More meat milk and eggs by and for the poor

CLEANED ex-ante environmental impact assessment of pig production systems in Uganda

Baseline validation workshop report

16-17 March 2021 | Kampala, Uganda

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Ministry of Water and Environment
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1. Introduction

The MorePork program under the CGIAR Research Program on Livestock aims at developing and testing an environmentally sustainable and gender-inclusive integrated intervention package that aims to improve pig productivity and incomes of value chain actors. The Alliance of Bioversity International and International Center for Tropical Agriculture (The Alliance) and the International Livestock Research Institute (ILRI), together with their partners, are jointly working on Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development **(CLEANED)** Assessment of pig production systems in Masaka and Mukono in Uganda.

This report presents the discussions and outputs of the CLEANED baseline validation workshop was organized by the Alliance and ILRI. The workshop took place in Kampala on 16-17th March 2021. Pig production is a growing sub-sector in the livestock enterprise and its effects on the environment and natural resources are evident. CLEANED runs were carried out for Masaka and Mukono districts with key input data including farm inputs, herd composition, animal whereabouts with the model quantifying land use, water impacts, soil impacts, and greenhouse gas emissions (GHG).

The workshop aimed to validate the baseline results quantified by CLEANED. This is a first step in understanding environmental trade-offs and thus designing systems that mitigate and enhance ecosystem services in pig production systems in Mukono and Masaka.

The CLEANED baseline validation workshop objectives included:

1. **Share** and **discuss** preliminary model results
    - Representation of types (production/animal numbers)
    - Evaluation of distribution of types across locations
2. **Assess** the relevance of CLEANED results and **identify** key decision makers/experts
    - Which results are most interesting?
    - Who are the key decision makers to target?
3. **Develop** future scenarios for model implementation that reflect best-bet integrated intervention packages per system.
    - Which livestock production challenges are prominent in the different locations?
    - Which combination of interventions makes sense for the different types?

The event was led and facilitated by Mr. Isaac Rubayiza, a Climate Change Mitigation Specialist at the Ministry of Water and Environment (MWE) currently a research consultant with The Alliance. This was a hybrid event with participants attending physically and virtually, and the full participants list can be found in Annex 1. The event agenda (Annex 2) guided the sequence of events.

The full presentation guiding through the workshop can be found **here.**

2. Knowledge, Attitude and Practices Survey (KAPS)

Before the workshop commenced a KAPS was given out. This survey aims to explore participants' profiles and their understanding of the importance of livestock and environment.

Below is a summary of those results presented in Figures 1 to 3. Participants included a mix of professions including scientist, farmers and policy makers. In regards to perceptions of the pork value chain, participants saw that pig production is most important for livelihoods focusing on income generation. The stakeholder that would most benefit from the quantification of environmental impacts were policy makers.

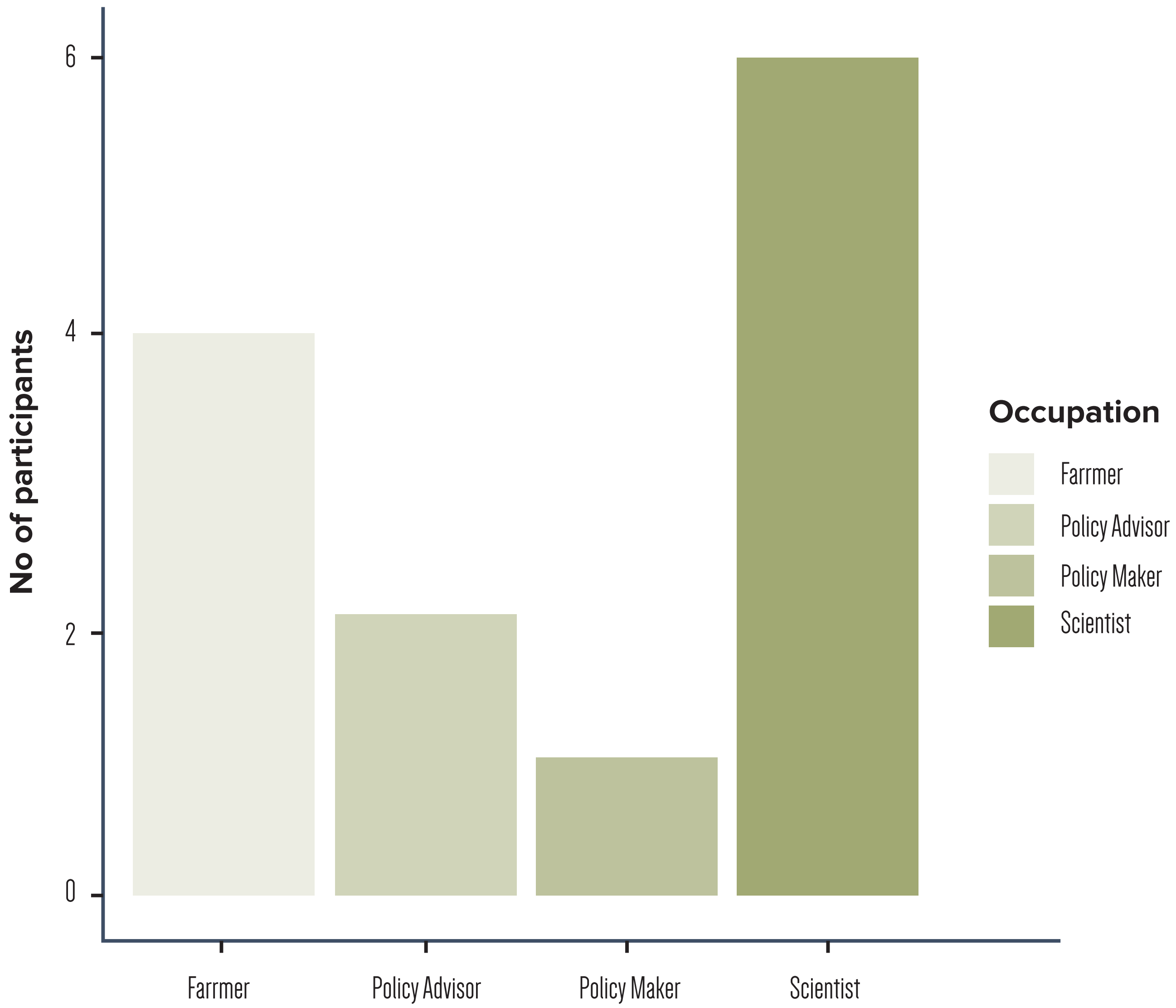


Figure 1 Participants' professions (KAPS survey)

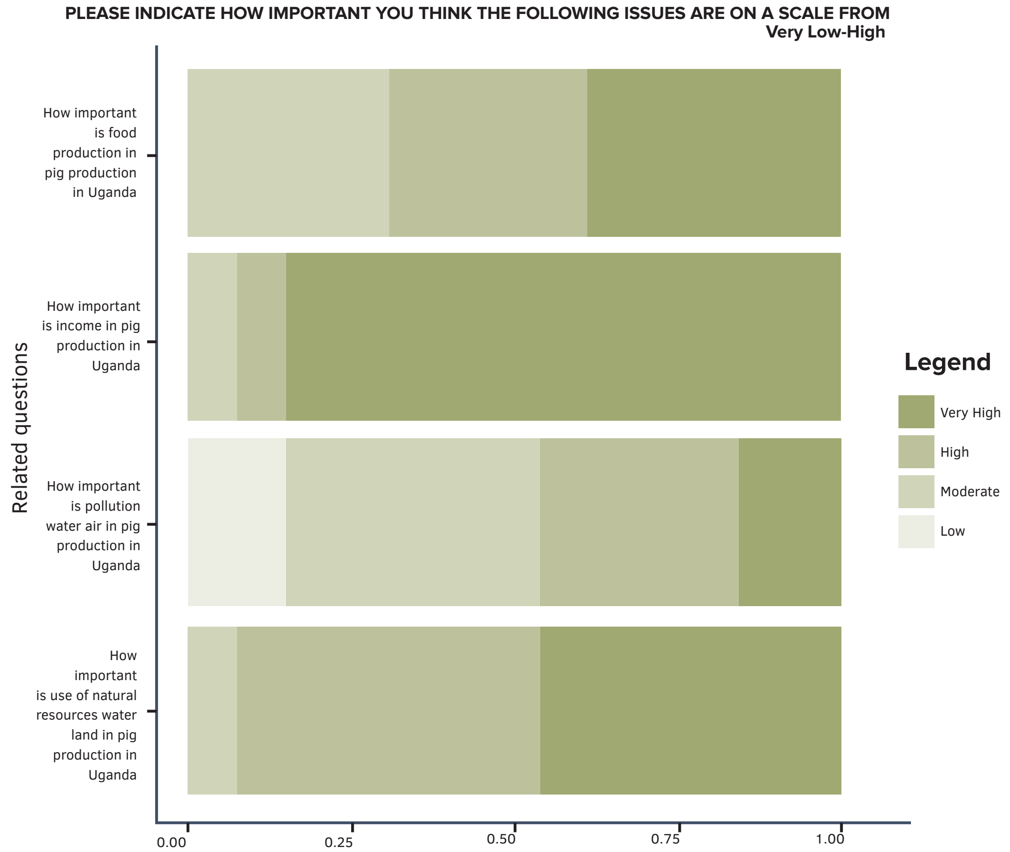


Figure 2 Participants ranking the importance of various environmental impacts of pig production in Uganda before the workshop (KAPS survey)

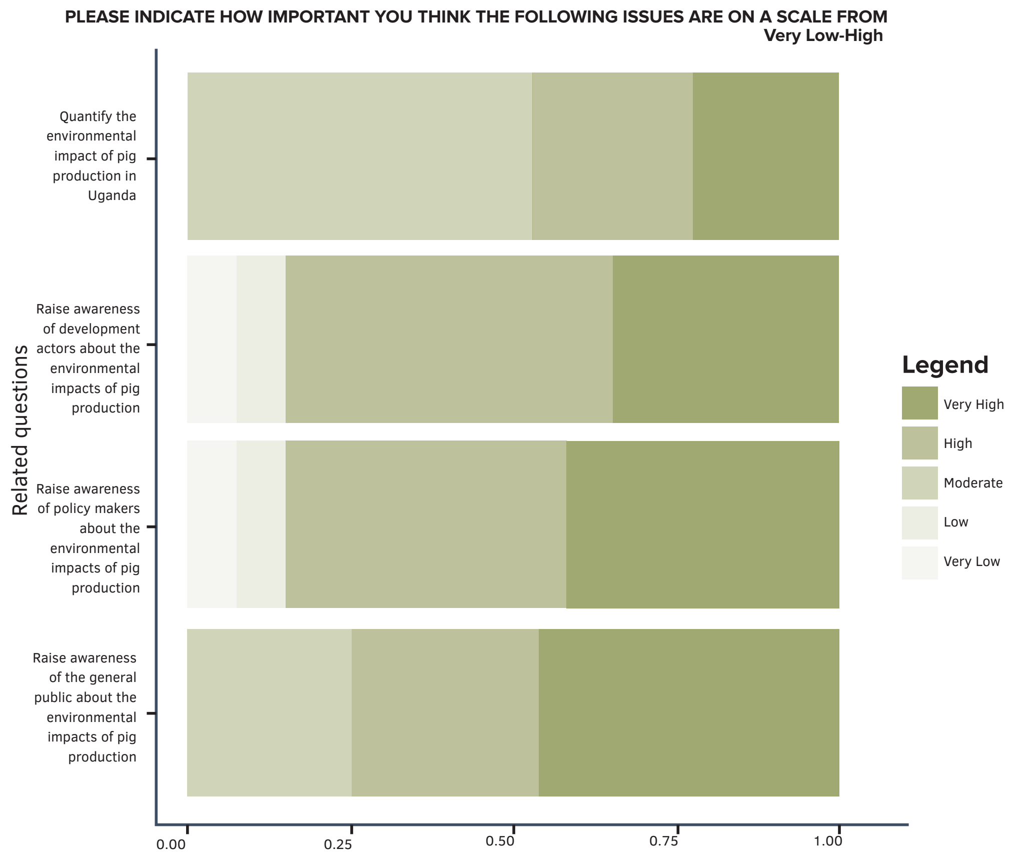


Figure 3 Participants ranking the importance of raising awareness of environmental impacts among different stakeholders before the workshop (KAPS survey)

3. Workshop sessions day 1

Project Briefing

The project briefing session was given by Dr. Emily Ouma, Senior Scientist and co-lead MorePork Uganda at ILRI welcomed participants and gave an overview of the project which aims to improve incomes of pig value chain actors through marketing arrangements and sustainable integrated technology package in Uganda. This will be achieved through identifying best-bet interventions which have been pilot tested individually since 2012, to improve the low uptake of these interventions due to financial constraints and market inefficiencies.

The project also focuses on supporting stronger and more profitable market linkages between pig market aggregators (buyers) and pig producers through market arrangements. To incentivize the uptake of an integrated package the team is looking at productivity and climate-smart options with a heavy focus on private sector involvement, utilization of a digital platform to disseminate knowledge and information on pig production, and inclusion of elements on the environment and climate change.

MorePork project objectives include:

- Pilot and evaluate innovative marketing arrangements at the level of pig aggregators to strengthen pig market linkages and link farmers to inputs and service providers;
- Implement and evaluate an integrated package for improving pig productivity and performance, through a PigSmart digital platform for farmers participating in the market arrangements;
- Develop, test and evaluate best-bet interventions for reducing the environmental footprint primarily through waste (manure) management and adaption to heat stress;
- Include environmental assessments of different packages of interventions (incl. different feed baskets) in terms of water and land, and competition with human food, while considering future climate change.

CLEANED description

Jessica Mukiri, Senior Research Associate at the Alliance of Bioversity and CIAT presented the CLEANED model description and how it is used for environmental impact assessments in livestock particularly in pig production systems in Uganda.

CLEANED is an ex-ante model/tool that lets users explore multiple impacts of developing livestock value chains in explicit ways. It models the impact of intensifying livestock along multiple pathways: particularly land requirements, productivity, economics, water impacts, soil impacts, and GHG emissions.

The model measures the environmental impact of a livestock enterprise. The boundary for assessment extends to all the inputs needed to sustain the livestock enterprise and not the whole farm. This includes the area and other inputs used for feed grown for feeding the livestock, including crops whose residues are fed. It does not include the whole farm area or crops grown on the farm that are not fed to the animals. It is important to note this model, model's livestock enterprise for ruminants and pigs.

The CLEANED tool process comprises of two stages:

1. Collect and input the baseline data;
2. Generate reports for different scenarios of how the livestock production systems might change.

Modeling methodology

Isaac Rubayiza presented the CLEANED modeling methodology used for in the assessment of the pig production systems particularly the interventions sites of Mukono and Masaka in Uganda. These production systems were developed via literature and conversations with key experts in the regions.

There are three major types of pig management systems. The common types in the Rural – Rural and Rural – Urban value chain domains are extensive/free range and semi-intensive/tethering, while intensive/confinement in corrals with either raised or non-raised floors is most common in Urban – Urban value chain domains. The assessment considered the extensive and intensive systems as these are the most prevalent systems in the selected areas see Table 1.

