific to designated organ systems. It is therefore possible to identify certain infectious diseases by looking at the lymph nodes only.

Table 6: Post mortem inspection process at Wambizzi abattoir

Activity	Systematically examined according to EU regulation no. 854/2004?	Remarks
1 Visual inspection of skin	Yes	
2 Visual inspection of head/throat	No	The exterior is inspected. It is not possible to inspect the inside of the head and throat because it is not common practice to split the skull in half. <i>M. masseter*</i> (mastication muscle) is incised.
3 Incision and examination of <i>Lnn. mandibulares</i> (tonsils)	No	If they are still present following the throat cut, then they are examined but they are not explicitly sought after; none of the lymph nodes are systematically inspected. According to the meat inspectors, the lymph nodes are sometimes congested with blood due to transit fever**
4 Visual inspection of mouth/face/ tongue	No	The head is not split open until it reaches the meat stalls; there is no inspection (see 2).
5 Palpation of tongue	No	The meat inspector demonstrated how traders check the tongue for cysts when they buy from farmers; if they find cysts, they do not buy.
6 Visual inspection of lungs, trachea (air tube), oesophagus (gullet)	No	Yes, if there are outward signs of disease or if the slaughter man requests inspection, they will be examined.
7 Palpation of lungs, bronchi, <i>Lnn. mediastinales</i>	No	Yes, if there are outward signs of disease or if the slaughter man requests inspection, they will be examined.
8 Lengthwise opening of trachea, main bronchi	No	If there are signs at ante mortem (i.e. coughing, panting), they are opened.
9 Incision of lungs	No	If there are signs at ante mortem (i.e. coughing, panting), they are opened.
10 Visual inspection of pericardium (sac around the heart)/heart	No	Yes, if there are outward signs of disease or if the slaughter man requests inspection, they will be examined.
11 Incision of heart	No	Examined if there are cysts in other muscles (see 12 and 24).
12 Visual inspection of diaphragm (thin sheet of muscle between the lungs and abdomen; predilection site for tapeworm cysts)	Yes	Along with a cut in other muscles*** it is checked for tapeworm cysts. If found, the masseter and gracilis (thigh) muscles are incised to look for more cysts. If cysts are found, the affected parts are condemned.

5. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:226:0083:0127:EN:PDF>

Activity	Systematically examined according to EU regulation no. 854/2004?	Remarks
13 Visual inspection of liver and associated lymph nodes	No	Yes, if there are outward signs of disease (i.e. milk spots, bumps, hardened liver tissue) or if the slaughter man requests inspection, they will be examined.
14 Palpation/incision of liver	No	Yes, if there are outward signs of disease (see 13).
15 Visual inspection of gastrointestinal tract	No	Because the gastrointestinal tract is not 'officially sold', it is not examined, although people do take the intestines and stomach for processing and eventual consumption. If there are other signs of tuberculosis in the animal, the gastrointestinal tract will be examined.
16 Palpation of gastrointestinal tract and associated lymph nodes	No	It is not done to minimize cross-contamination of meat with faeces.
17 Visual inspection of spleen	No	When referring to the gall bladder the inspector called it spleen.
18 Visual inspection of kidneys and associated lymph nodes	No	Yes, if there are outward signs of disease or if the slaughter man requests inspection, they will be examined.
19 Visual inspection of pleura/peritoneum (inner lining of chest cavity and abdominal cavity)	No	
20 Visual inspection of genital organs (female)	No	Yes, if there are outward signs of disease (abscesses in mammary glands), they will be examined. The uterus is not examined because it is not consumed by humans. Pregnant females are frequently reported.
21 Visual inspection of genital organs (male)	No	When asked about the testicles, the inspectors were surprised that lesions/abnormalities can be found in the testicles.
22 Visual inspection of udder and associated lymph nodes	Yes	The udder is observed from outside but not at the associated lymph nodes.
23 Young animals: visual inspection of umbilical region (navel), joints	Yes	Very young animals are rarely slaughtered. If slaughtered, they are examined from outside.
24 Incision of <i>M. triceps brachii</i> (triceps) or <i>M. gracilis</i> (thigh)	Yes	<i>M. gracilis</i> mainly on the left side ( <i>M. masseter</i> , <i>M. triceps brachii</i> if there are cysts in the diaphragm)

Lnn: lymph nodes

\*M. refers to the Latin word for muscle, *musculus*

\*\*Transit fever refers to the symptoms like panting, fatigue and lack of appetite that pigs show upon arrival due to stressful transport.

\*\*\*Hypaxial muscles (beneath the spine) and sternal intercostal muscles (muscles around the breast bone and the ribs) including a portion of the rectus abdominis muscle (lower abdominal muscle)

During the in-depth interview, the meat inspectors provided information on signs in slaughtered pigs whereas the abattoir workers were asked about frequencies (often, not so often, not at all) of observing signs in slaughtered pigs using 17 different picture cards (Annex 1). The results are presented in Table 7.

Table 7: Signs in slaughtered pigs as observed by meat inspectors and slaughter men

Frequency	Observed by slaughter men	Observed by meat inspectors	Remarks on signs observed by meat inspectors
Often	Haemorrhagic diathesis (bleeding tendency)	Skin	<b>Symptoms observed once every two weeks:</b> Jiggers, common in pigs from the north (skin around feet is pruritic); mange (skin is flaky and tough)
	Hepatitis granulosa (liver inflammation)	Meat	
	Milk spots	Respiratory	<b>Symptoms observed once or twice a year:</b> African swine fever (erythema around ears, ventral abdomen, stomach and perianal region); <i>Taenia</i> cysts in muscle. When trucks of pigs from the north come into the abattoir, one per week may be condemned; at other times, there are fewer animals found to have cysts
	Erythema		
	Erysipelas (was seen as lacerations not erysipelas per se; mostly in the improved breeds caused by flies)		
	Echinococcal cysts		
Swollen limbs (in pigs that were tethered before)		<b>Symptoms observed less than once a week:</b> Lung congestion and lungs stuck to ribs	

Frequency	Observed by slaughter men	Observed by meat inspectors	Remarks on signs observed by meat inspectors
Not so often	Parasites: Intestinal worms, scabies, larvae migrans in lungs (they did not know whether it was a lesion or came from the squeezing when pulling the lungs out of the body)  Cyanotic ears  Fungi  Sarcocystosis cyst in the heart muscle (said they sometimes find it in muscle but not heart) – cysts in general in muscles not seen usually, depends on source of pigs (Lango, Lira, calcified cysts in muscle)	Gastrointestinal	<b>Symptoms observed three times a year:</b> On a daily basis just before the school term starts: thin animals, malnutrition
Not at all		Respiratory	<b>Symptoms observed less than once a month:</b> Very rare to see respiratory signs; maybe granulomas in the lungs with tuberculosis; stress from travel and lack of water causes panting, leading to congestion in the lungs

During the discussion, the inspectors were asked about general disease signs and how often they observed them. One inspector said that carcasses were often thin due to malnutrition, which is especially common just before the start of each of the three school terms in Uganda, given that pigs are sold to raise money for school fees, regardless of the body condition of the animals. Both inspectors noted that pulmonary congestion was commonly seen (at least one case per month). One inspector suggested that this condition was caused by the stress of travel ('transit fever') from lack of water and overcrowding in the transport trucks. Skin abnormalities in the carcasses were said to occur often (about two cases per month), mostly hyperkeratosis (thickening of the skin) attributed to sarcoptic mange as well as erythema and lesions caused by abuse by the slaughter men. The inspectors said they observed skin lesions consistent with African swine fever—including reddening of the ears, ventral abdomen and perianal region—once or twice a year. On average, carcasses containing cysts were found once or twice per month, with the frequency increasing with deliveries of animals from the northern districts. Neither inspector addressed any findings regarding diseases of the cardiovascular, nervous or urogenital systems. This is because there is no systematic flow of carcasses for examination and ample time for inspection of each carcass (unless signs were visible ante mortem).

