Pathways for sustainable pig value chain development in Uganda: Report of a participatory ex-ante environmental assessment workshop, Hoima, Uganda, 30 September 2015




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Introduction

CLEANED is a framework for “Comprehensive Livestock Environmental Assessment for improved Nutrition, a secured Environment and sustainable Development” to investigate ex ante multiple environmental impacts, namely on water, greenhouse gas emissions, soil health and biodiversity that might follow from suggested from different interventions in livestock value chains.

The CLEANED approach is based on five steps as shown in Figure 1. Firstly, collection of secondary data is combined with a reconnaissance visit to the area to understand what the scope of CLEANED will be. Secondly, based on the first assessment, experts are consulted for the validation of the data collected and to identify eventual gaps to be complemented by additional secondary data. Thirdly a Participatory Geographical Information Systems (PGIS) exercise is conducted, to map out the resources for which geo-referenced data could not be found, identify the common productions systems, define their characteristics in detail and map them out both for the present situation as well as the possible development of the production systems by 2025. This step also includes a transect drive across the landscape with the value chain, so that the modeller can become acquainted with the reality on the ground in order to make more realistic assumptions when using remotely sensed data. Fourthly, all the information is used to parameterize and run the CLEANED tool to produce a spatially explicit indicator of the impacts of the current system and changes in the possible futures. Finally, results are brought back to policy and other decision makers in the form of a learning environment for innovation, where participants can learn about the environmental dynamics in a spatially explicit way and create a space for debate to identify trade-offs and synergies in order to bring innovation into the value chain that enhance sustainable intensification.

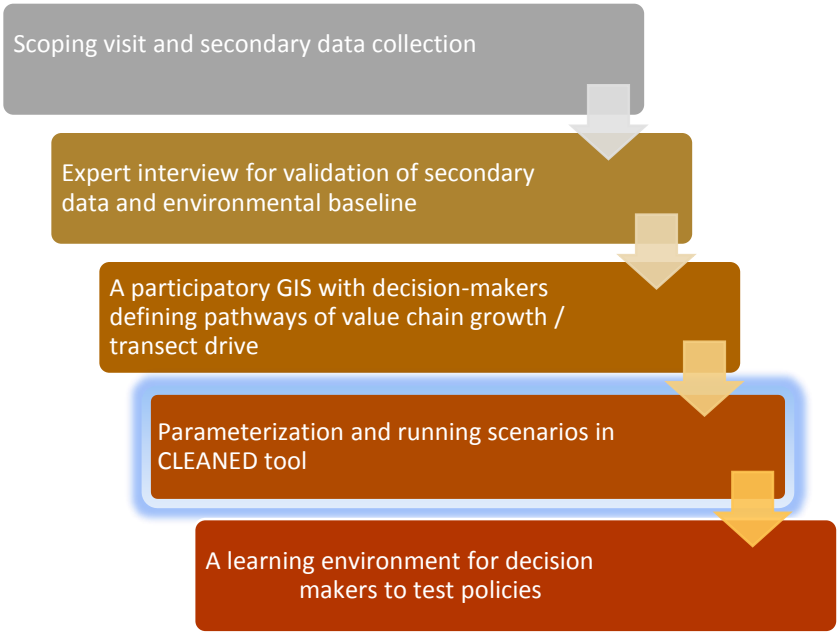

Figure 1 : The CLEANED approach

The aim of this report is to describe the implementation of step 3, the Participatory GIS and transect drive for the pig value chain in Hoima district of Uganda (Figure 2).