Giving an overview of the study area included their location, land and soil types, climate characteristics, temperature ranges, precipitation and land use types. He detailed the livestock systems, pig production types, seasonality, management systems, breed types prevalent in these systems, the type and number of average animals kept by farmers in these systems and the proportions of feeds by type and season used in the selected areas.

Table 1 Pig system types modelled in CLEANED for Masaka and Mukono

Site	Livestock systems	Production type	Season	Season Months	Management system	Breed type	Type and No. of animals	Type of feed (%)
Masaka	Intensive	Farrow to finish	Wet	Long rains (MAM), short rains (SON)	confined	Cross breed	Pigs – lactating exotic: 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers: 5	Forages (30) Concentrates (35) Crop residues (20) kitchen leftovers (15)
			Dry	Dec, Jan, Feb, June, July, Aug				Forages (17) Concentrates (36) Crop residues (25) kitchen leftovers (22)
	Extensive	Farrow to finish	Wet	Long rains (MAM), short rains (SON)	scavenging	Local	Pigs – lactating: 1 pregnant - sows:1 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers: 2	Forages (40) Concentrates (5) Crop residues (20) kitchen leftovers – (35)
			Dry	Dec, Jan, Feb, June, July, Aug				Forages (25) Concentrates (5) Crop residues (25) kitchen leftovers (45)
Mukono	Intensive	Farrow to finish	Wet	Long rains (MAM), short rains (SON)	confined	Cross breed	Pigs – lactating: 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers: 5	Forages (30) Concentrates (35) Crop residues (20) kitchen leftovers (15)
			Dry	Dec, Jan, Feb, June, July, Aug				Forages (17) Concentrates (36) Crop residues (25) kitchen leftovers (22)
	Extensive	Farrow to finish	Wet	Long rains (MAM), short rains (SON)	scavenging	Local	Pigs – lactating: 1 pregnant - sows: 1 Pigs - dry sows: 0 Pigs - boars: 0 Pigs - growers: 2	Forages (30) Crop residues (35) kitchen leftovers (15)
			Dry	Dec, Jan, Feb, June, July, Aug				Forages (50) Crop residues (30) kitchen leftovers (20)

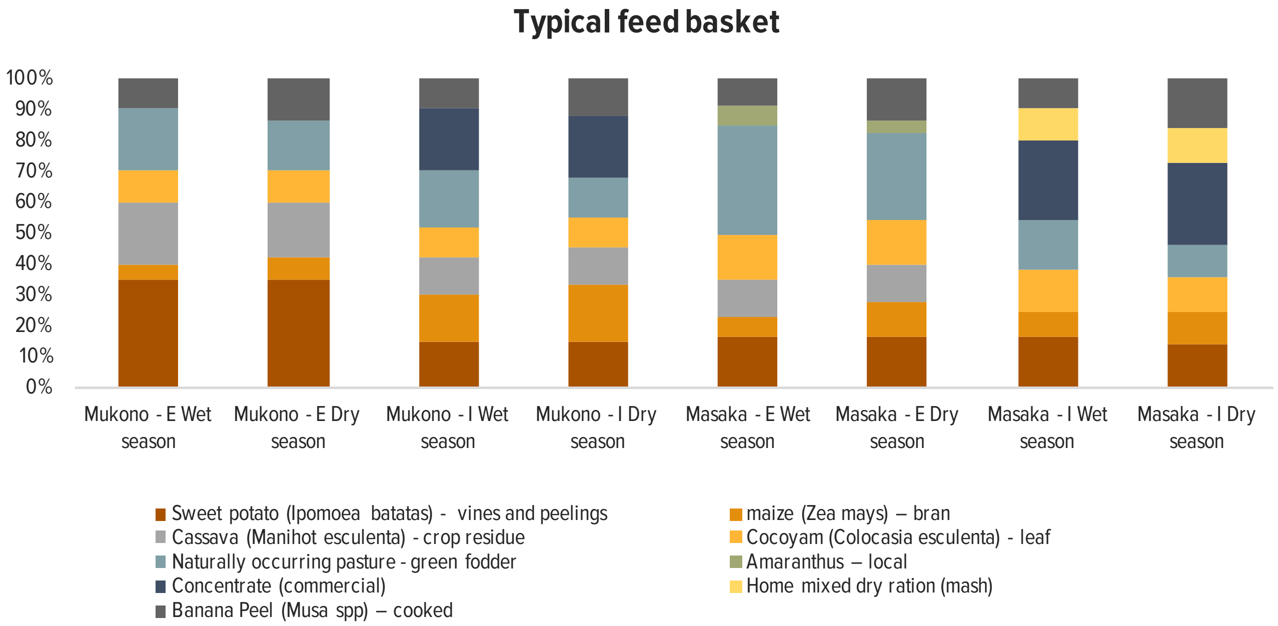


Figure 4 Typical feed basket in Masaka and Mukono regions

Baseline modeling results

Isaac Rubayiza presented the preliminary results for the modeled pig production systems in the assessment areas. The results covered land requirements, soil impacts, water impacts, and GHG emissions, (Figures 5 – 14), and complete results can be found in the presentation (here).

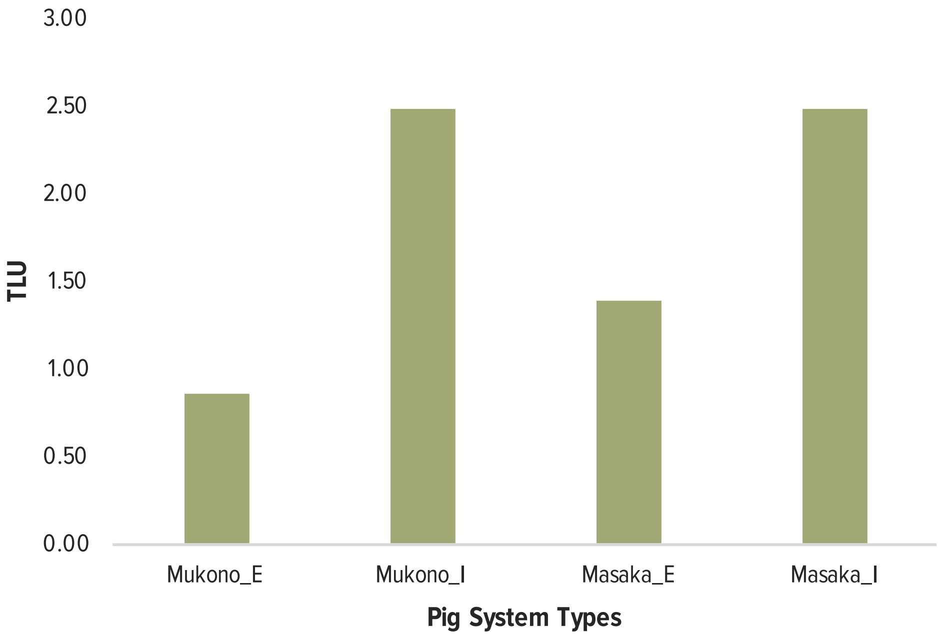


Figure 5 TLU quantification by CLEANED

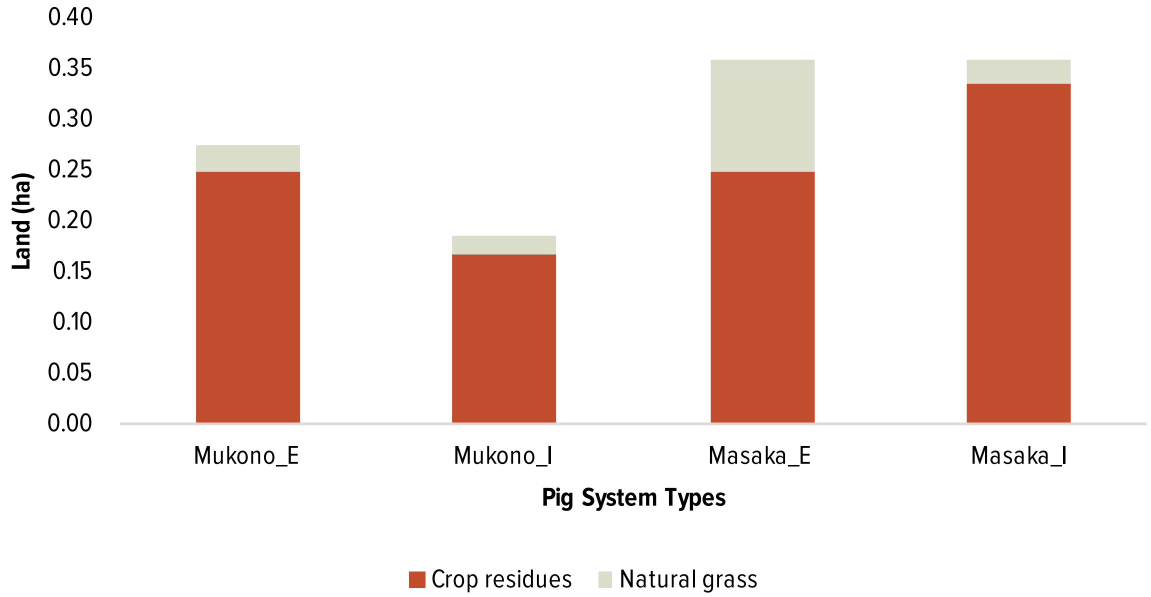


Figure 6 Land requirement for feed quantification by CLEANED

- High use of crop residues across all the systems
- Concentrates take about 20% of feed basket however no land is used on farm to produce concentrates
- Low land requirement despite high TLU in Mukono Intensive

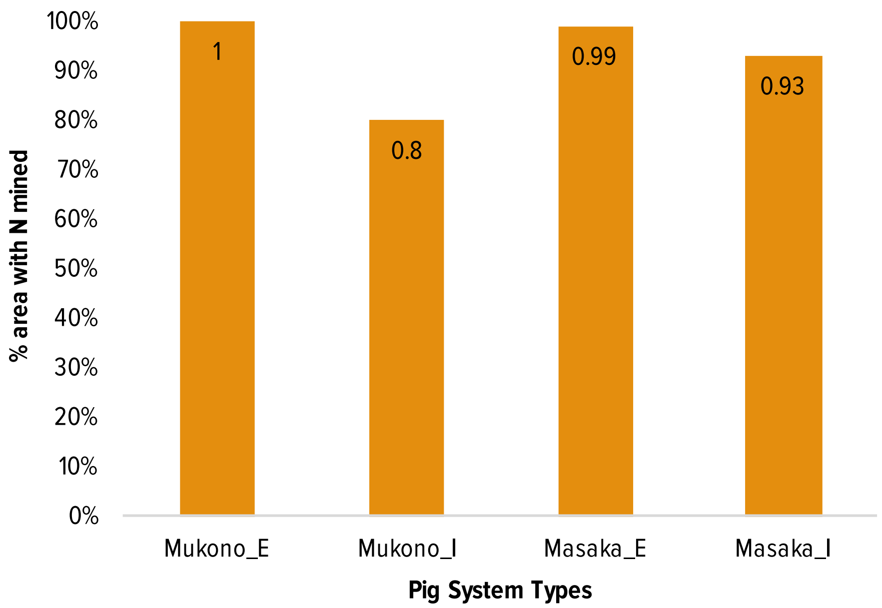


Figure 7 N mining as modelled by CLEANED

- Most of these systems are exporting N out of the system without replenishing back to the soil.
- Extensive systems of Mukono and Masaka as animals are free manure cannot easily be stored and replenishing on crops
- For the Intensive systems some manure is being replenished most is being sold b

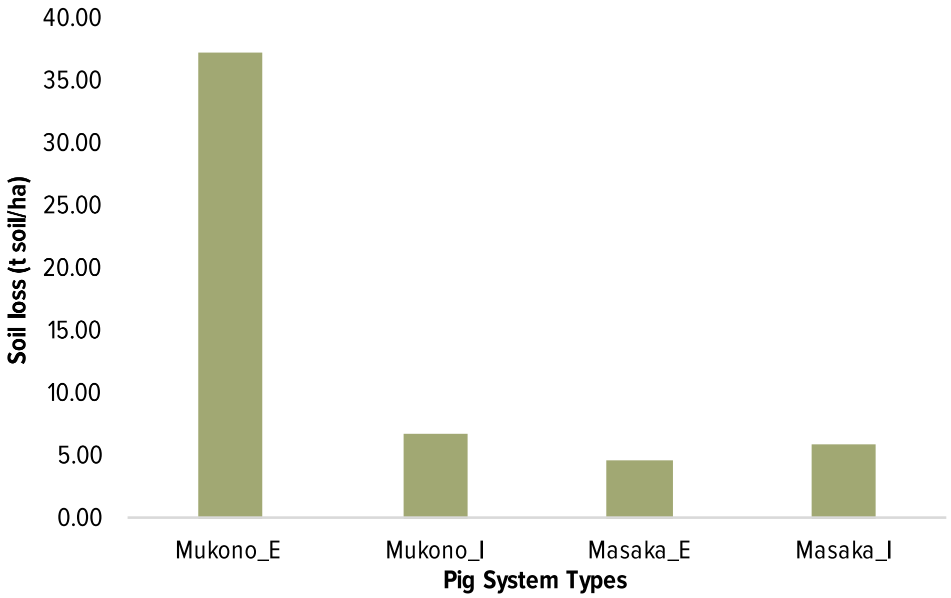


Figure 8 Soil erosion quantification by CLEANED

» **Erosion:** Erosion is expressed in annual t of soil loss.

» **Soil erosion** is estimated using the amount of rainfall, soil type, length and steepness of slope, crop cover factor and the, land management system (agricultural land).

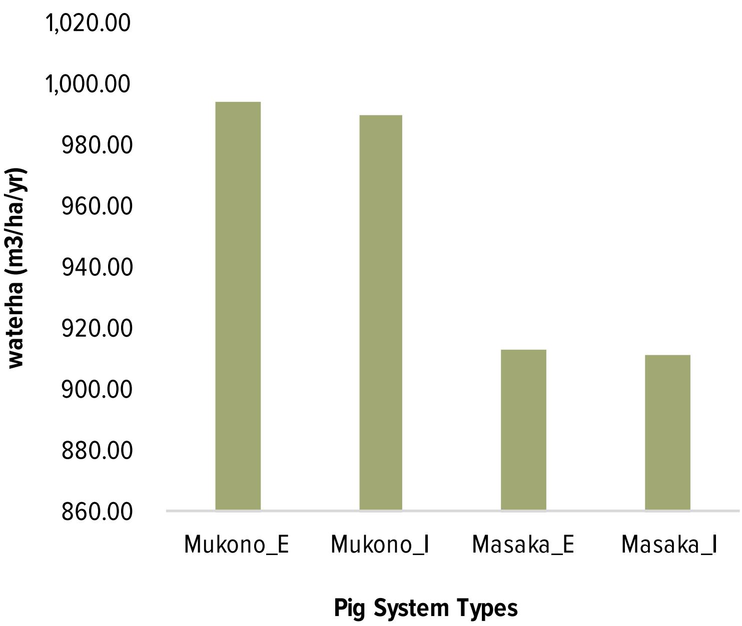


Figure 9 Total water use quantification CLEANED

» The model calculates how much of the water that is available goes into production for feed, how much water is used.