The meat inspectors reported abnormalities to both the abattoir management and the city council, with a detailed report made to the latter. According to the abattoir workers, if signs were found in the pig carcasses, it was the meat inspector to decide whether or not to condemn the parts or the entire carcass. The frequency of carcass condemnation was irregular and ranged from once a week to once a month. The principal reason given for the condemnation of carcasses was the finding of *Taenia solium* cysts in the meat.

The inspectors described a phenomenon that occurred in 2006, which they called blue pork syndrome. They reported that several carcasses inspected each day had blue-tinged body fat, the cause of which was never discovered despite sending samples to multiple laboratories in and outside of Uganda. These carcasses were not condemned but passed as low-grade at a lower wholesale price. The fat was trimmed from the meat before the meat was sold.

The condemnation of carcasses is reported to the abattoir management and the city council. Condemned carcasses are covered with paraffin and buried on the premises because burying the carcasses is less expensive than burning. While special circumstances, such as blue pork syndrome, warrant outside intervention and funding by the Ugandan government, the inspectors are not able to pursue further diagnostics for most of the diseases encountered at the abattoir.

## Flow of products, by-products and cash

Table 8 shows the marketing channels for pig products and by-products at the abattoir and Figure 9 shows a map of the locations on the abattoir premises where these products and by-products are sold. The numbering in Figure 9 corresponds to the numbers allocated to the products in Table 8. Figure 10 describes the flow of live animals, meat, by-products and cash.

Table 8: Marketing channels for products and by-products at the pig abattoir

Item	Product	Seller	Buyer 1	Buyer 2	Price (UGX) if sold
1	Head including: Tongue Nose Ears	Trader	Women	Anyone Anyone Dog trainers Anyone	5000–8000 per head depending on size Negotiable 1000–2000 per polythene bag Negotiable
2	Brains, eyes				Discarded
3	Collar	Trader	Slaughter men	Anyone	Negotiable
4	Udder	Trader	Slaughter men	Anyone	2000–3000
5	Heart, lungs, kidneys	Trader	Slaughter men	Anyone	1500–2500 (depending on size of lungs)
6	Spleen, pancreas	Trader	Slaughter men	Anyone	4000 per polythene bag
7	Liver	Trader		Anyone	2000
8	Gall bladder				Discarded
9	Visceral fat	Trader	Slaughter men	Anyone	1500
10	Diaphragm, sirloin, bacon	Meat inspector		Anyone	Negotiable
11	Stomach, small and large intestines, uterus		Whoever washes them	Anyone (for dogs)	Negotiable
12	Bladder				Discarded
13	Testicles		Whoever washes the intestines	Anyone (for dogs)	
14	Genitals (testicles, penis; uterus, vagina)				Discarded (including contents i.e. foetuses); testicles for the dogs
15	Tail	Trader	Slaughter men	Anyone	500
16	Skin	Trader			
17	Feet	Trader	Women	Anyone	6000 for four
18	Meat (including bones)	Trader		Anyone	6500 per kg wholesale price
19	Blood				Discarded
20	Faeces				Discarded (given out as manure)

Figure 9: Locations on the abattoir premises where products and by-products are sold.

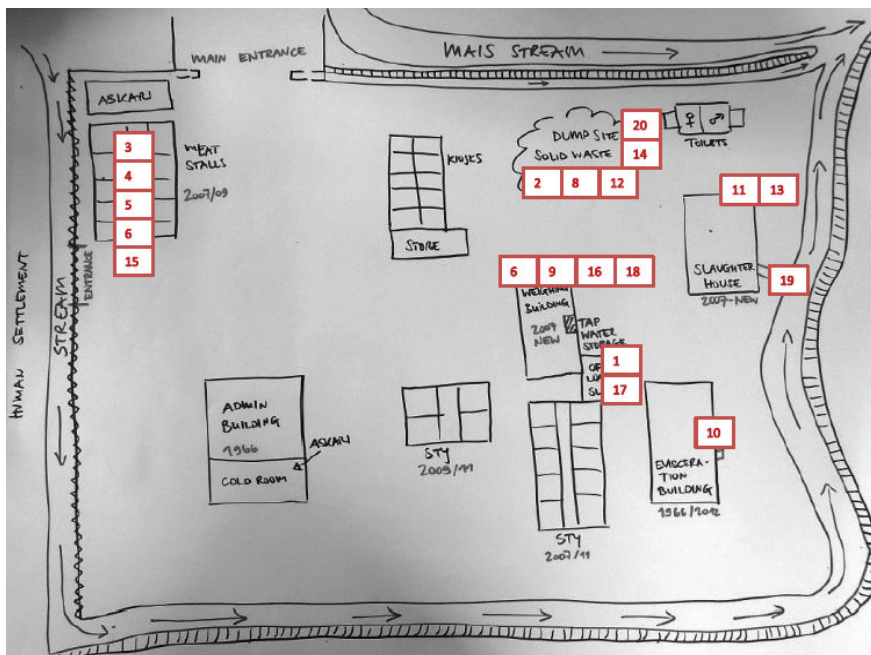
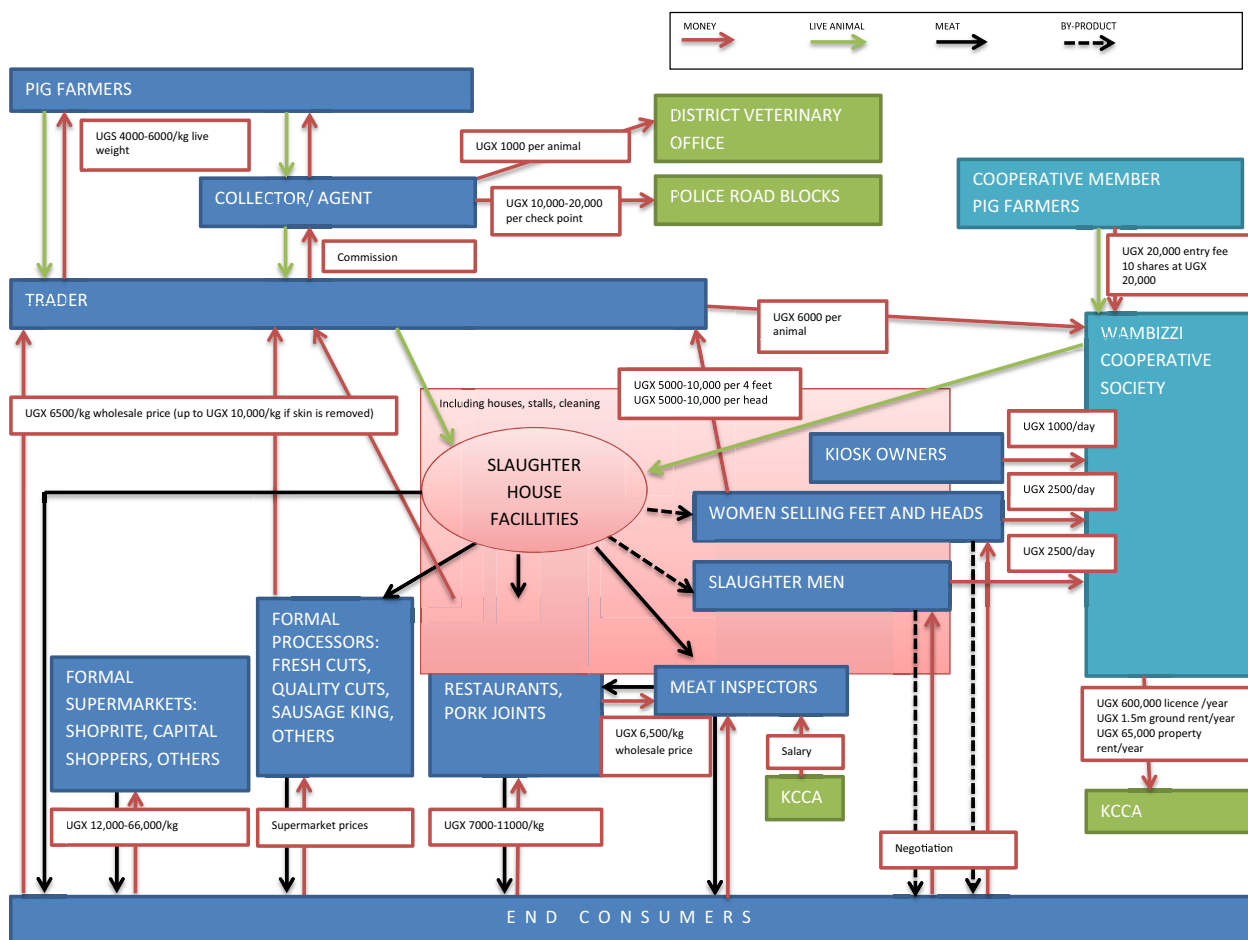