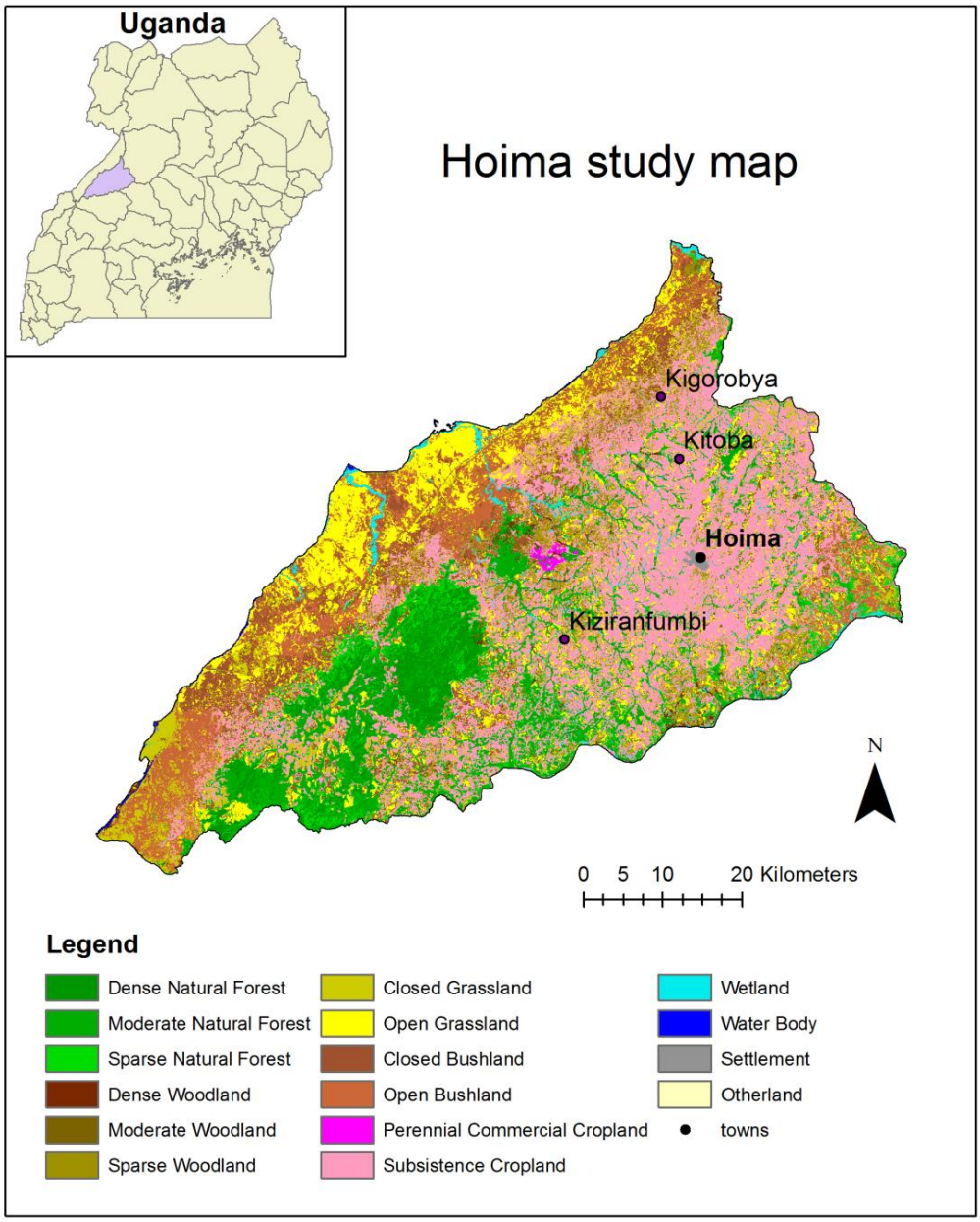

Figure 2: Hoima study area map (Land cover: SERVIR 2000)

Participatory GIS workshop

PGIS approach and material

Participatory GIS aims at letting expert and stakeholders make a detailed map of information for which no geo-referenced data exist, but also use the pretext of mapping to learn about the value chain.

In terms of supporting materials for the mapping exercise, the Afri-cover land cover map (GLCN 2013, Landsat 2000-2001, vector), and the digital elevation map (Jarvis et al., 2008) were colour printed in an A1 format. These maps can be found in the appendix. A boundary map with roads and rivers was printed on acetate layers (plastic transparent sheets) on which participants could draw. The advantage of using acetate layers is the opportunity to overlay the one or more hand drawn maps over several base maps.

The acetate layers with the participants' drawings were scanned, geo-referenced and digitized where relevant.

Participants

Participants in the mapping of the pig value chain in Hoima district through a PGIS exercise were selected from the Smallholder Pig Value Chain Development (SPVCD) stakeholder platform with which ILRI works on a regular base. Targeted selection ensured that relevant governmental officers were invited, complemented with opinion leaders and other stakeholders that have a good understanding of the area, namely the different actors in the pig value chain. Participants therefore also included: district officers, farmer cooperatives, individual farmers and extension workers.

The meeting started with the registration of the 25 participants. The participants were asked to map several pig production systems and environmental resources. The participants were first divided into 4 groups, namely Green, Yellow, Orange and Pink, making sure that each group represented all actors. Each group was assigned to a facilitator. Later in the afternoon new groups were formed based on the newly emerged future projections of production systems, which were used to facilitate drive further discussions and participation.

Study area boundary

CLEANED tool assesses value chains as a system, for which defining the boundary is critical. As a start to the exercise the participants were asked to discuss a set of questions on what the boundary of the value chain was: Where do all the processes associated with a Hoima pig occur? Where does the value chain start and at which point is feed considered as an import to the region?