» Crop water requirements are represented by the actual crop evapotranspiration. Evapotranspiration (ET) is a term used to describe the water consumed by plants over a period of time.

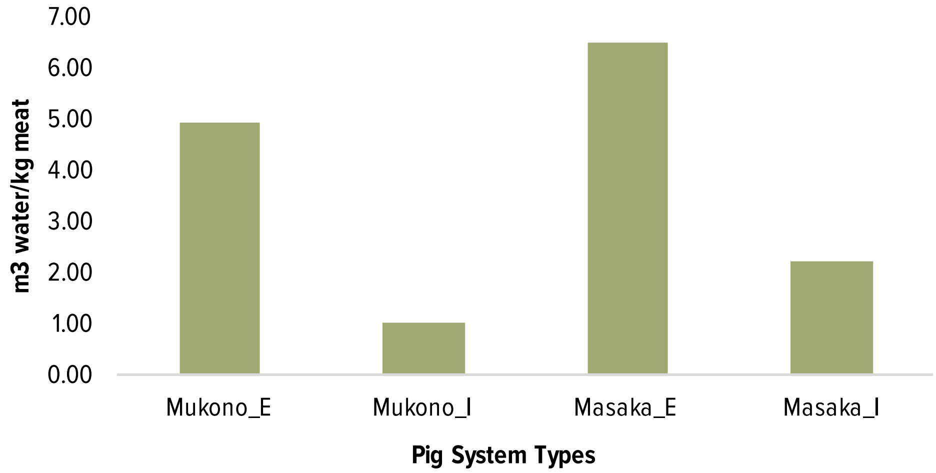


Figure 10 Total water use for meat production quantification by CLEANED

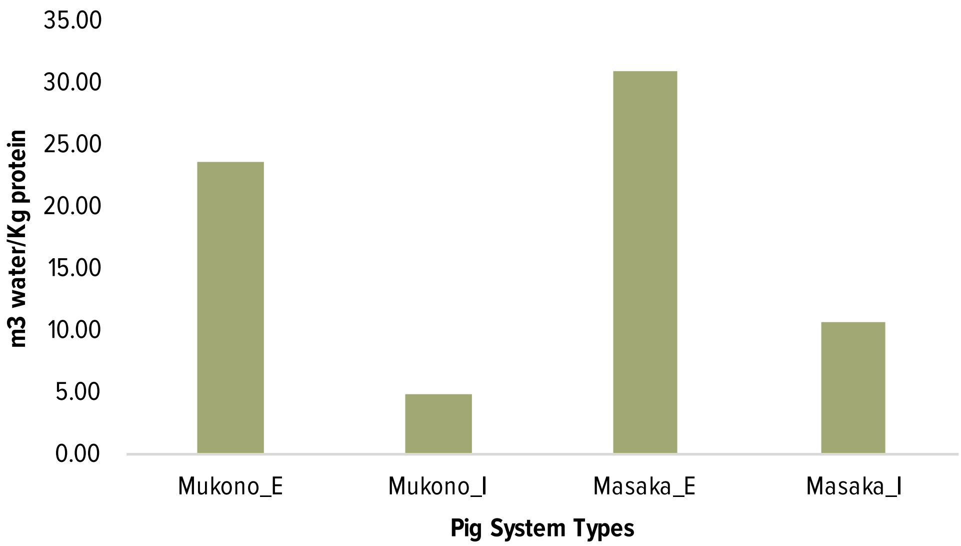


Figure 11 Total water use for kg protein production quantification by CLEANED

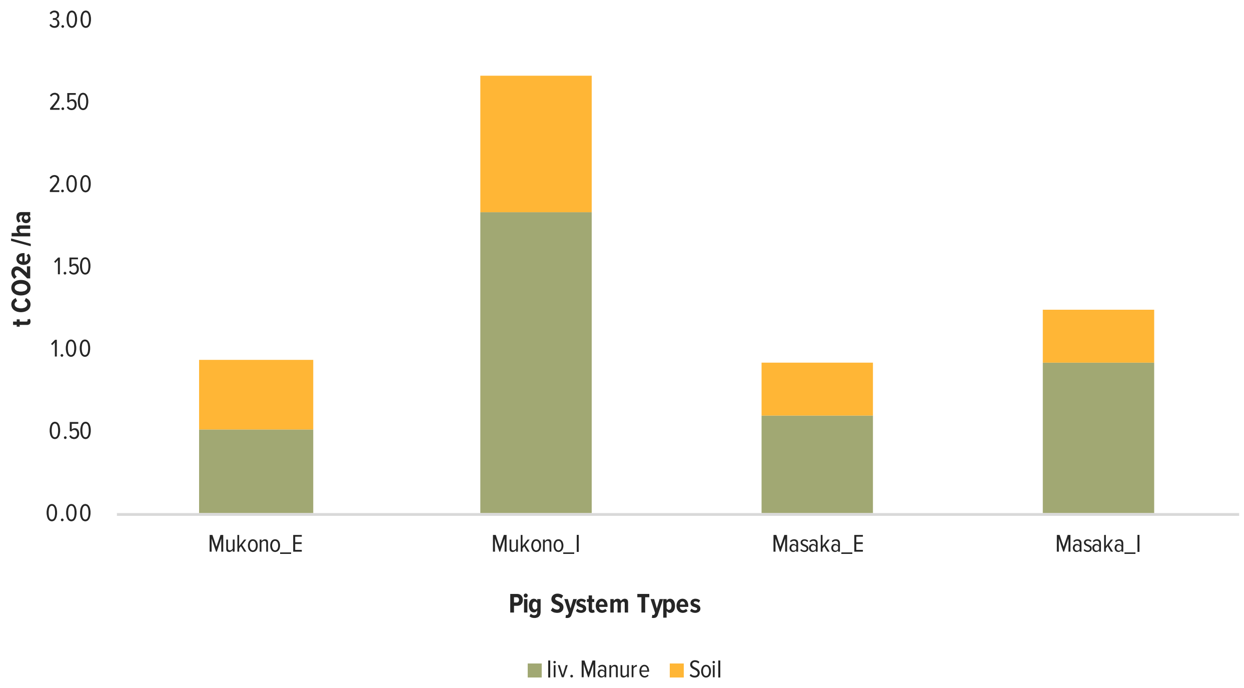


Figure 12 GHGe quantification per hectare as modelled with CLEANED

» Most emissions come from manure management

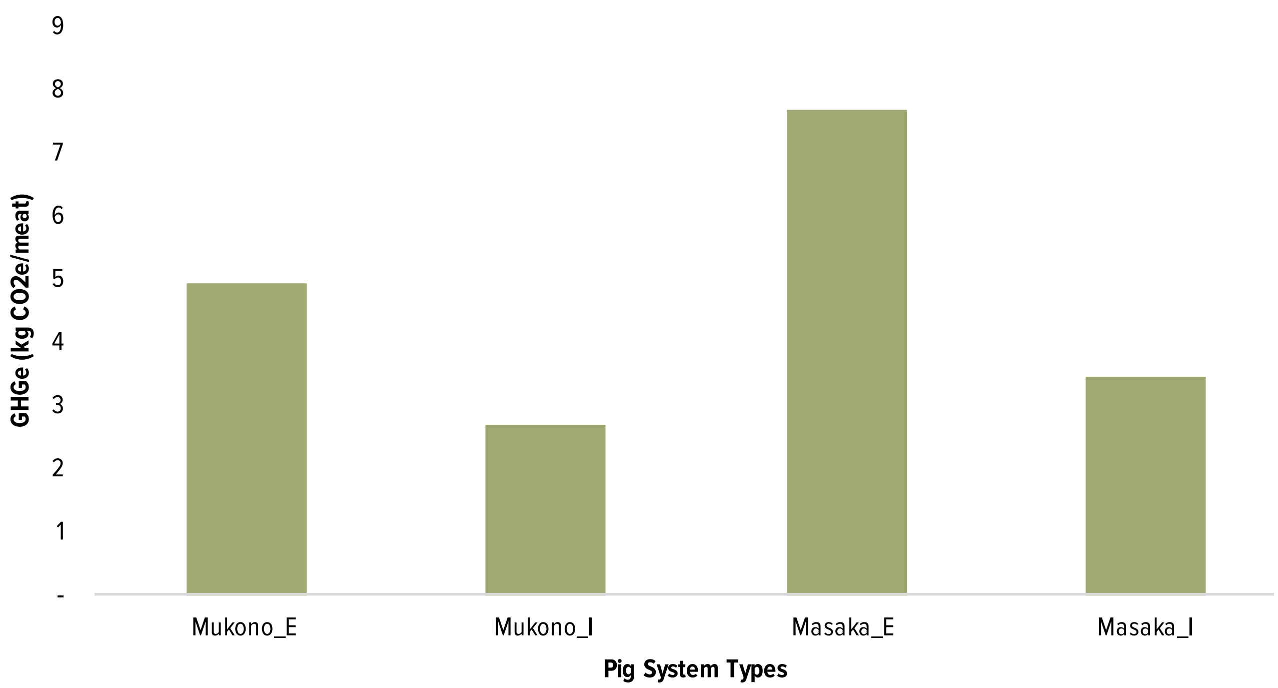


Figure 13 GHGe intensity per kg meat as modelled with CLEANED

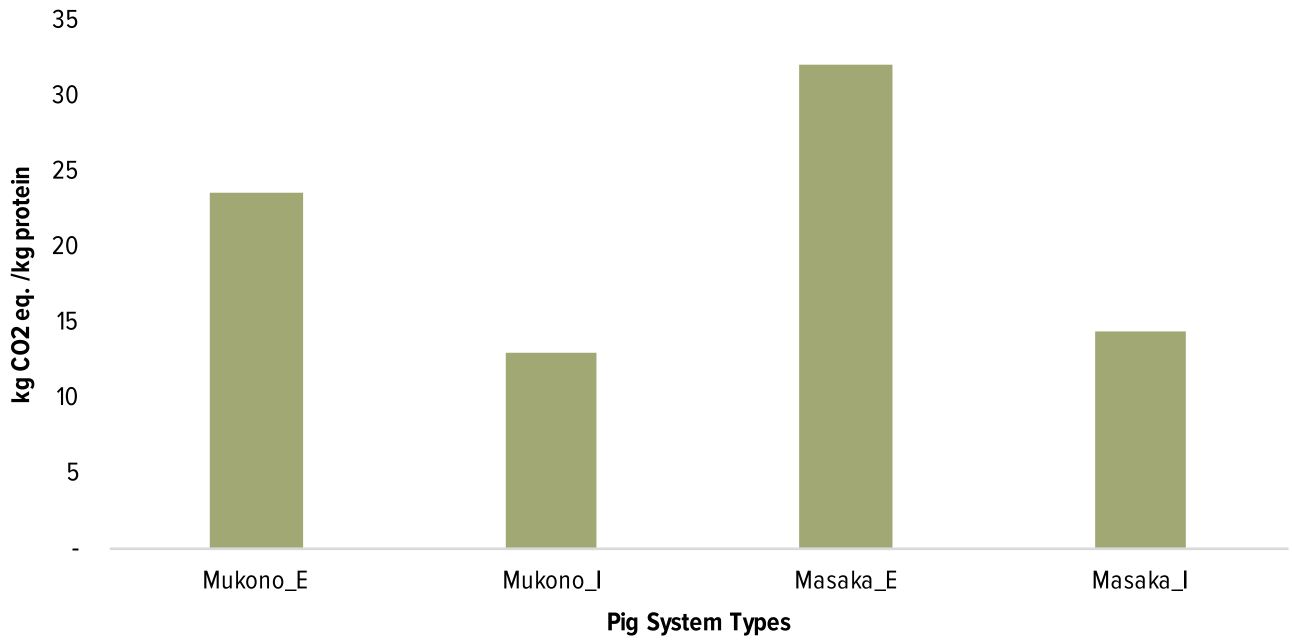


Figure 14 GHGe intensity per kg protein as modelled with CLEANED

» The intensive systems are more efficient in producing kg protein and meat

Figure 15 Isaac Rubayiza presenting results to workshop participants

It was observed that there is a relatively high dependence on natural pasture in the Masaka extensive system compared to the rest of the systems, which subsequently results in high land requirements for feed production. It was also noted that there is a generally high dependence on crop residues for all systems. Pig production systems in Masaka had a higher land requirement for feed production as compared to those in Mukono.

The modeled results depicted a high nitrogen (N) use in all systems, this could be based on minimum N addition to the soil coupled with high crop cultivation leading to high N nutrient mining in all the production systems.

It was observed through the preliminary modeling results that the Mukono extensive systems had exceedingly high soil erosion per hectare. A high level of soil erosion in Mukono extensive may be attributed to topographical nature of the area, high crop cultivation activities, less soil conservation practices, farming practices, and relatively more rain.

Analysis of the water impacts showed that production systems in Mukono required more water as compared to Masaka for crop/feed production. The extensive production systems in the study areas exhibited high water requirements per kilo of pork produced with the intensive systems requiring less water per kilo of pork produced. The extensive systems require more water for every kilogram of protein produced. Water is lost through evapotranspiration in line with the crop produced for feed and fodder. Production of high-yielding crops can reduce the associated loss.

Results for GHG emissions showed high emissions for all production systems with emissions from manure being predominant followed by those from soil use and little from off farm activities. These emissions can be attributed to poor manure management, nitrogen from manure and fertilizer use, and volatilization from soils. Production and use of improved forages and proper manure management are highly recommended

Table 2 gives a summary of questions and comments that came from the session.

Table 2 Question and answers from modeling results session

Questions/Reactions	Answers
Rose Nakyejjwe Was there a portion of land demarcated for the study in order to measure soil erosion? Emissions from the intensive feeding system produces more emissions, are there ratios for the systems? Emissions from manure are dependent on the amount of manure and the corresponding N in the manure. Prof Don Kugonza Regarding feed analysis, did you analyze for quality, and was any lab analysis conducted? Soil impacts; what are the contribution of livestock to soil erosion? Comparison of results show Mukono has relatively higher variations in results compared with Masaka, which areas in Mukono were considered? Water for feeds, did you consider that feeds also come from beyond the district? Could this be a national picture as the feeds come from beyond the intensive systems in the districts? How much emissions are emitted from pigs and how is it compared to cattle and other ruminants?	Jessica Mukiri A lot of questions are related to what the exercises/ validations are about, these are the first results for the model and are adopted from experts, literature, and desktop reviews which have been well referenced.

Questions/Reactions	Answers
Dr. Ibrahim Wanyama Why is the semi-intensive system missing out? We see lots of emissions from the intensive system, can you break this down? Attribute it to its causes? Water use, talked about wet and dry season, what was the unit of measure for water and the respective sources? What were the areas in which the study was carried, if so what was the basis for generalization of the study areas. What was the regional coverage for the assessment? Derrick Senyonga I need clarification, what reasons for the choice of the intensive and extensive system? Regarding the breeds for the systems, Intensive having cross breeds versus extensive having local breeds, do we have local breeds in the country? How are exotic breeds catered for? Is it only the identified breeds in these systems?	This is not meant to reflect a bad light on pig production than to show the possibility for improvement in the pig production system. The project has more to do with the more pork and specifically looking at pigs. We are looking for what best represents the areas from desktop analysis and from the experts, practitioners on ground. What we are looking is for ground truthing and verification of inputs and parameters used to improve the modeling in the tool.