Figure 10: Flow of products, by-products and cash.



## Knowledge and attitudes

### Education and training

The four members of management had all passed secondary-level education: one was a teacher, one had a diploma in business administration and the remaining two had multiple diplomas related to cooperative business administration, finance or accounts as well as agriculture. However, none of them had received formal training in meat hygiene.

The meat inspectors, who reportedly follow regulations set out in the Animal Disease Act and the guidelines of the Draft Uganda Standard (DUS 734), were asked about the education and training they had received to become meat inspectors. Both went to agricultural colleges in Uganda, where they earned diplomas in animal husbandry. At the time, the training included coursework on meat handling and abattoir standards. One inspector had gone to the Netherlands for training specifically on pig slaughter and marketing. Both inspectors had undergone continuing professional education courses since finishing their diplomas; one had been to only one course in 10 years of work at the abattoir while the other went for training twice per year. The training courses were funded and organized by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

Out of nine abattoir workers, four had received vocational training (two as mechanics, one as a construction worker and one as a percussion trainer). None had received training in meat hygiene; the abattoir management had promised to provide training but had not yet done so.



## Awareness on zoonotic diseases

The management was asked if they knew about diseases that can be transmitted from pigs and pork to people. After a short debate on whether the swine epidemic in the news in 2009 was swine flu or swine fever, they decided it was swine flu. Moreover, tapeworms, round worms, worms in general and *Cryptosporidium* can be transmitted through pigs and pork. The diseases are transmitted through eating poorly cooked meat, through close contact with infected animals, through the air, when walking barefoot or through dirty water. During the interviews, the meat inspectors were asked to name some diseases they knew could be transmitted between pigs and humans, including the name of the disease in people, the mode of transmission and whether any control measures were in place (Table 9).

Both inspectors mentioned tuberculosis first, saying that it was transmitted either by improper cooking or through the environment to people working closely with pigs. The only control measure for tuberculosis in pigs was partial condemnation of the carcass. Secondly, both inspectors identified cysticercosis caused by *Taenia solium*, which they said was transmitted to pigs from humans in areas where latrines were not used and to humans from pigs by ingestion of improperly cooked pork. Control measures that were mentioned included advising people to build and use latrines and condemning carcasses containing cysts. One inspector mentioned sarcoptic mange, because that inspector had been diagnosed with and treated for scabies three years earlier. The other inspector identified 'stomach problems' as a disease in humans caused by contamination of pork but did not specify a pathogen. The same inspector also listed 'poison' as a causative agent in meat that caused 'stomach problems' in humans. The exact toxin or pathogen that was meant was unclear.

Table 9: Summary of meat inspectors' knowledge on pork-borne zoonoses

Pathogen, disease or causative agent	Disease in humans	Inspector A		Inspector B	
		Mode of transmission	Control measures	Mode of transmission	Control measures
Tuberculosis	Tuberculosis	Infected people working closely with the animals transfer tuberculosis to the pigs in table scraps. The pigs then transmit it to each other in the environment and then it is passed again to humans when they eat pork from affected animals.	None for pigs	Improper cooking	Partial condemnation
<i>Taenia solium</i>	Cysts in brain (cysticercosis)	Eating pork with cysts; pigs acquire infection when eating in areas where there are no latrines for human waste.	Advise people from these areas (especially in northern Uganda) to construct latrines	Unboiled pork; when the cysts are older they are white and can be consumed accidentally	Condemnation when translucent cysts are found during inspection
Contamination through post-process handling	Stomach problems				
Poison Mites ( <i>Sarcoptes</i> )	Stomach problems	Direct contact	None		

## Attitude on training in meat hygiene

In 2009 and 2010, two of the four members of the management attended two workshops on hygienic meat handling facilitated and funded by MAAIF. In 2011, they were invited to participate again but for a fee hence they did not attend.

Of the nine workers interviewed, three had worked at the abattoir for less than six months, four had worked there for between six months and eight years, and the remaining two had worked there for eight and nine years,

respectively. When asked about the training of the people working in the premises, they responded that only the two permanent meat inspectors were trained but they did not know what kind of training they had received since inspectors are employed by KCCA. According to the management, the workers did not undergo any training related to meat hygiene.

## Attitude on meat quality

All three groups indicated that they ate pork or offal at least twice a month. The abattoir workers consumed by-products (meat and offal) almost on a daily basis. All three groups were asked about what attributes they considered for good quality pork.

Abattoir workers mentioned the following quality attributes: colour (prefer white), clean sales environment, meat from female pigs (softer than meat from male pigs) and meat free of dirt and disease. Meat inspectors mentioned lean pork (not too much fat), meat from female pigs (meat from males has a different smell and taste), pork from young animals (more tender); smell and colour. The management mentioned the environment of the butchery, the butcher, licence, stamp, source of meat, smell, 'not so red' colour and little fat. In addition, the abattoir management was asked how they ensure that these criteria are accomplished. They wanted to provide the meat that they would like to buy and hence they had to meet minimum standards.

## Attitude on the provision of a hygienic and healthy working environment

The management was asked whether they provided the slaughter men with personal protective equipment (e.g. boots and overalls) and tools (e.g. knives and hooks). The abattoir workers had to buy their own personal protective equipment but the cooperative followed minimum standards which were supervised and enforced by the management on a daily basis. These standards required the workers to wear overalls and boots which should be cleaned regularly. The workers were allowed to clean their equipment on the premises but there were no lockers for storing them. Moreover, the management was asked whether they provided the workers with hand washing facilities. They said that in the past they had provided hand washing basins, tap water in jerry cans and soap. However, they had been stolen shortly after.