Yellow group

The yellow group discussed the pig value chain boundaries by taking a broader look at pig production areas, including locally available feeds, commercial feeds, animal health facilities, including drug shops, extension services, and markets.

Some areas outside the district were mapped as pig production areas as shown in

Figure 3. In addition, the group also marked and mapped pig markets which were either existing or emerging from outside the district

The areas covered mainly fell under the administrative boundaries hence settling up with the set administrative boundary as the study area. However, it was acknowledged that the chain extended and covered other areas outside the district, especially Kampala, where most of the commercial feeds came from and considered as an import to the district.

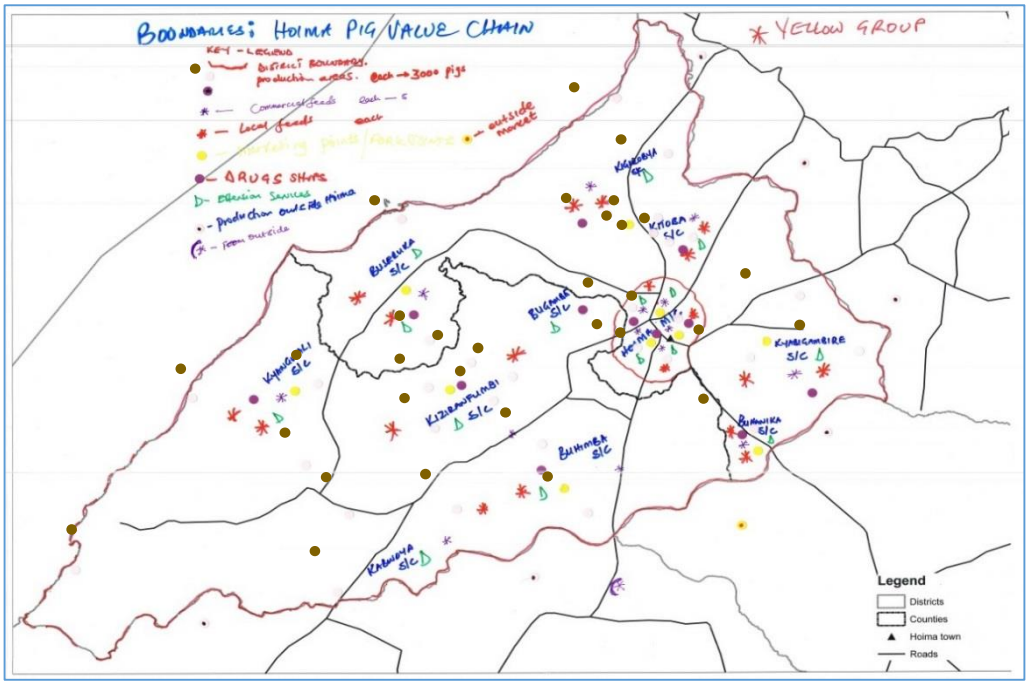

Figure 3 : Definition of the boundary of the Hoima pig value chain from the yellow group

Orange group

The orange group identified the initial administration boundaries plus Bulisa district as part of the value chain as shown in Figure 4. We learnt that farmers also got most of their fish and maize from the district.