Figure 16 Participants from Masaka discussing environmental impacts in groups

Group work: system and result validation

Participants were divided into two groups, Masaka and Mukono, discussing and verifying results, input data that can be found in figures and tables above and Annex 3:

i. Pig Systems

ii. Model results

iii. Model input data

See tables below for summaries.

Pig production system distribution

This exercise involved discussing the pig production systems and their representativeness (Table 1).

Table 3 summarizes the response given by participants on pig systems in Mukono and Masaka. We can see that the predominant system in Mukono is extensive, and in Masaka intensive. For the CLEANED assessment, we left out the semi-intensive systems which participants also recognized as being part of these systems. Part of the reason we focused on the extensive and intensive systems is that these are the most prevalent livestock systems in these districts, with most farmers engaged in either system or transitioning to one. Furthermore, the MorePork project had also focused its priority interventions in these systems.

Table 3 Validation of pig system types in Mukono and Masaka

Type	Reasons for yes/no answer			
	Yes	No	Percentage (%) Low / Medium / High (0 -29 / 30 -60 / 61 -100)	What information is needed to further verify the results
Mukono_Extensive			61-100	Most prevalent system
Mukono_Intensive			0-29	Less prevalent system
Masaka_Exensive			0-29	Some farmers do semi-intensive especially for piglets up to weaning time.
Masaka_Intensive			61-100	Typically, intensive, farmers are business-oriented and consider biosecurity with caution. Well-designed structures. A small area of operation and damage. Manure collection and disposal are maximized. Theft control. Good husbandry management.

Validation of baseline results

Modeling results for the selected production systems were assessed and validated by the different groups concerning what is considered to be the true reflection of the same on the ground, these were backed by justification.

Validation of these results can be seen in Tables 4 to 7. Results that attributed to the proportion of input/parameter related to production of protein or meat was not validate as the participants could not get a unit of association for measurement and sought clarification.

Ms. Mukiri Jessica, clarified as follows; Nitrogen balance is based on how much is put and how much is removed, we assumed that little manure is used on the crops, most of the manure being sold. Regarding carbon, efficiency the intensive system are better but overall extensive systems produce less emissions. Some of the results per product were not as interesting for farmers. Some systems require how much water/soil to grow a kg of beef/pork or protein for example growing legumes as compared to raising pork.

Sections that are represented with NA show that participant were not confident to verify results.

Table 4 Validation of CLEANED results Mukono Extensive

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
Total area under feed production			This is realistic and a common practice
N nutrient mining			About 90% nutrient mining
Soil erosion per ha			This is too high. About 5t soil loss
Total water Use m3/ha/yr.	N/A	N/A	
Total water use meat			7.3 m3/kg
Total water use to produce a kg of protein	N/A	N/A	
Sources and Sinks of CO^2	N/A	N/A	
GHG emission intensity	N/A	N/A	
GHG emission intensity per kg protein	N/A	N/A	
GHG emission intensity per meat	N/A	N/A	

Table 5 Validation of CLEANED results Mukono Intensive

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
Total area under feed production			About 0.1ha. Where farmers practicing intensive farming generally have smaller land due to urbanization
N nutrient mining			About 70%
Soil erosion per ha			About 10t. There is more water usage/wastage in cleaning
Total water Use m3/ha/yr.			
Total water use meat			About 10.95m3/kg
Total water use to produce a kg of Protein	N/A	N/A	
Sources and Sinks of CO^2	N/A	N/A	
GHG emission intensity	N/A	N/A	
GHG emission intensity per kg protein	N/A	N/A	
GHG emission intensity per meat	N/A	N/A	

Table 6 Validation of CLEANED results Masaka Extensive

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
Total area under feed production			
N nutrient mining			N nutrient efficiency is lower in extensive farming systems due to poor manure management, hence mining and leaching or surface runoff affects N balance
Soil erosion per ha			
Total water Use m3/ha/yr.			
Total water use meat			
Total water use to produce a kg of Protein	N/A	N/A	
Sources and Sinks of CO^2			
GHG emission intensity	N/A	N/A	
GHG emission intensity per kg protein	N/A	N/A	
GHG emission intensity per meat	N/A	N/A	

Table 7 Validation of CLEANED results Masaka Intensive

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
Total area under feed production			The proposition is representative because mast farmers use residues as feeds for pigs and supplement with natural grass. Evidence based research is needed
N nutrient mining			In intensive systems, manure disposal is well managed and purposively taken to the fields for crop production
Soil erosion per ha			The results don't reflect what is on ground as most farmers do not use soil conservation methods.
Total water Use m3/ha/yr.			The quantity of water used is higher than expected, it should be half the result.
Total water use meat	N/A	N/A	
Total water use to produce a kg of Protein	N/A	N/A	
Sources and Sinks of CO^2			In intensive systems, there is more manure collection and residual wastes that contribute to CO^2 production.
GHG emission intensity			In intensive systems, more manure collections contribute to GHG emission intensity. GHG emission intensity per kg protein
GHG emission intensity per kg protein			Pigs in intensive farming systems are normally fed on high protein concentrates and therefore excrete more waste that contributes to GHG emissions.
GHG emission intensity per meat	N/A	N/A	

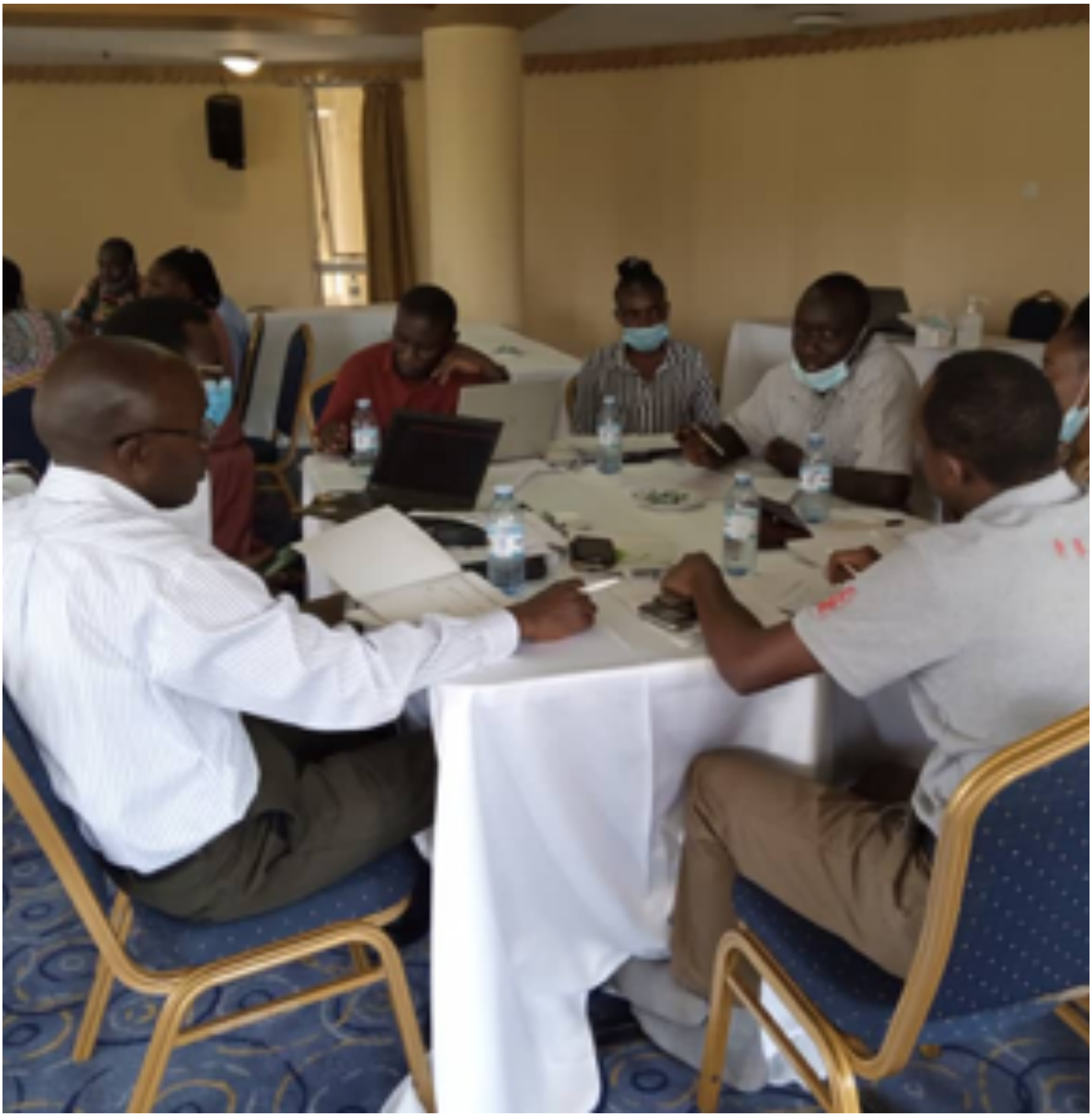


Figure 17 Participants from Mukono discussing environmental impacts in groups

Characterization of inputs and parameters

A review of the inputs and parameters used in modeling are detailed in Tables 8 and 9. The discussion highlighted issues that were thought to deviate from what is on the ground within the production types in Masaka and Mukono. It was noted that some farmers in Masaka's extensive system use communal boars, though agreed with the heard composition. The participants disagreed with the value of average body weight noting that farmers in extensive systems do not follow any feeding standards. The participants agreed with the rest of the parameters for both production types in Masaka.

For participants from Mukono, they proposed changes to the average annual growth per animal, average body weight, litter size, and the proportion of feeds used. The adjustments are reflected in Table 9.

Cells in the table with N/A show that the participants did not get around to completing the exercise

Table 8 Inputs and Parameters Verification

	Herd composition (no)	Average annual growth per animal (kg)	Average Body weight (kg)	Litter size (pigs)	Feedbasket/ Diet	Animal Whereabouts	Maize / DM Yield tonne/ha	Natural pasture/ DM Yield tonne/ha	Cassava/ DM Yield tonne/ha	Sweet potato/ DM Yield tonne/ha	Cocoyam leaf/DM Yield tonne/ha	Banana/ DM Yield tonne/ha
Mukono_E	N	N	Y	Y	Y	N	N/A	N/A	N/A	N/A	N/A	N/A
Mukono_I	N	Y	Y	N	N	N	N/A	N/A	N/A	N/A	N/A	N/A
Masaka_E	N	N	Y	N	N	N	N	N	N	N	N	N
Masaka_I	N	N	N	N	N	N	N	N	N	N	N	N

Table 9 Adjustments to the inputs and parameters

	Average annual growth per animal (kg)	Average Body weight (kg)	Litter size (pigs)	Feed basket/ diet
Mukono_E		50 - 60	6	Sweet potatoes – 35%
Mukono_I	45-50	Should be lower		
Masaka_E		Should be lower		

Next users of CLEANED results

This section of the workshop was to discuss:

- Who is/will be using CLEANED, what are their professions?
- Where does it fit into their responsibilities?

From this the participants, we asked to list five stakeholders who could benefit from CLEANED and which of the graphs would be relevant to their occupation:

1. Farmers
2. Policy Makers
3. Environmentalists
4. Animal Health Practitioners
5. Agriculturalists

Figure 18 reports that participants found that total area under feed production, nitrogen nutrient mining, soil erosion, total water use per product, sources and sinks of carbon dioxide, and GHG emission intensity are the most relevant for farmers. For policymakers, it is observed that total area under feed production, soil erosion, total water use per product, sources and sinks of carbon dioxide, and GHG emission intensity are of the highest relevance. These were the only two categories that participants ranked, due to time constraints.

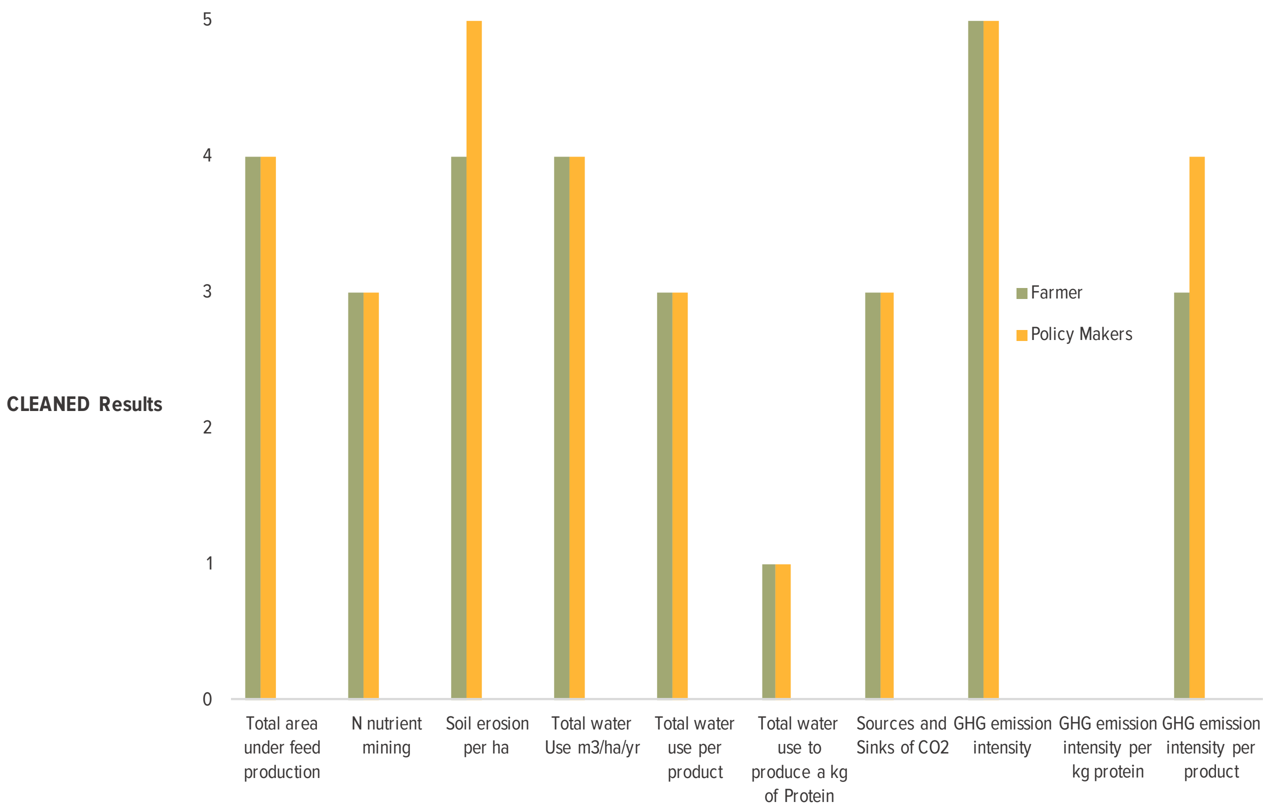


Figure 18 Relevance of CLEANED results to different stakeholders

4. Workshop sessions day 2

On day two of the workshop, the same participants focused on:

i. the challenges facing pig production in Masaka and Mukono;

ii. designing intervention packages based on the solutions being promoted by the More Pork Project

Challenges faced by the pig value chain

Pius Lutakome from ILRI gave a short presentation highlighting the key challenges faced in the Masaka and Mukono region:

- Disease control
- Low quality forage
- Low performance of A.I
- In-breeding
- Poor manure management

The groups went back into groups to discuss these challenges, the tables summarizing this activity.