When asked about when and where they changed their uniforms, the abattoir workers said they left their uniforms at the abattoir where some women who do not have regular jobs wash the boots and overalls for a fee (UGX 2000). They did not have a designated changing room so they changed wherever was convenient. At the end of the work day, they left their tools with somebody who lived close to the abattoir for fear of being arrested by the police for carrying knives. Besides the boots, overalls and knives they also had to buy their own razor blades at UGX 200 (available at kiosks in the premises).

Some statements about meat hygiene in the slaughter process were read out to the abattoir workers and the workers were asked to indicate their level of agreement or disagreement. The responses are shown in Table 10.

Table 10: Attitude of abattoir workers on meat hygiene during slaughter, n = 9

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Don't know
In this job, it is more important to work quickly than to keep the carcasses clean	9				
People doing this job are more likely to get sick	3			1	5
In this working environment, keeping clean is easy		5	1	3	
A little dirt on the clothes or tools will not cause harm	1	1	5	1	1
Health is more important than wealth	9				
Ensuring hygiene is the role of the management	9				
If meat is well-cooked then it is always safe to eat	8	1			

Adapted from Mwai (2011).

## Discussion

The study was conducted in 2012 while this present report was only finalized in 2015. However, one week after the study, we held a feedback workshop with the Wambizzi abattoir management, the meat inspectors and other stakeholders from the local and national government to report on the preliminary findings (Roesel and Holmes 2012). The abattoir management held a meeting with their staff to discuss the preliminary findings and recommendations. This was followed by regular follow-up visits and meetings with the partners at Wambizzi and has led to a number of changes already. These have been cited under the relevant section in the discussion of the results.

### The organization of the abattoir

When the abattoir was set up in 1971, its purpose was to facilitate input and service provision to pig farmers as well as slaughtering and marketing of pigs owned by the cooperative's members. At the time, cooperatives were still supported by government funds and the demand for pork in Uganda was still very low at 0.5 kg per capita per year (FAOSTAT 2014). The cooperative was well organized and able to provide many incentives to its members, namely, feeds and other inputs as well as transport of live pigs from the villages to Kampala. In addition, the abattoir was connected to the communal electricity grid and had a functioning cold room and a cold truck.

From 1978 to 1986, Uganda was almost constantly at civil war which also affected the infrastructure of the cooperative. Vehicles and equipment were destroyed or stolen and never replaced, and following the years of unrest, the government stopped financial support to cooperatives. The cooperative is still trying to recover from the setbacks encountered during the 1970s and 1980s while at the same time pork demand has been steadily rising in Kampala since 2002. This is, of course, an opportunity but at the same time an enormous challenge: the abattoir is operating way beyond its physical capacity and is facing organizational problems. Pig traders use the facilities to slaughter their pigs and have them inspected and stamped 'fit for human consumption' because they are selling to the formal market where inspection is a requirement. On the other hand, they find it difficult to comply with the standards set by the abattoir management and sometimes disrespect slaughtering hours, refuse to hand in movement permits or try to influence the decisions of the meat inspectors. The abattoir management must be more stringent, for instance, lock the premises at night, only slaughter and inspect pigs that come with a movement permit and deny the traders access to the slaughter and inspection facilities. The management needs more support from KCCA in terms of enforcement.

Currently, the abattoir does not function as a cooperative but runs as an enterprise independent of a network of members. It meets private individuals' need for a slaughterhouse without receiving much financial and institutional support. The management is of the view that few people use the abattoir because of high prices of inputs and services which make pig keeping expensive. It is also assumed that there is sufficient market demand in the rural areas thus selling the pigs in Kampala is not an attractive option for rural farmers. It is indeed interesting to argue that urban traders complain about high transaction costs of procuring pigs from the villages because they literally have to search for pigs, while farmers report a lack of buyers and traders not offering competitive prices (Ouma et al. 2013). There

is certainly a market for pork in rural areas though consumption is much less regular as opposed to urban centres including Kampala where pork is eaten weekly or even daily (Roesel et al. 2013) and an estimated 300–500 pigs are slaughtered per day (Tatwangire 2013). However, there are currently not many incentives for pig farmers to join the cooperative. Nevertheless, the management has reported an increase in new members, especially from the western region.

## Spatial and seasonal distribution of the source of live pigs and the problem of traceability

Pigs are slaughtered at Wambizzi throughout the year, though there are seasonal peaks at holidays and at the start of school terms. Supply also increases during times of suspected disease outbreaks, especially swine fever. Rumours of outbreaks in the rural areas cause panic and farmers start to sell their animals before they die. Even though there is no risk to consumers from eating meat infected with swine fever, there are no rapid tests available to quickly confirm that the disease symptoms are caused by any of the swine fever viruses and not by any other (potentially zoonotic) diseases which can also cause sudden fever, cyanosis and death in pigs. These could be porcine reproductive and respiratory syndrome, erysipelas, salmonellosis, Aujeszky's disease (pseudorabies) in younger pigs, pasteurellosis or any other septicaemic condition (Fernández and White 2010).

If pigs carry African swine fever virus, it may remain viable for up to six months in blood, faeces and tissues, especially infected, uncooked or undercooked pork products (Fernández and White 2010). The density of road networks has been noted as a major risk factor for the spread of African swine fever (Gulenkin and Korennoy 2011) and a study in Gulu notes that it is likely that the virus is carried by vehicles or through infected pork (Tejler 2012). Testing for serum antibodies before transport may not be effective because pigs may be transported in incubation or chronic infection state; stress during transport can reactivate the virus and cause viraemia sufficient to infect other pigs in the batch (Tejler 2012). All pigs from high-risk areas could be quarantined for 15 days (incubation time) at a designated area in the place of origin. However, this would have financial implications because somebody would have to bear extra costs for feeds and housing, and the marketing would require better planning as pigs would not be available at short notice. Moreover, enforcement would require additional resources. Another option could be the establishment of regional slaughterhouses in the western, eastern and northern regions to minimize transport distances and thus transmission routes.

Animals are transported to Wambizzi abattoir from as far as Lake George in the western region and Rakai District on the border with Tanzania without ever being examined by veterinary officers and without the movement permits stipulated by the Animal Disease Act (1964) and the Animal Diseases Rules (1968). These movement permits are supposed to control the spread of diseases and must be issued by the authorized veterinary officers in the sub-counties (within district movement), the district veterinary officers (between district movement) or the Commissioner for Livestock Animal Health and Environment (international trade) when transporting animals from one sub-county to another, from one district to another or from one country to another, respectively.

A risk map of the spatial distribution of transboundary or zoonotic pig diseases in Uganda could help to inform the allocation of funds for staff and checkpoints at high-risk areas. However, this would require the close coordination of MAAIF, the local governments and the Ministry of Trade to minimize corruption at checkpoints. Unfortunately, only some areas at high risk of a small number of pig diseases are known because not much research has been done on prevalent pig diseases that may be transmissible to people, either at farm, during slaughter or through consumption. Therefore, it is difficult for Ugandan policymakers to prioritize allocation of funds for farm-level disease surveillance and develop targeted standard operating procedures for disease surveillance at pig meat inspection. There are no financial or staff resources allocated for systematic surveillance programs at pig slaughter because there has been a lack of evidence on the spatial distribution of pig zoonoses and transboundary diseases such as foot-and-mouth disease and swine fever (both classical and African swine fever).