Table 10 Production challenges Mukono Extensive

Production Challenges	Is the production challenge affecting your pig system type?		If Yes: How important is this production challenge in dairy type and location. Percentage (%). Mildly important/ Important / Very Important	Reasons for answer
	Yes	No	(0 -29 / 30 -60 / 61 -100)	
Feeding			Important	Seasonal availability of feed. Variable cost of feeds which affect cost of production, poor feeding, low weight, and poor quality pigs.
Health			Very important	Lack/insufficient veterinary services (unavailability). Poor quality of veterinary services. Fake drugs in the market. ASF presents serious challenges.
Genetics			Important	Different breeds are associated with different litter sizes and animal weight gains and susceptible to diseases.
Environment/ Manure mgmt.			Mildly important	Poor disposal of manure and losses due to not harvesting the manure. Predisposition to diseases and parasites. Loss of pigs/piglets due to heat stress or heavy rains.

Table 11 Production Challenge Mukono Intensive

Production Challenges	Is the production challenge affecting your pig system type		If Yes How important is this production challenge in dairy type and location Percentage (%) Mildly important/ Important / Very Important	Reasons for answer
	Yes	No	(0 -29 / 30 -60 / 61 -100)	
Feeding			Important	Poor feeding will result in poor production and poor productivity. Variable cost and quality of feeds and ingredients.
Health			Important	Poor health of pigs results in reduced production and productivity, limited growth. High costs of treatment.
Genetics			Very important	Poor quality breeds result in poor quality pigs, marketing challenges, and reduced growth rates. Need access to good breeds.
Environment/ manure management				If the housing is good, and the farmer has a proper pit for manure disposal, then not a problem

Table 12 Production challenges Masaka Extensive system

Production Challenges	Is the production challenge affecting your dairy type		If Yes How important is this production challenge in dairy type and location Percentage (%) Mildly important/ Important / Very Important	Reasons for answer
	Yes	No	(0 -29 / 30 -60 / 61 -100)	
Feeding			Important	Feeding is cheap and easy.
Health			Important	Disease acquisition due to community exposure. Malicious damage to animals. Animal theft.
Genetics			Mildly important	Farmers careless and mostly rare local resistant breeds of pigs.
Environment/ Manure mgmt.			Important	Environment pollution. Disease spread (agent transmission). Contamination of water bodies.

Table 13 Production challenges Masaka Intensive

Production Challenges	Is the production challenge affecting your dairy type		If Yes How important is this production challenge in dairy type and location Percentage (%) Mildly important/ Important / Very Important	Reasons for answer
	Yes	No	(0 -29 / 30 -60 / 61 -100)	
Feeding			Very important	Feeds cost about 70% of the whole production process. Feeds are expensive. Low quality raw materials. Price fluctuations on market due to seasonal changes. Inadequate certified feed dealers.
Health			Very important	Inadequate qualified technical service providers. Inadequate training to farmers to create awareness. Health services are a bit costly. Climate change effects lead to diseases and pest occurrence increasing. Heat stress and inadequate water supply. Lack of regulation of service providers this leading to selling of counterfeit products.
Genetics			Very important	Inadequate knowledge and skills to identify pig breeds. A lot of inbreeding due to low traceability. Few breeding centers and breeders take long to change boars in the breeding stock. AI services are expensive.
Environment/ Manure mgmt.			Important	Poor management leads to the transmission of disease in animals and humans. Lack of knowledge on manure management practices hence GHG emissions. Lack of capacity of farmers to transform manure and its products to biogas. Poor housing facilities that do not support good hygiene. Poor manure disposal.

Interventions disseminated by MorePork

Table 14 Interventions as disseminated by the More Pork project

Flagship	Summary of intervention	The interventions
Genetics	Community-based AI and synchronization	Community AI & Synchronization
Environment	Manure management options	Composting manure Fertilization of crops Biogas Fish feed
Feeds	Improved planted forages	Grasses Brachiaria - Mulato Brachiaria – Cayman Brachiaria – Cobra Legumes Crotalaria juncea Desmodium Greenleaf
Animal health	Herd health package	Antimicrobial De-wormers Best animal welfare practices e.g. biosecurity

Packages

Within the groups and based on the systems, participants formulated different intervention packages that were anchored in the various challenges and specific locations. Using the MorePork project interventions, packages/scenarios were mapped out with emphasis on their usefulness and applicability for farmers and entrepreneurs.

Table 15 Packages formulated by participants

	Mukono Extensive	Mukono Intensive _ package_1	Mukono Intensive _package_2	Masaka Extensive	Masaka_ Intensive_ package_1	Masaka_ Intensive_ package_2
Herd health	Best animal welfare practices for example practicing bio security	best animal welfare practices for example practicing bio security	Deworming	Deworming, tethering	Deworming, anti-microbial Biosecurity – best animal welfare practices.	
Feeds and Forages	Using improved forages of sweet potato vines, legumes and Desmodium green leaf.	Increasing forages (planted forages)		Use of forages – Brachiaria, Desmodium green leaf, legumes.	Use of concentrates (homemade) and promote silage (from sweet potatoes)	
Genetics	Community A.I to promote good/better breeds. Getting exotic breeds to improve the local ones.	Community A.I and synchronization	Synchronization			Community A.I – to avoid inbreeding, save on transport costs, disease spread, physical damage. Synchronization
Environment/ manure management			Composting manure and fertilizing crops			Composting manure and fertilizing crops

Table 16 Effect of the package of interventions on the production, inputs and parameters in Masaka

Intervention	Inputs
Health	Biosecurity, deworming, rational antimicrobial use, reduced expenses on drugs used, herd immunity, overcome microbial resistance. Reduced incidents of diseases outbreaks
Feeding	Use of concentrates and silage. Parameters- faster growth rate, increased number of pigs, meatiness, resilience to diseases, increased revenue due to increased productivity.
Genetics	Community based AI and synchronization; better breeds, less diseases outbreaks, reduced injuries from natural mating, reduced breeding costs. Increased opportunity of AI technicians, keep inbreeding at bay as there is better record keeping.
Manure management	Composting and soil fertilization. Parameters; reduced pollution, reduced incidents of related diseases, increased crop yield and hence food security for both humans and animals, income from the sale of manure.

Table 17 Effect of the package of interventions on the production, inputs and parameters in Mukono

Intervention	Inputs
Health	Farmer sensitization, promoting of best animal management practices through farmer sensitization; will help improve the body weight from 50 to about 60, reduce losses from death from about two piglets lost to about one. Increased numbers for sale from the bigger litter sizes, with litter sizes increasing from 6 to 8. Reduced treatment costs due to biosecurity.
Feeding	Planting improved forages e.g. leafier sweet potato vines and legumes, for the extensive system improving seasonal availability to about 50% for extensive system and 25% for the intensive system. Better forages will contribute to better weight gain, increased litter sizes, better quality, and more pork.
Genetics	Promotion of better breeds through community AI having bigger litter sizes from 6 to8 for the extensive system and 9 to 14 for the intensive system through community AI. Improved growth rate from 50 to 65 intensive system and up to 60 kg for the extensive system.

These first formulations of the packages were to be further refined by the CLEANED Ugandan team to ensure the packages formulated by the participants were in line with the MorePork objectives. Refinement of the packages are then to be modeled as scenarios to then assess the trade-offs in environment impacts based on the different interventions.

Photo: Kabir Dhanji/ILRI

Plenary session: questions and responses

The plenary session covered the overall flagship matters and issues that arose from the two days' discussions with matters raised as questions and comments, these are summarized in the table 18 with the corresponding responses.

Table 18 Plenary discussion

Issues	Questions/comments	Responses
Feeds	Considering improved and/or planted forages in the extensive system, it might be difficult to plant the extra type of grasses and legumes. Is it possible to consider sweet potato vines as they would address food insecurity at home as well as feeding pigs? This would be helpful in the dry season as well.	The proposals for the feeds are quite wide and these proposals can be taken up.
Environment	There are technologies that the intensive system would use like artificial wetlands to treat effluent from the intensive systems. Application of blue green algae to support decomposition of the effluent. Manure management, now farmers are required to have an EIA, this discourages farmers from progressing to commercial level, this needs to be addressed to support farmers.	The numbers are small, this could be applicable to large scale farms or use at a micro scale of these technologies. This could be applicable at community/ cooperative level. There are different EIAs like screening, if MorePork considers this, they can design a package to consider issues regarding waste management for intensive farmers. Regarding waste management and the need for EIAs, EIAs are designed for large scale industries. As part of the intervention for waste management, we could train farmers on the different waste management practices. Consider the management of the different waste streams from the farm. For large scale farmers, it is critical that they have a waste management plan.
Animal health	We need more clarity on antimicrobial use as a package as we are trying to reduce the use of medicines.	Regarding the microbial, part of herd health packages to reduce microbial use and their effects shared as advisory on the impacts of microbial use this will result in reduced microbial use. Dr. Wonekha expounded on the use of microbial, he noted that the global goal is to go organic and minimize the use of microbial, he further emphasized that the critical issue is how to use them appropriately since excessively using them would affect their farm products, and farmers should learn how to treat their animals. Most farmers normally sell off pigs when they think they will not survive if critically sick. Policymakers need to address the issues of how to manage and use drugs in the short and medium term as these products may have drugs that could affect consumers.
Other comments	Regarding community farming and this is generated from within for example in Kamuli, the challenges were more pronounced in these cooperation's when the dry season hit, as the burden of looking after the pigs were left to the person in the homestead. Regarding the use of biogas, this is not feasible for small scale farmers. This may work for dairy farmers. Let us think though packages that can grow farmers according to their sizes.	Biogas use shouldn't be left out, the packages should be designed according to the size of the farm.
	The need to implement, share and follow up on research findings as some of this knowledge may be lost along the way if not shared and taken up by farmers.	

5. Final remarks

Jessica Mukiri thanked everyone for the participatory engagement and all the hard work put into the workshop and validation of the CLEANED preliminary results, taking part in the discussion to share what is happening on the ground to support verification of the modeled information. We shall share the workshop report and then move on to modeling of the packages for the different systems as well as the report from that process.

Dr. Wonekha Deogracious applauded the partnership of ILRI, Alliance of Bioversity and CIAT, farmers, extension workers, and other partners. The ministry is pleased with the work done by the partners and brings you greetings from the Commissioner of animal production. MAAIF appreciates all the work and that is why the representation is maintained. MAAIF is committed to extend the information shared wither through MAAIF, or through the district technical teams, and appreciate the engagement.

For all these interventions, there are supposed to be enabling laws. MAAIF is working hard to ensure these are in place, for example, the gaps in breeding, provision of health services, inadequate regulation. MAAIF is in the final stages of concluding the animal feed bill, and this will provide a regulatory framework to regulate and probably reprimand those involved in feed production and are not qualified. MAAIF also works on veterinary practices and practitioners' bills to regulate players in the veterinary field.

Now that we have been given this evidence-based information, the partners should put in place good management practices to produce good pork. Can we use and put into practice the knowledge and information shared, using the packages and information on heat stress management. These proposed packages should be cascaded down to farmers and extension workers should remind them of the knowledge gained and hence will have more pork on the market and more money in the pocket. I implore farmers to share the information from the workshop with other farmers to help them improve.

Regarding Environmental Impact Assessments (EIAs), some of these farms have EIAs but do not necessarily practice waste management. Partners should suggest and share mitigation measures with farmers as they think that these issues are only procedural and are unaware of the explicit implications of these environmental issues. This will help us have a safe environment now and in the future.

Thank you, all partners, and MAAIF pledges to share and propagate the information coming out of these researches. The partners should also contribute to the formulation of the laws as these are issues that affect us all.

6. Evaluation

At the end of the workshop participants were given the same KAPS questions to see if perceptions have changed, participants were rated questions mentioning pig production and environment highly or very highly as opposed to earlier in the workshop. They also evaluated the workshop more results on these can be found in Annex 4.

In summary the participants were able to understand of the importance of assessing environmental impacts of pork production. They objectives of the workshop were achieved and some positives were the:

1. Interactions with different stakeholders, specially farmers being welcomed
2. Flexibility in talking in native language
3. Adherence to COVID-19 protocols

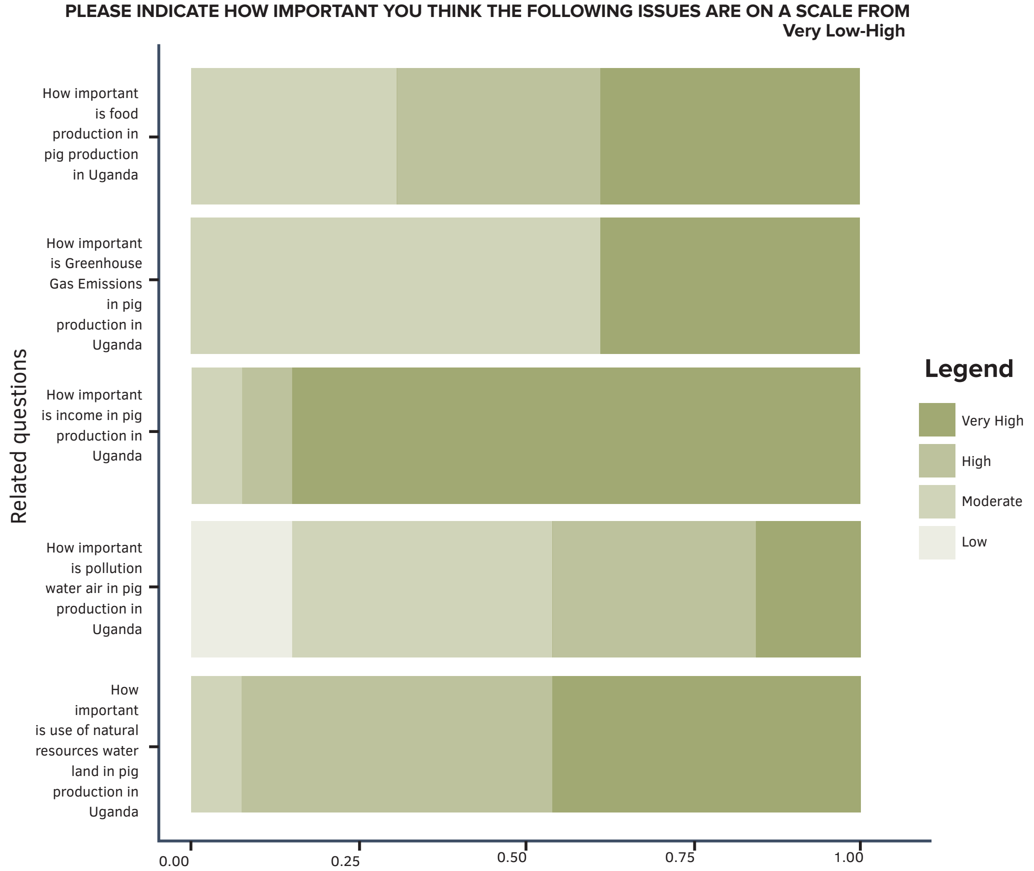


Figure 19 Participants ranking the importance of various environmental impacts of pig production in Uganda after the workshop (KAPS survey)

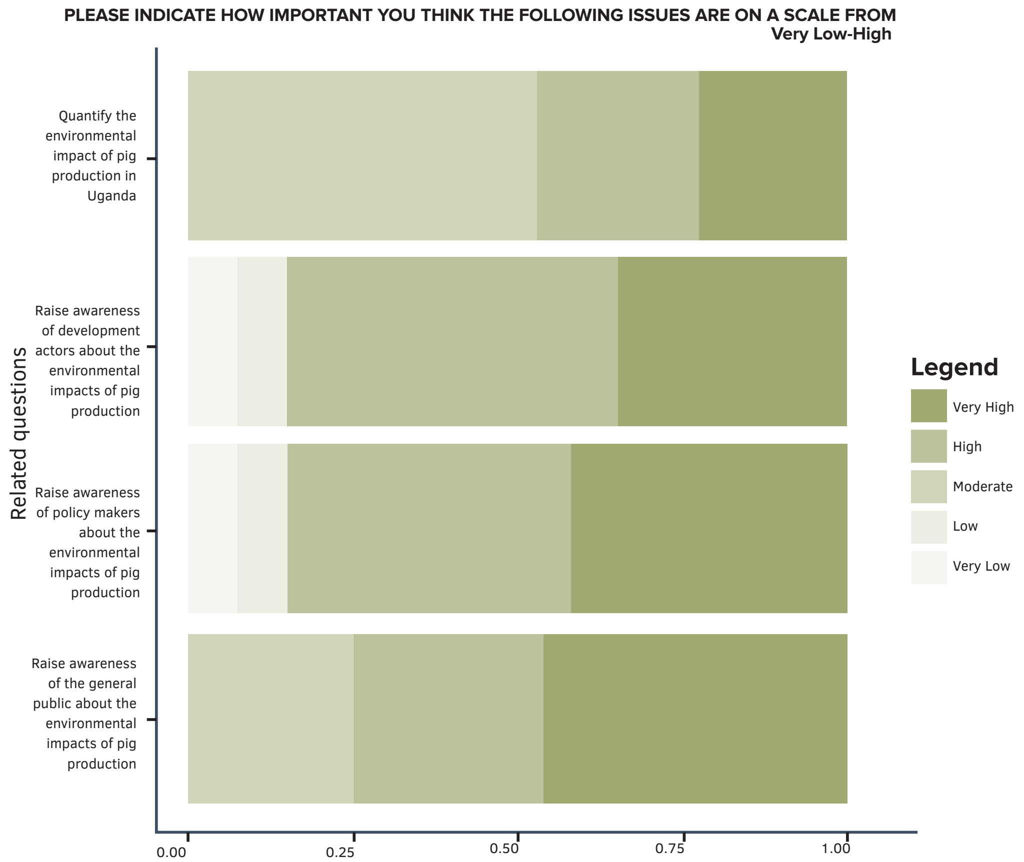


Figure 20 Participants ranking the importance of raising awareness of environmental impacts among different stakeholders after the workshop (KAPS survey)

Annex 1: Participants list

No	Name	Institution	Position
1.	Mr. Senyonga Derick	Ministry of Water and Environment	Climate Change Officer - Mitigation
2.	Mr. Samanya Musa	Mukono	Farmer
3.	Ms. Mbeiza Esther	Mukono	Farmer
4.	Dr. David Kiryabwire	Mukono District Local Government	Senior Veterinary Officer
5.	Ms. Kasujja Hellen	Mukono	Consultant
6.	Ms. Annet Zawula	Masaka	Farmer
7.	Ms. Rose Nakyejjwe	Masaka District Local Government	District Natural Resources Officer
8.	Dr. Ssimbwa David	Mukono District Local Government	Veterinary Officer
9.	Prof. Donald Kugonza	Makerere University	Assoc Prof
10.	Dr. Deogracious Wonekha	Ministry of Agriculture Animal Industries and Fisheries	Senior Veterinary Officer
11.	Dr. Wanyama Ibrahim	International Livestock Research Institute	Consultant
12.	Ms. Namanda Proscovia	Masaka	Farmer
13.	Mr. Sseruwanyiri Henry	Masaka District Local Government	Veterinary Officer
14.	Dr. Lubega Simon	Masaka District Local Government	Veterinary Officer
15.	Mr. Mutalya Innocent	Mukono District Local Government	Senior Environment Officer
16.	Dr. Emily Ouma	Alliance Bioversity and CIAT	Senior Scientist
17.	Mr. Pius Lutakome	International Livestock Research Institute	Livestock Researcher
18.	Mr. Ambrose Atuhaire	Alliance Bioversity and CIAT	IT
19.	Mr. Paul Zaake	Alliance Bioversity and CIAT	Consultant
20.	Mr. Isaac Rubayiza	CIAT	Consultant
21.	Ms. Jessica Mukiri	CIAT	Environmental Modeler
22.	Ms. An Notenbaert	CIAT	Senior Scientist

Annex 2. Workshop Agenda

Stakeholder Workshop: CLEANED Assessment Mukono and Masaka Uganda

16th – 17th March Golf Course Hotel, Kampala Uganda

Agenda

Objectives

1. **Share** and **discuss** preliminary model results
   I. Representation of types (Production/Animal Numbers)
   II. Evaluated the percentage of each type found in each location
2. To **assess** the relevance of CLEANED results and **identify** key decision makers/experts
   I.I Which results are most interesting?
   I.II Who are the key decision makers to target?
3. To **develop** future scenarios for model implementation that reflect best-bet integrated intervention packages per system
   I.III Which livestock production challenges are prominent in the different locations?
   I.IV Which combination on interventions make sense for the different types?

Time	Activity	Responsible
DAY 1: Verifying Typologies + Results		
8:30 -9:00am I 30 minutes	Participants arrival and registration	**Alliance of Bioversity and CIAT**
9:00-9:20am I 20 minutes	Welcome and introductions	**Jessica Mukiri** **Isaac Rubayiza**
9:20-9:40aml 20 minutes	Overview of the project	**Dr. Emily Ouma**
9:40-10:00aml 20 minutes	Workshop objectives and activities	**Isaac Rubayiza**
10:00-10:30 am	***TEA BREAK***	
10.30 – 11:00am I 30 minutes	a. Plenary presentation on the CLEANED model + b. Methodology used c. Typology	**Jessica Mukiri** **Isaac Rubayiza**
11:00 - 11.30am I 30 minutes	d. CLEANED results	**Isaac Rubayiza**

Time	Activity	Responsible
11:30 - 12.00 pm l 30 minutes	e. Group work on validating results i. Do the results make sense? ii. Are the results of interest?	**Groups**
12:00 - 1:00 pm	***LUNCH***	
1:00-1:30 pml 30 minutes	f. Plenary presentation of group mapping of results and feedback from all participants	**Groups**
1:30 - 2:15pm l 45 minutes	g. CLEANED characterization context + importance of each type iii. A look at the typology and system/type characterization iv. Parameters (yield - feeding basket, production – livestock parameters) v. Importance of the different systems/types vi. Q&A – does this typology and how they are defined make sense? How to improve?	**Jessica Mukiri** **Isaac Rubayiza**
2:00 - 2:30pm l 30 minutes	h. Plenary presentation of group characterization + importance of each type	**Groups**
2:30 - 3:00pm l 30 minutes	i. Group work on mapping of results to key experts/ institutions	**Groups**
3:00-3.30pm	***TEA BREAK***	
3:30-4:00 pm l 30 minutes	j. Plenary presentation of group mapping of key experts/ institution and feedback from all participants	**Groups**
4:00-4:10pm l 10 minutes	*Closing of the day*	**Alliance of Bioversity and CIAT**
DAY 2: Building the packages and Scenarios		
8:30-9:00am l 30 minutes	Recap of Day 1 and overview of Day 2	**Jessica Mukiri** **Isaac Rubayiza**
9:00-9:20 am l 20 minutes	Plenary presentation a) Discussion production challenges of feeding systems/health/ genetics/markets – what are the packages and options given what is to be modelled?	**Pius Lutakome,** **Jessica Mukiri**
9:20-10:00 am l 40 minutes	Group work on scenarios	**Groups**
10:00-10:30 am	***TEA BREAK***	
10:30-11:00 am l 30 minutes	Group work on scenarios	**Groups**
11:00-11:30 am l 30 minutes	Plenary presentation of scenarios and feedback from all participants	**Groups**
11:30-11:50 am l 20 minutes	Evaluation of the workshop	**Groups**
11:50 : 12:00pml 10 minutes	Closing Remarks	**Alliance of Bioversity and CIAT**
12:00 - 1:00 pm	***LUNCH***	

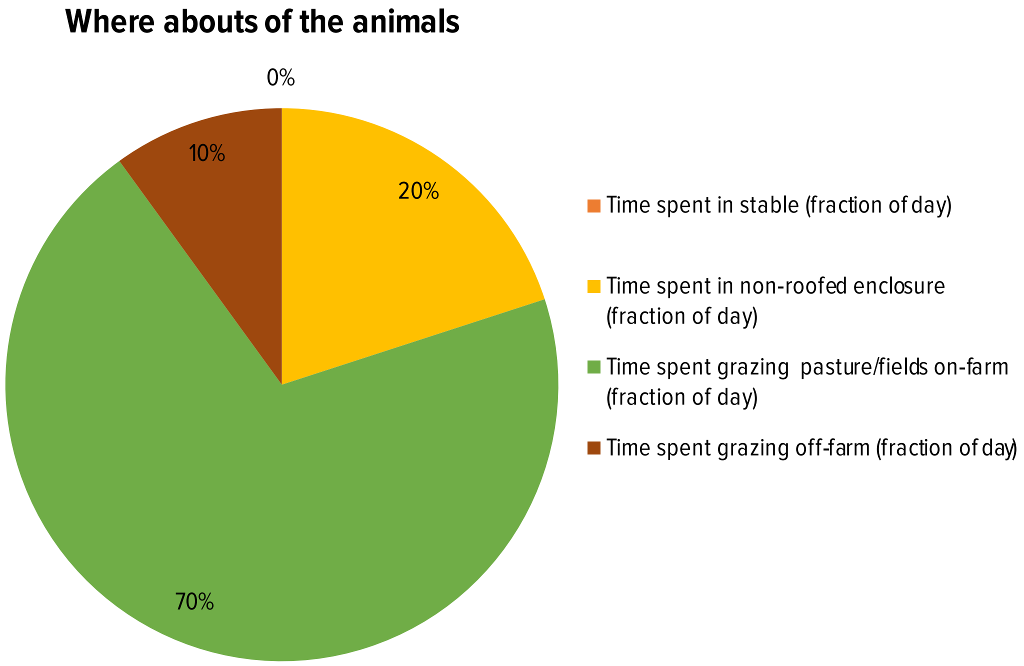
Annex 3: CLEANED INPUT data

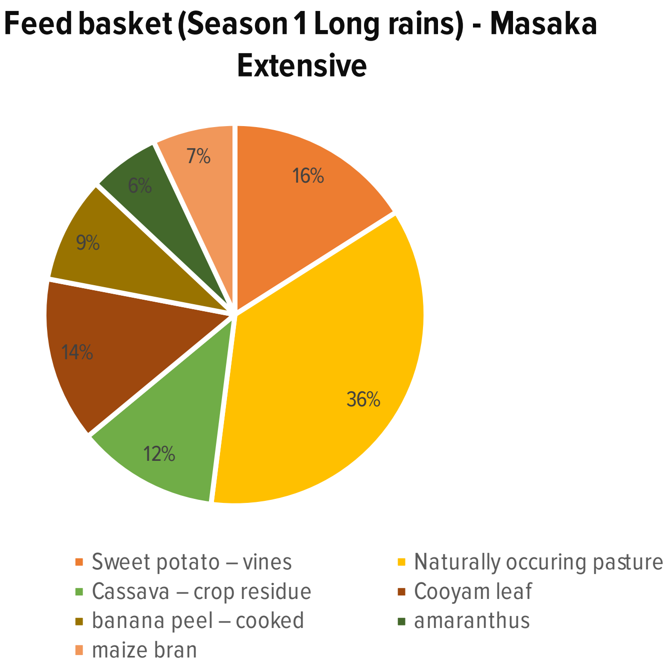
Masaka Extensive System Overview

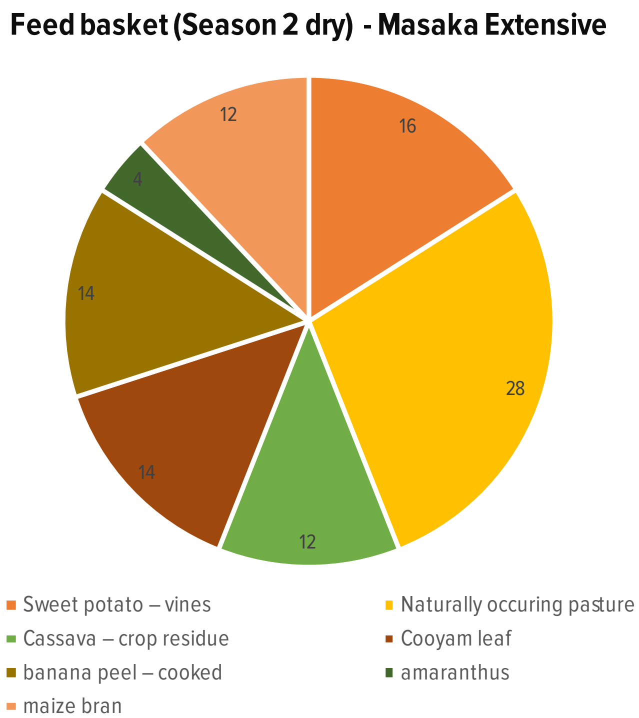
	Livestock systems	Production type	Season	Season Months	Management system	Breed type	Type and No. of animals	Type of feed
Masaka Extensive	Extensive	Farrow to finish	Wet	Long rains (MAM),Short rains (SON)	scavenging	Local	Pigs – lactating : 1 pregnant - sows: 1 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 2	Forages – 40% Concentrates – 5% Crop residues – 20% kitchen leftovers – 35%
			Dry	Dec, Jan, Feb, June, July, Aug				Forages – 25% Concentrates – 5% Crop residues – 25% kitchen leftovers – 45%

Animal Herd Composition

	Herd composition (no)	Average annual milk (kg)	Average annual growth per animal (kg)	Average Body weight (kg)	Litter Size
Pigs - lactating	1			80	
Pigs - pregnant sows	1			80	8
Pigs - dry sows	1			60	
Pigs - boars	1			70	
Pigs - growers	2		40	28	


Where abouts of the animals
0%
10%
20%
70%
Time spent in stable (fraction of day)
Time spent in non-roofed enclosure (fraction of day)
Time spent grazing pasture/fields on-farm (fraction of day)
Time spent grazing off-farm (fraction of day)