Ocaido (2014) conducted a systematic literature review on pig- and pork-borne zoonoses in East Africa (Table 11). Out of 32 infectious hazards, 26 infectious diseases affecting pigs and potentially people have never been researched in Uganda. These include bacterial diseases such as diamond skin disease, porcine brucellosis and salmonellosis as well as parasitic diseases known to infect pigs such as trichinellosis or toxoplasmosis and viral infections such as influenza, rabies and ebolavirus. The presence of drug and pesticide residues, mycotoxins and heavy metals has also never been investigated. In 2013, ILRI and partners conducted a cross-sectional study and sampled over 1200 pigs at household level, over 100 pork samples from retailers and butchers in Kamuli, Masaka and Mukono districts and over 200 samples at Wambizzi abattoir. The samples were analysed for a range of zoonotic and transboundary pathogens and the forthcoming results help to inform not only farmers, retailers and consumers about the status and risks of those diseases but also policymakers to prioritize pig disease surveillance efforts.

Table 11: Spatial distribution of pig zoonoses researched in Uganda

Region	Proportion slaughtered at Wambizzi <sup>a</sup>	Pathogens previously reported in pigs <sup>b</sup>	Pathogens reported in recent prevalence studies by ILRI and partners <sup>c</sup>
Central	57%	<i>Trypanosoma</i> spp., <i>Mycobacterium tuberculosis</i> and non-tuberculosis <i>Mycobacterium</i> , <i>Taenia solium</i>	<i>Brucella suis</i> , <i>Trypanosoma</i> spp., zoonotic helminths ( <i>Trichuris</i> spp., <i>Ascaris</i> spp., <i>Taenia</i> spp., <i>Trichinella</i> spp.); <i>Salmonella</i> spp.
Eastern	21%	<i>Trypanosoma</i> spp., <i>Taenia solium</i>	Zoonotic helminths ( <i>Trichuris</i> spp., <i>Ascaris</i> spp., <i>Taenia</i> spp., <i>Trichinella</i> spp.)
Northern	15%	<i>Trypanosoma</i> spp., <i>Taenia solium</i>	No ILRI study sites until 2014
Western	7%	<i>Trypanosoma</i> spp., <i>Trichuris</i> spp., <i>Ascaris</i> spp., <i>Taenia solium</i>	No ILRI study sites until 2014

<sup>a</sup>From Figure 4

<sup>b</sup>Source: Ocaido (2014)

<sup>c</sup>Source: forthcoming publications

## Potential public health risk factors at Wambizzi abattoir

### Factors associated with the setup of the abattoir

The abattoir is located in a swampy area which is prone to flooding during the seasonal rains, in the middle of an industrial area and near a busy tarmac road. Since the buildings are not closed and meat is carried from one building to another as well as weighed and sold in the open, the meat is exposed to dust and other contaminants. Anyone from outside can access the premises and make contact with the carcasses during processing or interact with the meat inspectors. This can not only contribute to cross-transmission from dirty to clean areas but may also bias the decision-making of the meat inspectors because they may feel harassed. During the survey, it was not possible to distinguish clean and dirty areas at the abattoir. However, this should be a rule of thumb at a slaughterhouse to avoid cross-contamination. Live animals must never be in contact with meat or slaughter by-products. At Wambizzi abattoir, the lairage is located between the evisceration building and the weighing house.

There are no biosecurity measures in place. Vehicles and people are allowed to enter and leave the premises without disinfection. This may contribute to the spread of transboundary diseases like African swine fever as animals are crowded at the slaughterhouse and if the infection is maintained at the abattoir, vehicles could easily carry the virus back to villages when picking up new pigs for slaughter. Provisions should be made at the slaughterhouse to disinfect vehicles, equipment and people before they leave the abattoir premises, for instance by using spray pumps. The abattoir could increase the existing fee of UGX 6000 per slaughtered animal by UGX 500 to cater for the purchase and maintenance of the disinfection equipment. The management should make sure that movements on the premises are carefully documented.

There is no facility to isolate clinically sick pigs from healthy pigs. Many pigs from different areas are crowded in a lairage on a dirt floor which is never cleaned and therefore provides perfect conditions for pathogens to thrive and survive. The abattoir management should make provisions for an isolation pen where sick animals can be examined by a veterinarian.

In 2012, tap water was available at the premises but only at the weighing house and not in the buildings where animals were slaughtered, had their hair removed and were eviscerated. Therefore, workers had to carry water in jerry cans to the operation buildings. This led to a number of poor practices. Workers at the back of the evisceration building, who had to walk only a few metres to the stream surrounding the premises (see Figure 7) compared to carrying water from 100 metres away, opted to fetch water from the very stream that drains water from the industrial area into the Nalukolongo main channel. On the other hand, those workers who diligently collected water from the tap contributed to cross-contamination of meat lined up in the weighing house. Moreover, workers frequently used the water from the jerry cans for rinsing the carcasses, cleaning their utensils and drinking out of their contaminated hands, exposing them to diseases like salmonellosis which reportedly occurs at Wambizzi (Tinega et al. 2016).

Based on the findings of the survey, the abattoir management is considering installing four water taps in the evisceration building and adding chlorine to the water tank. This could facilitate sanitizing hands of abattoir workers and surfaces in the slaughterhouse. Chlorine is an effective surface disinfectant (Skaarup 1985) but a concentration of 200–300 mg/litre must be guaranteed. The presently used tank at Wambizzi is constantly fed from the tap, leading to continuous dilution of the chlorine solution which renders it ineffective. It could be useful to add an additional tank where chlorinated water is stored for the day before being filled up with water and chlorine again at the end of the work day. When using hypochlorite, it is very important that it is never mixed with acid as this could lead to the development of toxic gases. A disadvantage of the use of hypochlorite is the risk of corrosion of metal, especially aluminium and galvanized iron (Skaarup 1985), thus stainless steel knives are advised for use.

When the study was conducted in 2012, the abattoir was not connected to the electrical grid so slaughter and meat inspection were performed partly in the dark or with the help of a torch. This increased the risk of injury of the slaughter staff as they handled sharp knives and increased the risk of cross-contamination and microbiological growth because each step of the process took more time. In addition, the poor practice of slaughtering the pigs without stunning was aggravated by the fact that slaughter staff had to handle and cut the throats of extremely stressed animals in the dark, increasing the risk of prolonged agony and hence reducing the shelf life of the meat. In 2013 and as a result of the feedback meetings, the abattoir management organized for electrical wiring of all the buildings. However, this increased transaction costs for electricity and supply is still not fully reliable due to regular power cuts.

There is only one toilet on the compound which is collectively used by the workers, vendors, clients and even the community outside the premises. At the time of the study, the toilets did not appear to be in use and were infested with maggots. There were no provisions for hand washing including water and soap. The abattoir management had previously made efforts to provide hand washing basins and soap but they were stolen. An option could be to chlorinate the water as suggested above. This could help decrease surface contamination (including hands) during the regular slaughter process. Moreover, the management should make sure that the port-a-potties are emptied on a regular basis. If they are infested with maggots and have a bad odour, people are discouraged from using them.