Feed basket (Season 1 Long rains) - Masaka Extensive
16%
36%
12%
14%
9%
6%
7%
Sweet potato – vines
Naturally occuring pasture
Cassava – crop residue
Cooyam leaf
banana peel – cooked
amaranthus
maize bran


Feed basket (Season 2 dry) - Masaka Extensive
16
28
12
14
14
4
12
Sweet potato – vines
Naturally occuring pasture
Cassava – crop residue
Cooyam leaf
banana peel – cooked
amaranthus
maize bran

Reference List

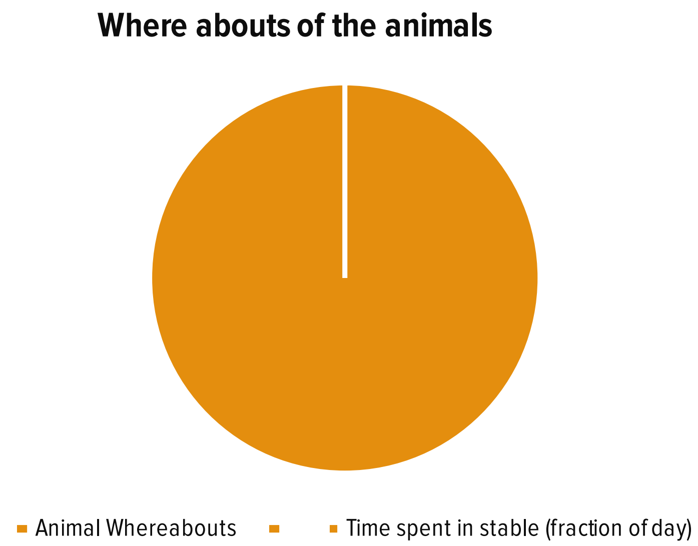
Input/ Parameter	Value	Reference
Herd composition (nr)	6	Expert data,
Average annual growth per animal (kg)	40	An Evaluation of Current Pig Feeding Practices on Smallholder Farms in Masaka and Kamuli Districts Uganda
Average Body weight (kg)	80	Okello, Emmanuel & Collins, Amonya & De Greve, Henri. (2015). Analysis of performance, management practices and challenges to intensive pig farming in peri-urban Kampala, Uganda. International Journal of Livestock Production. 6. 1-7. 10.5897/IJLP2014.0223.
Litter size (pigs)	8	Tatwangire, A. 2014. Uganda smallholder pigs value chain development: Situation analysis and trends. Nairobi, Kenya: International Livestock Research Institute (ILRI).
Feedbasket/ Diet	see pie charts	Expert data,
Animal Whereabouts	100% stable	Expert data,
Maize/DM Yield tonne/ha	1.3	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Natural pasture/DM Yield tonne/ha	13.05	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Cassava/DM Yield tonne/ha	4.27	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Sweet potato/DM Yield tonne/ha	4.11	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Cocoyam leaf/ DM Yield tonne/ha	0.72	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Banana/DM Yield tonne/ha	0.76	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Amaranthus/DM Yield tonne/ha	0.03	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data

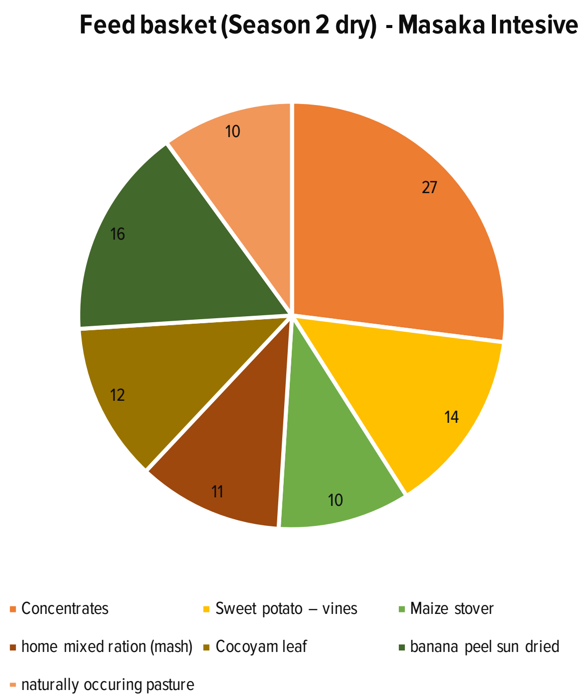
Masaka Intensive System Overview

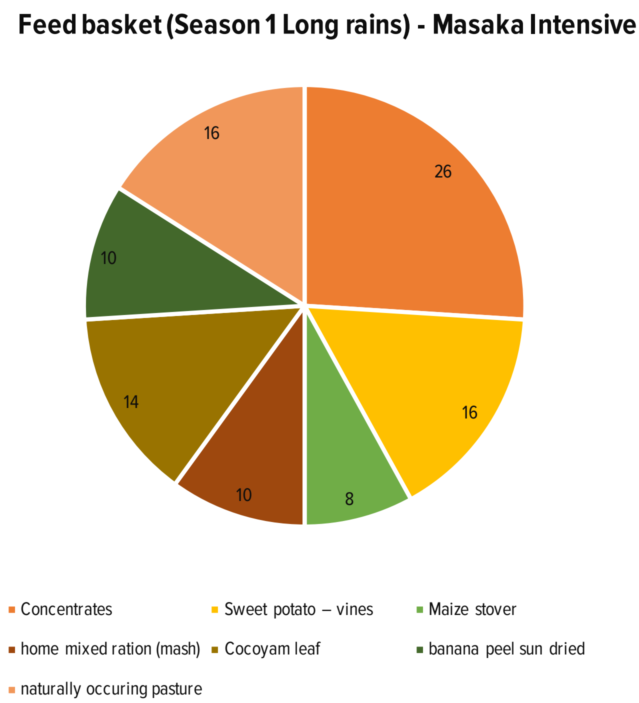
	Livestock systems	Production type	Season	Season Months	Management system	Breed type	Type and No. of animals	Type of feed
Masaka Intensive	Intensive	Farrow to finish	Wet	Long rains (MAM), Short rains (SON)	confined	Cross breed	Pigs – lactating exotic : 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 5	Forages – 30% Concentrates – 35% Crop residues – 20% kitchen leftovers – 15%
			Dry	Dec, Jan, Feb, June, July, Aug				Forages – 17% Concentrates – 36% Crop residues – 25% kitchen leftovers – 22%

Animal Herd Composition

	Herd composition (no)	Average annual milk (kg)	Average annual growth per animal (kg)	Average Body weight (kg)	Litter size
Pigs - lactating	1			90	
Pigs - pregnant sows	2			90	9
Pigs - dry sows	1			70	
Pigs - boars	1			100	
Pigs - growers	5		40	36	







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Input/ Parameter	Value	Reference
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Average Body weight (kg)	90	Okello, Emmanuel & Collins, Amonya & De Greve, Henri. (2015). Analysis of performance, management practices and challenges to intensive pig farming in peri-urban Kampala, Uganda. International Journal of Livestock Production. 6. 1-7. 10.5897/IJLP2014.0223.
Litter size (pigs)	9	Tatwangire, A. 2014. Uganda smallholder pigs value chain development: Situation analysis and trends. Nairobi, Kenya: International Livestock Research Institute (ILRI).
Feedbasket/ Diet	see pie charts	Expert data
Animal Whereabouts	100% stable	Expert data
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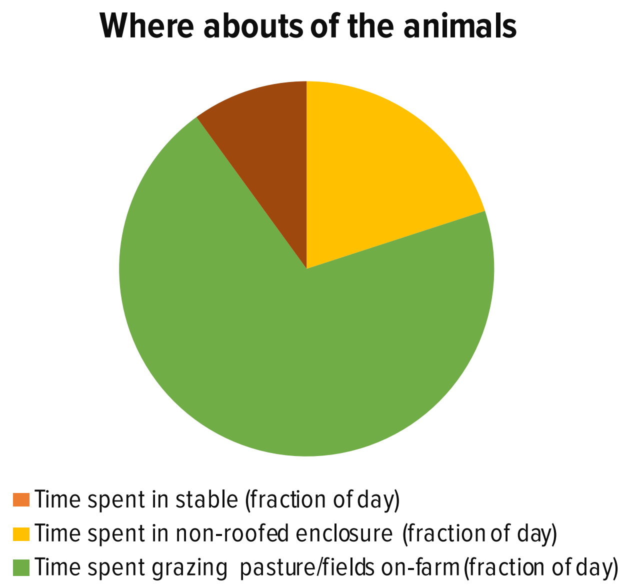
Sweet potato/ DM Yield tonne/ha	4.11	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Cocoyam leaf/ DM Yield tonne/ha	0.72	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)
Banana/ DM Yield tonne/ha	0.76	Tropical forage Factsheets, (2019), Feedipedia (n.d), Expert data, Amdihun A. et. al,(2014)

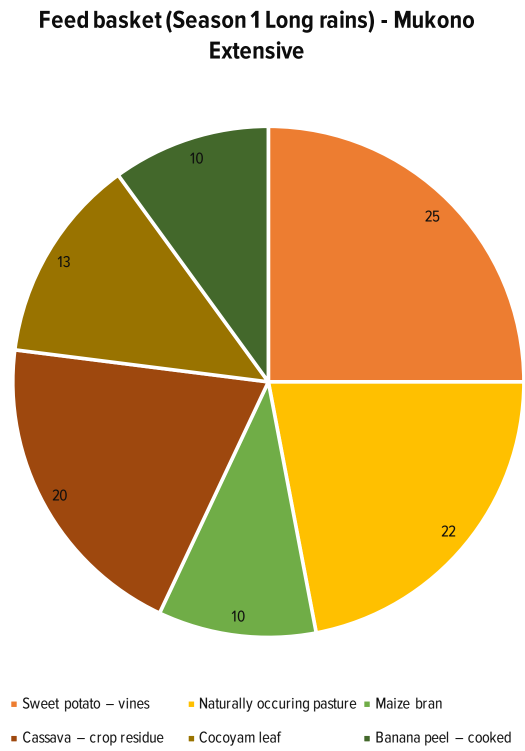
Mukono Extensive System Overview

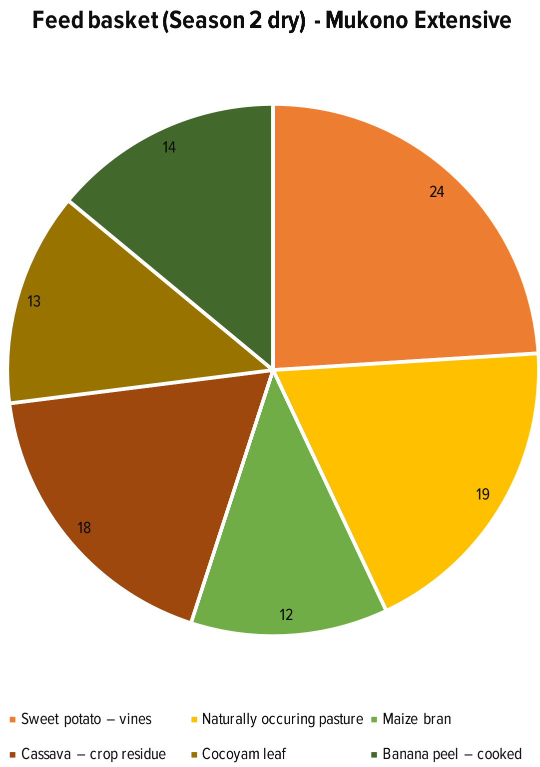
	Livestock systems	Production type	Season	Season Months	Management system	Breed type	Type and No. of animals	Type of feed
Mukono Extensive	Extensive	Farrow to finish	Wet	Long rains (MAM), Short rains (SON)	scavenging	Local	Pigs – lactating : 1 pregnant - sows: 1 Pigs - dry sows: 0 Pigs - boars: 0 Pigs - growers : 2	Forages – 30% Crop residues – 35 kitchen leftovers – 15%
			Dry	Dec, Jan, Feb, June, July, Aug				Forages – 50% Crop residues –30% kitchen leftovers – 20%

Animal Herd Composition

	Herd composition (no)	Average annual milk (kg)	Average annual growth per animal (kg)	Average Body weight (kg)	Litter size
Pigs – lactating	1			80	
Pigs – pregnant sows	1			80	8
Pigs – growers	2		40	28	







Reference List

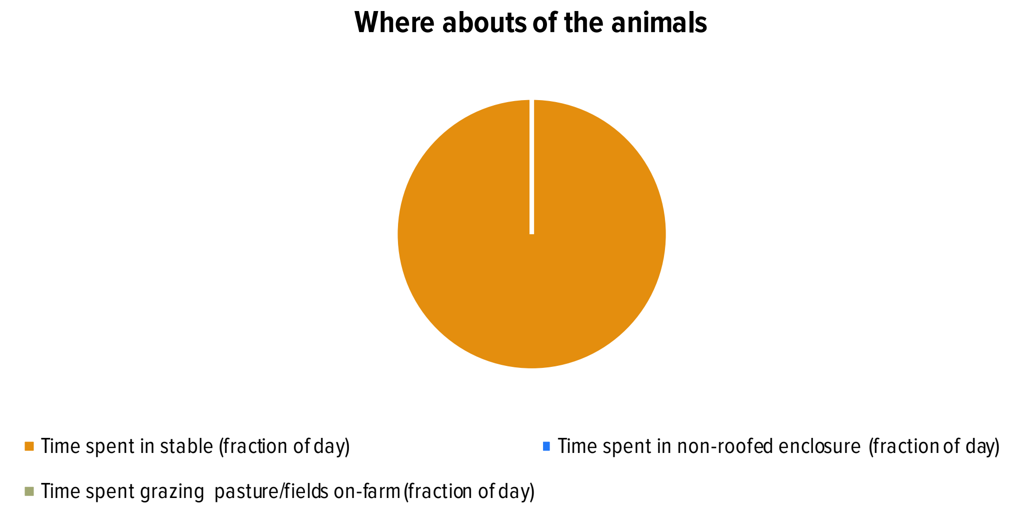
Input/ Parameter	Value	Reference
Herd composition (nr)	4	Expert data,
Average annual growth per animal (kg)	40	An Evaluation of Current Pig Feeding Practices on Smallholder Farms in Masaka and Kamuli Districts Uganda
Average Body weight (kg)	80	Okello, Emmanuel & Collins, Amonya & De Greve, Henri. (2015). Analysis of performance, management practices and challenges to intensive pig farming in peri-urban Kampala, Uganda. International Journal of Livestock Production. 6. 1-7. 10.5897/IJLP2014.0223.
Litter size (pigs)	8	Tatwangire, A. 2014. Uganda smallholder pigs value chain development: Situation analysis and trends. Nairobi, Kenya: International Livestock Research Institute (ILRI).
Feedbasket/ Diet	see pie charts	Expert data,
Animal Whereabouts	100% stable	Expert data,
Maize/ DM Yield tonne/ha	1.3	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Natural pasture	13.05	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Cassava /DM Yield tonne/ ha	4.27	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Sweet potato/ DM Yield tonne/ha	4.11	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Cocoyam leaf/ DM Yield tonne/ha	0.72	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Banana/ DM Yield tonne/ ha	0.76	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)

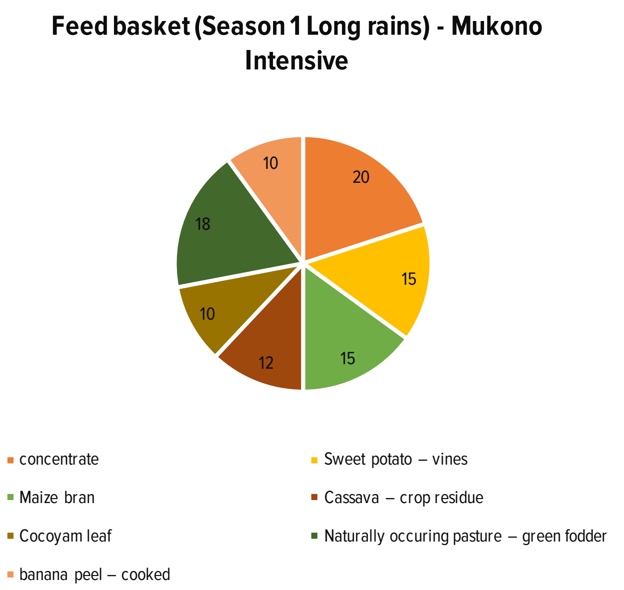
Mukono Intensive System Overview

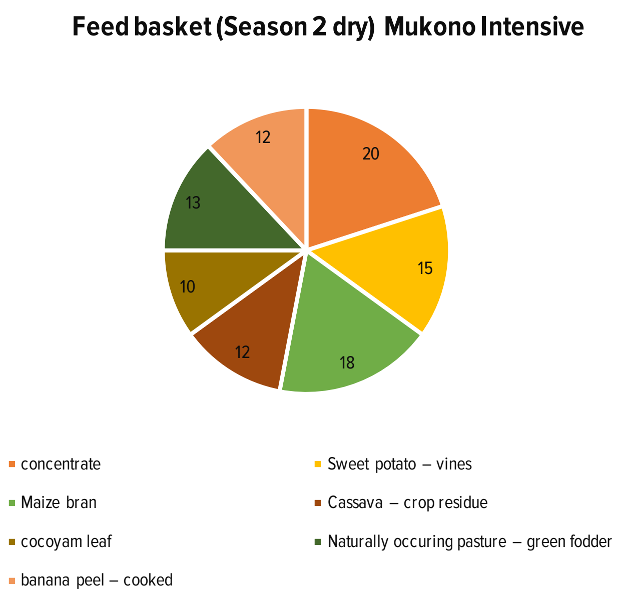
	Livestock systems	Production type	Season	Season Months	Management system	Breed type	Type and No. of animals	Type of feed
Mukono Intensive	Intensive	Farrow to finish	Wet	Long rains (MAM), Short rains (SON)	confined	Cross breed	Pigs – lactating : 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 5	Forages – 30% Concentrates – 35% Crop residues – 20% kitchen leftovers – 15%
			Dry	Dec, Jan, Feb, June, July, Aug				Forages – 17% Concentrates – 36% Crop residues – 25% kitchen leftovers – 22%

Animal Herd Composition

	Herd composition (no)	Average annual growth per animal (kg)	Average Body weight (kg)	Litter size (pigs)
Pigs - lactating	1		90	
Pigs - pregnant sows	2		90	9
Pigs - dry sows	1		70	
Pigs - boars	1		100	
Pigs - growers	5	40	36	





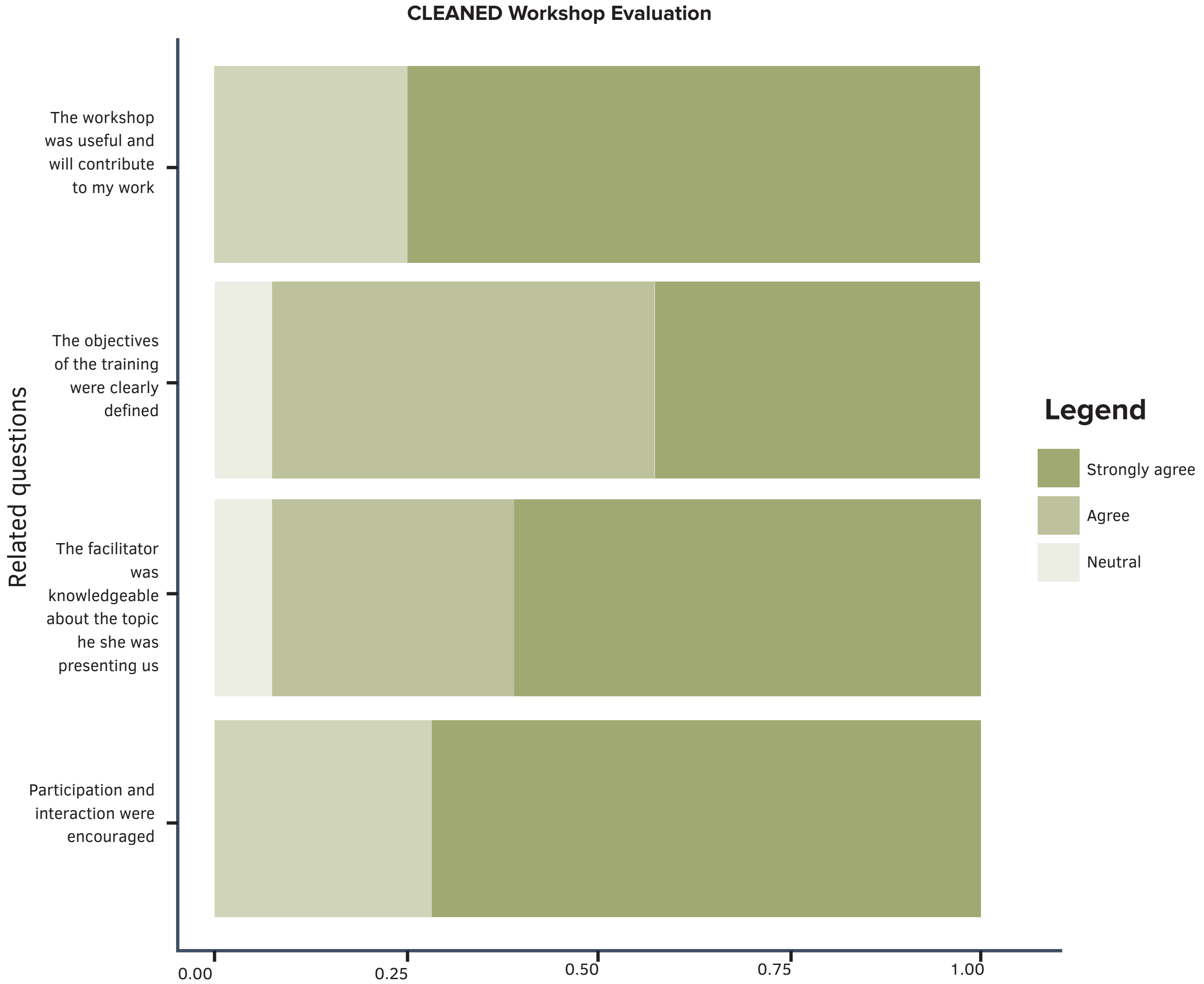


Reference List

Input/ Parameter	Value	Reference
Herd composition (nr)	10	Expert data,
Average annual growth per animal (kg)	39.639	An Evaluation of Current Pig Feeding Practices on Smallholder Farms in Masaka and Kamuli Districts Uganda
Average Body weight (kg)	90	Okello, Emmanuel & Collins, Amonya & De Greve, Henri. (2015). Analysis of performance, management practices and challenges to intensive pig farming in peri-urban Kampala, Uganda. International Journal of Livestock Production. 6. 1-7. 10.5897/IJLP2014.0223.
Litter size (pigs)	9	Tatwangire, A. 2014. Uganda smallholder pigs value chain development: Situation analysis and trends. Nairobi, Kenya: International Livestock Research Institute (ILRI).
Feedbasket/ Diet	see pie charts	Expert data,
Animal Whereabouts	100% stable	Expert data,
Maize/ DM Yield tonne/ ha	1.3	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Natural pasture/ DM Yield tonne/ha	13.1	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Cassava/ DM Yield tonne/ha	4.3	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Sweet potato/ DM Yield tonne/ha	4.1	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Cocoyam leaf/ DM Yield tonne/ha	0.7	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Banana/ DM Yield tonne/ha	0.8	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)


Photo: Kabir Dhanji/ILRI

Annex 4: CLEANED Workshop Assessment



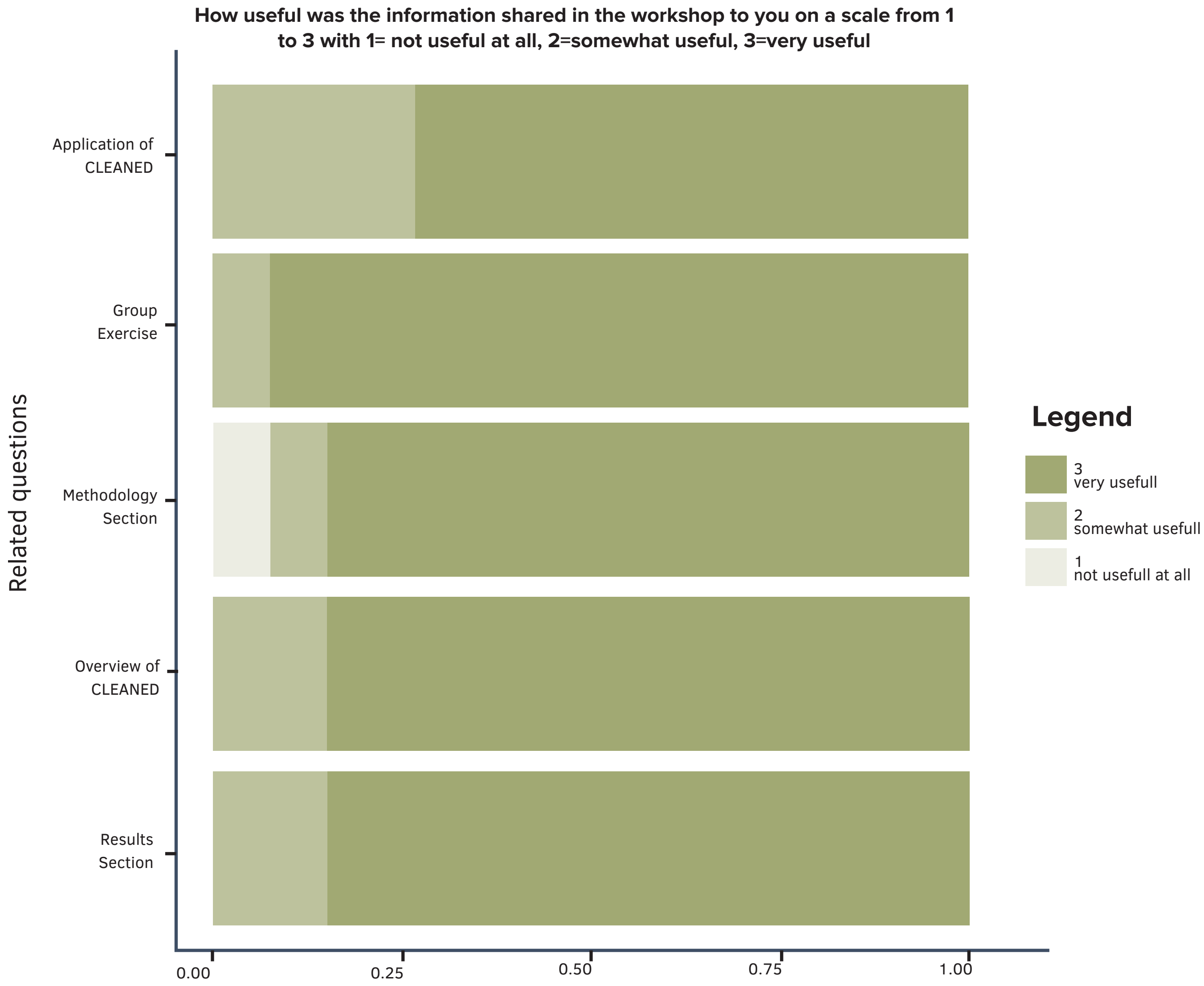

How useful was the information shared in the workshop to you on a scale from 1 to 3 with 1= not useful at all, 2=somewhat useful, 3=very useful
Related questions
Application of CLEANED
Group Exercise
Methodology Section
Overview of CLEANED
Results Section
0.00
0.25
0.50
0.75
1.00
Legend
3 very usefull
2 somewhat usefull
1 not usefull at all

Table 19 Views on the workshop

What did you like most about this workshop?	What should we have done differently?
The clear presentations Timeliness Focused discussions with clearly evidence-based information	Needed a little more time...sometimes there was a rush over certain items without clear comprehension
The very candid presentation and discussions	More time per session. I felt the engagement with farmers required more time Also, the farmers were the biggest stakeholders, but the number was small.
Initiation of EIA in pig mgt	Some topics were allocated limited time
Group work	Nothing
Participatory contributions from different stakeholders in the pig value chain.	Using evidence based research results from demonstration sites know by stakeholders especially farmers.
1. Clear presentation of the results 2. Group discussions that complemented the research finding	Everything was okay
The discussions were engaging and a lot of knowledge was generated	More time should have been allotted, to have more discussion in particular with modelling to generate information and costing therein
It was a participatory and informative workshop	Details on protein requirement per product and its impact on carbon dioxide levels and greenhouse gas emissions
The interactive session on analyzing the results was wonderful.	Have more prior engagement with farmer on data collected.
The voice and issues of farmers being heard	Increase on the number of participants
The ability to communicate in our local languages	None
Interaction with other practitioners.	Have more participants
Interaction with stakeholders	Include more stakeholders beyond project sites.
Participation of farmers	People who were interviewed were not invited. At some point we wanted to know the basis on which the respondent answered some of the questions but they were not available
The workshop was well organized. Appropriate stakeholders especially farmers were invited. There was sufficient time for the workshop.	I think a sample survey should have been conducted to obtain ascertain the information from farmers.

Was the format of the meeting suitable for you?	Reason for previous answer
Yes	Had both online and physical attendance options which was favorable to me
Yes	The order of the sessions was appropriate.
Yes	Presentations followed by group discussion
Yes	It allowed interactions
Yes	Because it strictly observed the COVID-19 SoPs.

Was the format of the meeting suitable for you?	Reason for previous answer
Yes	The organization of the presentations and group work influenced my active participation in the meeting
Yes	It had a number of stakeholders
Yes	It was easy to interpret and understand the content
Yes	Staying at the hotel made the engagement smooth.
Yes	Yes it followed the ministry of health SOPs
Yes	It was interactive and safe given the current conditions.
Yes	we managed to engage with no issues arising
Yes	Allowed some level of interaction
Yes	It was interactive
Yes	Yes. It helped improve my knowledge on the impacts of Pig production (and other animals generally) on the environment.

Photo: Kabir Dhanji/ILRI

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