## Pre-slaughter handling and the effects of stress on meat quality

Animals under stress become more susceptible to new infections, and increased levels of stress hormones lead to conditions in the gastrointestinal tract that favour the growth of pathogens such as *Escherichia coli*, *Salmonella* and *Campylobacter*. Moreover, animals that already excrete bacteria show an increased defaecation frequency (Rostagno 2009). The combination of increased shedding of disease-causing bacteria due to stressed animals, crowding of animals and the lack of separation between clean and dirty areas at the slaughter facilities makes Wambizzi abattoir prone to cross-contamination of carcasses. Some formal processors try to counter this problem by disinfecting the surface

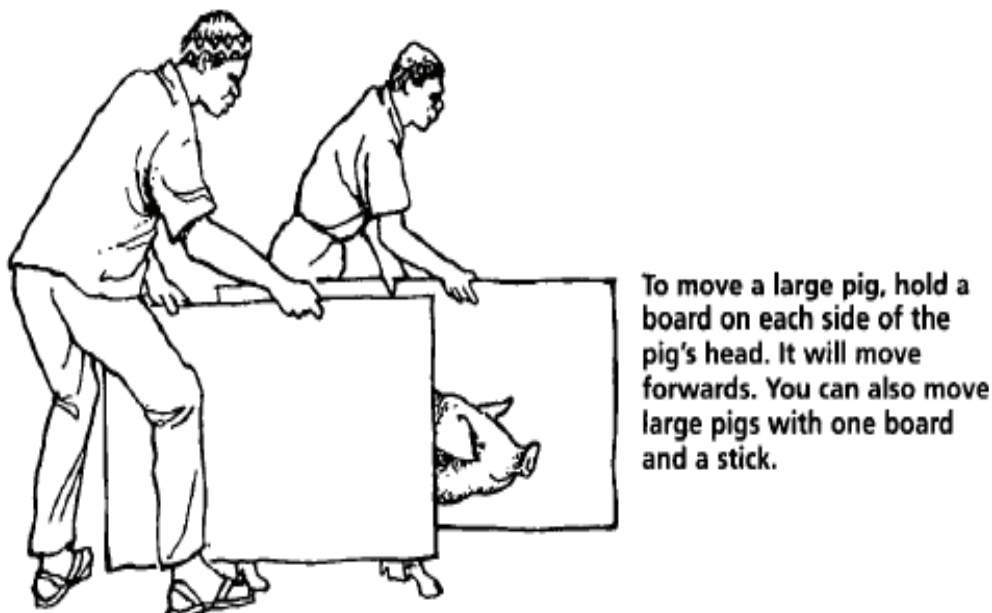
of the meat as soon as it is delivered to the processing plant (Anonymous, personal communication) but small-scale butchers do not know of this potential source of contamination. In addition, increased cross-contamination facilitates the exchange of resistance genes between bacteria as in the case of *Salmonella* (Tinega et al. 2016).

Pigs are very sensitive, smart and social animals. Increased levels of stress in live animals prior to slaughter will compromise the processing properties, functional quality (shelf life) and eating (sensory) quality of meat (Adzitey 2011). Animals cannot understand that a truck just passed a pothole or that it had to stop suddenly because the vehicle in front came to a sudden halt. Moreover, pigs are more susceptible to stress than ruminants, for instance, and between farm and slaughter, they are exposed to many stressors. Warriss (2000) notes several factors that contribute to increased stress levels in pigs. Physical stressors include high ambient temperature, vibration and changes in acceleration, confinement, noise and overcrowding, while psychological stressors include breakdown of social groupings, mixing with unfamiliar animals, unfamiliar or noxious smells and novel environment.

Bruising, injuries as well as poor handling during loading, unloading and on the way from the lairage to slaughter are additional stressors and these have been frequently observed at Wambizzi abattoir prior to slaughter. The management plans to build a crush to move the live pigs and rails with hooks to transport the slaughtered pigs from the scalding tank to the evisceration house and further on to the weighing house.

Appropriate trucks for transporting pigs in developing countries are not feasible for use in Uganda as they are too big for the numbers of pigs currently transported in the country and would increase transaction costs unreasonably. However, transporters can take precautions so that animals are not exposed to the sun which may cause sunburn or dehydration. They could also always carry ramps on their trucks to avoid throwing animals on and off the trucks. Boards can be used (and have been given to the abattoir management by ILRI) to move animals into the truck, to the lairage and from there to the ultimate slaughterhouse (Figure 11). Pulling a pig's tail up causes intense pain and may lead to bone fractures and even internal bleeding. This way the pig will become even more reluctant to move and a grown boar in agony may even throw himself at an abattoir worker and injure him.

Figure 11: How to move a grown pig using boards.



Source: Forse (1999).

The lairage should give the animals the opportunity to rest from transport. However, crowding or mixing different males or males with females can cause a lot of additional anxiety and even fights and injury hence reducing meat quality. Extreme pre-slaughter stress can result in premature death (at Wambizzi often called 'transit fever'), which could ultimately mean the total loss of the carcass; at Wambizzi abattoir, those animals are still introduced into the processing chain. At times and due to bruising or bleeding of some injured muscles, meat yields are reduced because the respective parts need to be trimmed off. At the time of the study, to speed up the slaughtering in batches, pigs

were 'collected' in the pits that are designated to collect blood. For the 'collection', the pigs were thrown into the pits and to get them out, a worker jumped inside kicking the animals out. This poor practice was sanctioned by the slaughterhouse management following the study.

## Possible risk factors associated with the slaughter process

Many of the factors listed above contribute to poor slaughter practices. The slaughter process cannot be expected to be free of contamination if the setup of the slaughter facilities does not allow this. For example, if there is no clear separation between clean and dirty areas or if there are no requirements and prerequisites for regular cleaning and disinfection, there will be constant cross-contamination.

The process itself is hindered by the fact that slaughtering is done in batches. This is because each trader has a team of workers (usually around five men) slaughtering pigs for him to sell. Each team is supposed to slaughter a certain number of animals for the trader and, ideally, the meat would be ready for sale at around 0800 hours when the clients (butchers, restaurant owners or private individuals) start coming to the abattoir to buy from the trader or when the meat is supposed to be delivered to processors and restaurants amongst other clients. This is, however, not possible because there is only one scalding tank through which each pig needs to pass for convenient hair removal. This step is the bottleneck resulting in what the management calls 'traffic jam'. On average, six pigs are bled and scalded at the same time and their hair is then removed by the team. After being hoisted, the pigs are quickly eviscerated by one member of the slaughter teams. The meat inspectors have no chance to look at the organs that come with the carcass, which may have been able to indicate diseases that manifest in internal organs. They are only left to inspect the carcass. It is recommended that the pluck is hung on a hook next to the carcass and the gastrointestinal tract is kept near the carcass, for instance on a concrete bench. The latter is already being planned by the abattoir management.

Workers and other staff do not wear gloves. This not only exposes them to zoonotic pathogens such as *Brucella suis* (causing brucellosis) or *Streptococcus suis* (causing meningitis) but also contributes to an increased risk of cross-contamination of pig carcasses during handling. There is no systematic ante mortem inspection. Live pigs are randomly examined, for instance, if they show outward signs of disease such as coughing, bleeding and panting. It is difficult for the inspectors to systematically conduct ante mortem inspection as many of the pigs arrive during the night when none of the inspectors is present. Since slaughtering starts before the inspectors arrive, they are not able to examine all animals. The abattoir management should ensure that slaughtering only starts after an authorized member of staff has collected the movement permit and examined the live animals.

Figure 12: Announcement by the abattoir management during the high season for pig slaughter.





Meat inspection lacks consistency and structure. There are no official standard operating procedures in Uganda that could be used for post mortem inspection of pigs. Practically, only macroscopic lesions (i.e. muscle cysts) can be examined because there is no possibility to submit specimens for microbiological or parasitological laboratory analysis. Moreover, even if the results were positive, the carcass would not be withheld and would have long been sold in the market. Macroscopic lesions like enlarged lymph nodes are not part of systematic meat inspection due to minimal disassembling of the carcass. This practice has disadvantages such as the aforementioned but also advantages because it reduces the surface exposed to cross-contaminants.

The slaughtered pigs are not fully utilized and a lot of organic waste is generated. For instance, blood is simply drained into the stream surrounding the abattoir premises. In Vietnam, for example, blood is collected and turned into blood cake for food and animal feed. Since pigs are not a traditional livestock species in Uganda, eating blood (even if cooked) may not be culturally acceptable in Uganda. However, there is a high risk associated with the current practice of draining blood into the stream surrounding the premises. The stream eventually drains into the Nalukolongo main channel and ultimately into Lake Victoria after crossing a number of wetlands. If contaminated with zoonotic diseases or a transboundary disease like African swine fever, this practice may contribute to the spread of diseases. Even if there are no pathogens in the blood, the organic matter may contribute to eutrophication of Lake Victoria (Msomphora 2004). Faeces are sometimes given out for use as fertilizer, a practice that contributes to the transmission of pathogens such as *Cryptosporidium parvum* if the manure is contaminated. At the time of the study, the intestines were washed in the stream behind the building where the slaughtering and scalding were performed (Figure 7). Following the study, the abattoir management built an annex to the building with a concrete floor and a pit in the middle. The intestines (and uteri) are no longer washed in the stream but in a pit in a designated area attached to the slaughterhouse with a concrete floor and a roof (Figure 13).

Figure 13. Following the study, intestines and uteri were cleaned in a separate room instead of into the stream. The photograph was taken in January 2015.



Photo: Rod Kubyk

## Knowledge and attitudes

Knowledge on pig diseases, including zoonotic ones, is very limited among all actors at the abattoir including meat inspectors. This could be partly because so far, the focus of meat inspectors' training in Uganda has been on beef and not pork. Also, only a few pig diseases have been documented in Uganda to date (Table 11), preventing targeted meat inspection. Furthermore, there is neither a standard operating procedure for pig meat inspection that authorized staff could follow nor the prerequisites to carry out further diagnostics such as microscopy or microbiology. Abattoir workers, who have hardly received any kind of training, learn on the job from more senior workers. They have never received any instructions on good slaughtering practices, good hygienic practices or risks of occupational diseases.

Moreover, they never undergo medical check-ups. The abattoir management is keen to learn new aspects on how to successfully run an abattoir but is financially limited to implement them.

After the survey, efforts were made to sensitize the management on good hygienic practices and enforce implementation of the same. The management lacks training on business administration and public health as well as institutional support by KCCA to put the lessons learned into action. KCCA should consider how to better support its meat inspectors in enforcing laws. If the inspectors decide that a carcass is unfit for human consumption, they are exposed to harassment by traders at the abattoir who do not want to lose a carcass to condemnation. In general, all abattoir processes are dominated by a business-oriented attitude and pork safety is not the major concern of the parties involved. There is no consistent condemnation policy in place and compliance with general guidelines is generally poor because assurance of pork safety is neither incentive-based nor enforced and there is no critical mass of consumers demanding it.

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## Conclusion

Now that market demand for pork is growing, the abattoir management should use any opportunity to improve its facilities to provide good quality pork. This includes ensuring the clear separation of clean and dirty areas; restricting access of people not directly involved in slaughtering and inspection to avoid biased decision-making and cross-contamination; better utilization of waste (for instance, through a biogas digester) to avoid environmental pollution, cross-contamination of meat and infestation with pests; making gradual improvements to limit pre-slaughter stress in pigs to improve meat quality and safety; and raising the awareness of and support for abattoir workers through the provision of internal training sessions and work equipment.

Wambizzi is the only registered abattoir and offers a unique selling point: meat inspection and carcasses stamped 'fit for human consumption'. Illegal slaughter can easily destroy this reputation; therefore, the premises should be locked at night. Improvements should be carefully documented and presented to KCCA during regular meetings. In turn, KCCA should provide support in implementing plans to improve quality (i.e. land allocation in a non-swampy area, enforcement and security). The abattoir management should seek support on how to develop a sound business plan and keep track of costs and benefits so as to be able to make economically sound decisions.

Generally, more research should be carried out on the prevalence and spatial distribution of pig diseases in Uganda. Based on those findings, a meat inspection protocol targeting diseases of relevance in Uganda could be developed and resources (training, staff and equipment) allocated in a more focused manner.

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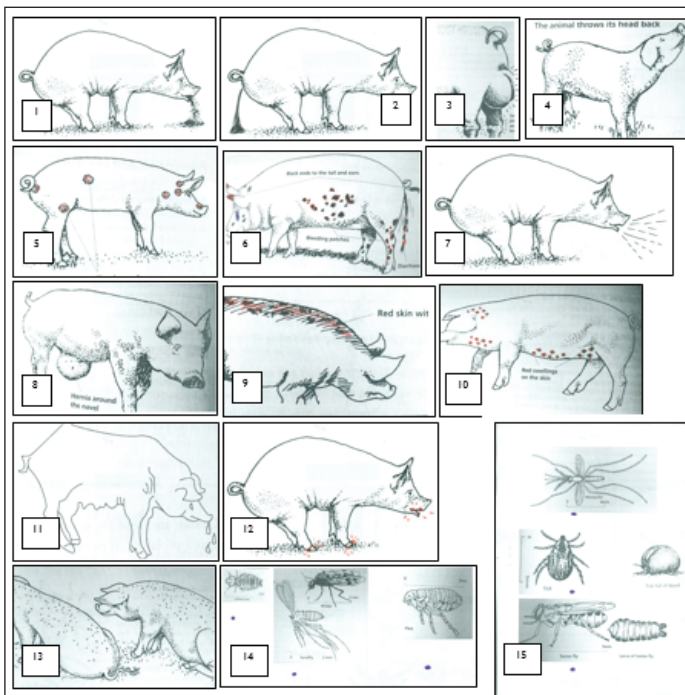
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# Annex I

## Picture cards used for proportional piling

### Signs in live pigs

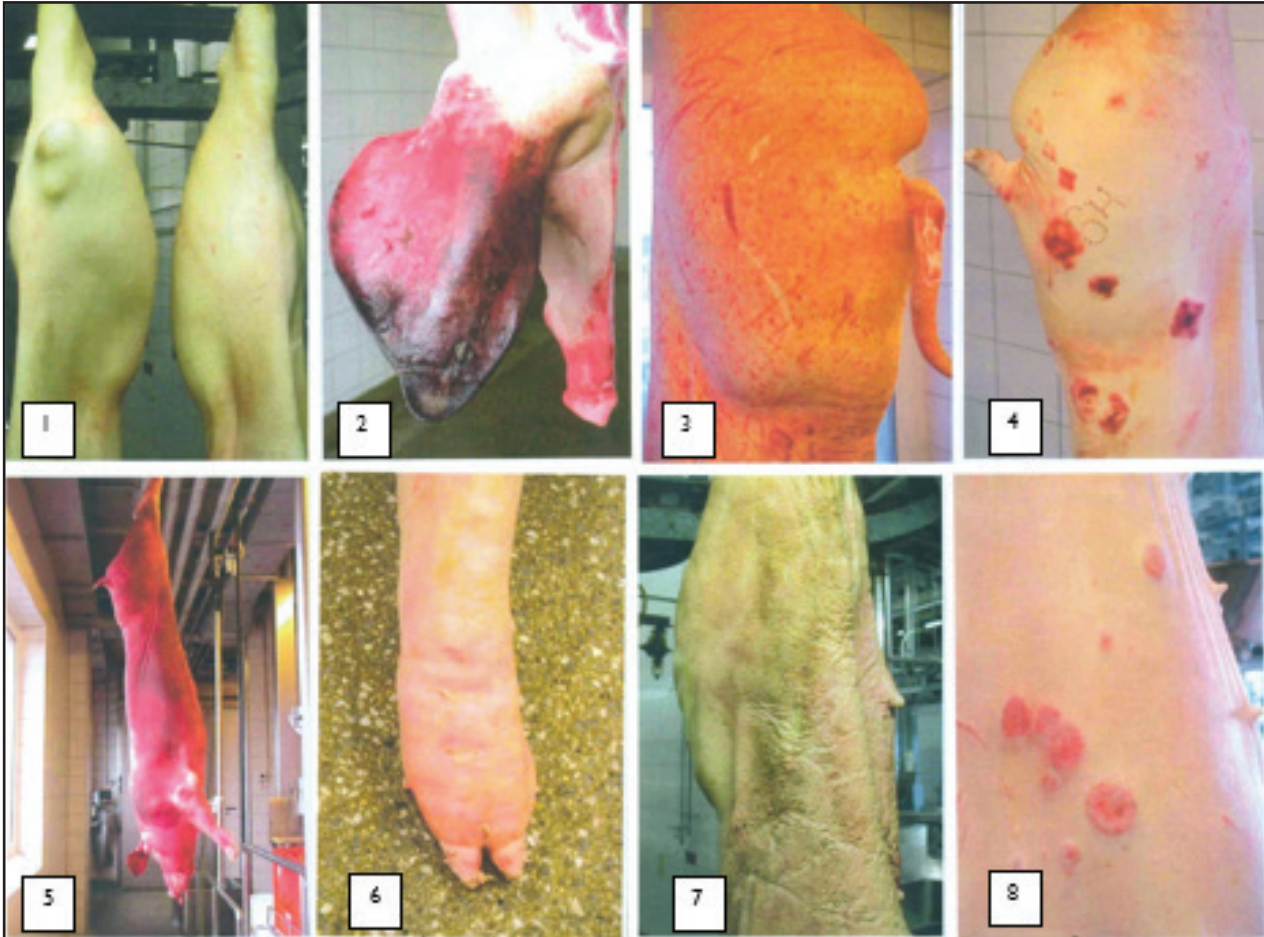
- |    |   |     |  |
|----|---|-----|--|
| 1: | vomiting  | 9:  | red skin with blisters (sunburn)       |
| 2: | diarrhoea   | 10: | red swellings on the skin (erysipelas) |
| 3: | swollen joints and testicles                              | 11: | running nose                           |
| 4: | animal throwing head back                                 | 12: | sores and blisters on feet and mouth   |
| 5: | circular scabs  | 13: | ectoparasites                          |
| 6: | cyanosis, bleeding patches, nasal discharge and diarrhoea | 14: | different types of ectoparasites I     |
| 7: | coughing and sneezing                                     | 15: | different types of ectoparasites II    |
| 8: | hernia  |     |  |



Source: Forse (1999).

## Signs on the skin of slaughtered pigs

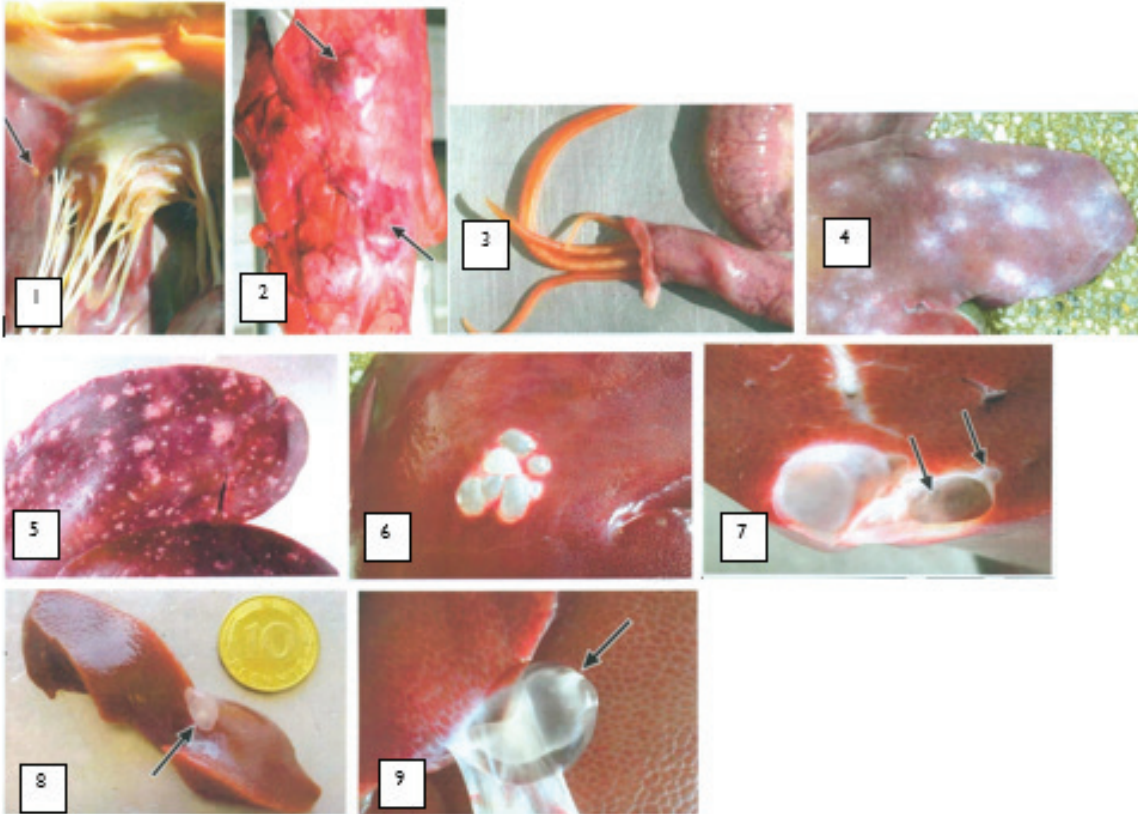
- |    |   |    |                               |
|----|---|----|-------------------------------|
| 1: | subcutaneous abscess                    | 5: | haemorrhagic diathesis        |
| 2: | cyanosis of the ears                    | 6: | pachyderma (lymph congestion) |
| 3: | dermal petechial                        | 7: | scabies                       |
| 4: | erysipelas (acute diamond skin disease) | 8: | dermatomycoses (fungus)       |



Source: Vallant (2003).

## Internal organs

- |    |  |    |   |
|----|--|----|---|
| 1: | Sarcocystiosis   | 6: | Cystic echinococcosis                                       |
| 2: | Ascariidiosis (lungs)                                  | 7: | Cystic echinococcosis                                       |
| 3: | Ascarid worms  | 8: | <i>Cysticercus cellulosae</i> ( <i>Taenia solium</i> )      |
| 4: | Hepatitis interstitialis parasitaria ('milk spots')    | 9: | <i>Cysticercus tenuicollis</i> ( <i>Taenia hydatigena</i> ) |
| 5: | Hepatitis granulomatosa ( <i>Mycobacterium avium</i> ) |    |   |





ISBN 92-9146-495-3



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