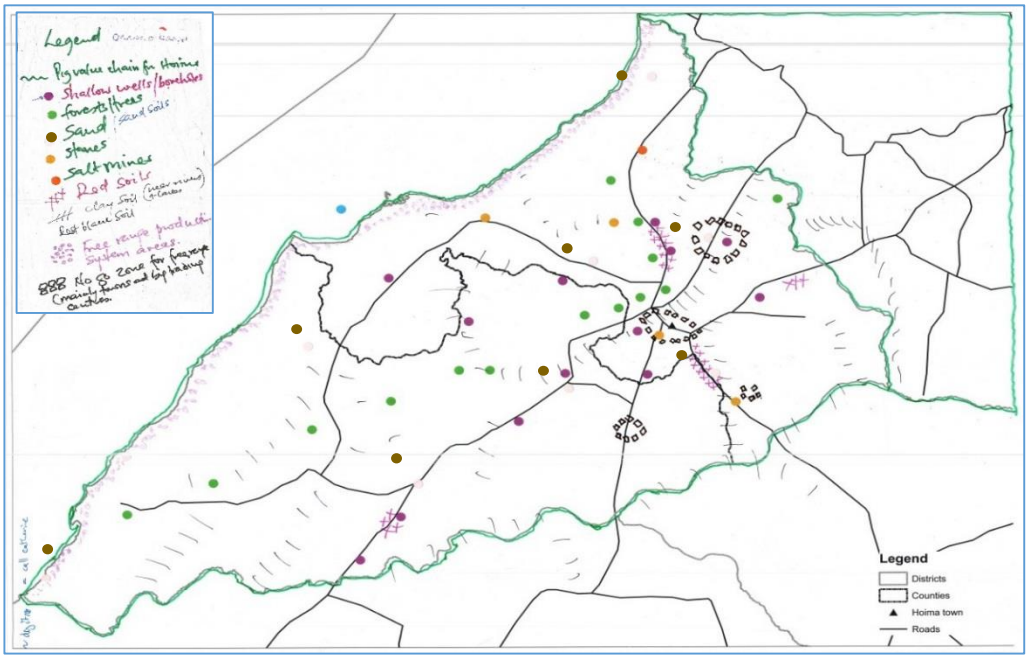

Figure 4: Definition of the boundary of the Hoima pig value chain and natural resources from the Orange group

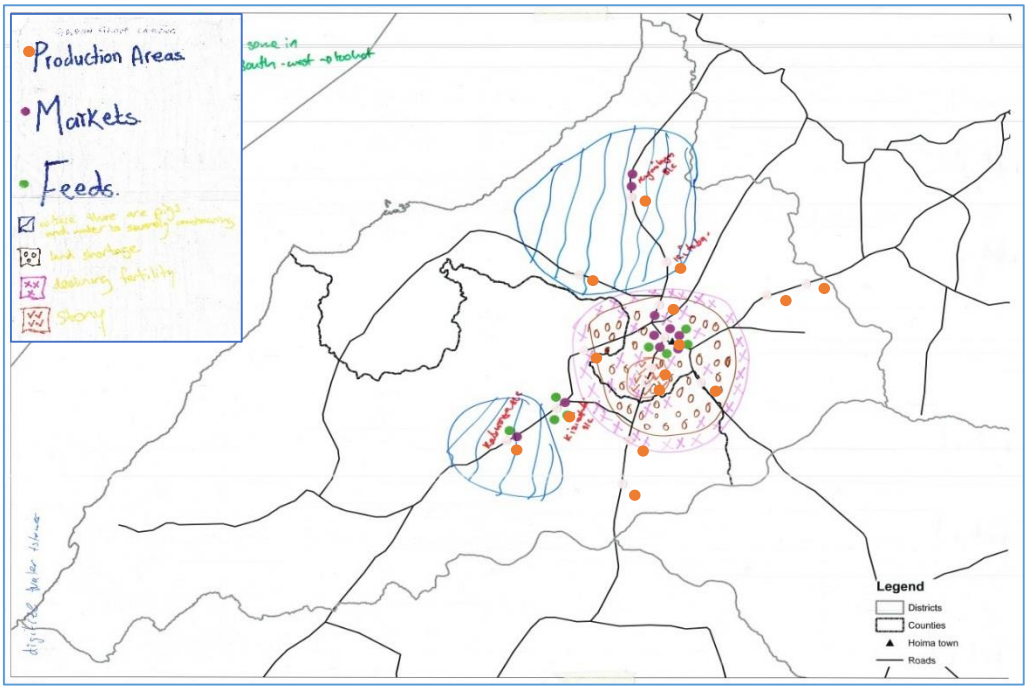

Figure 5: Definition of the boundary of the Hoima pig value chain and natural resources mapped by the Green group

Pink group

The pink group found the identification of pig value chain boundary question irrelevant, as most of its participants were working for organisations that could only reach out to Hoima, and therefore decided that the pig value chain boundaries are simply covered by the administration boundaries.

Green group

The green group (Figure 5) didn't start with defining a boundary but rather concentrated on identifying pig production areas (orange dots) and pig marketing areas (purple dots) in order to end up drawing a boundary around them. They also excluded some of the South East, and included part of Masinde, Bulisa and Kibale districts which were neighbouring the district. Unfortunately the group did not have enough time to agree on a boundary.

Mapping vulnerable or constrained natural resources

As a second exercise, the participants were asked to discuss and map out a maximum of the two most constrained or vulnerable natural resources in the area. In addition to that, two groups where asked to map water access (yellow and pink) and the other two groups worked on soil health (orange and green).

Yellow group

The yellow group was assigned to map water access, which was considered by the group as the most constraining natural resource. This group therefore mapped some of the areas where water was scarce as shown in Figure 6; implying that in those areas farmers were unable to get water and therefore had to walk very far to get water (the distance was not specified). Piped water is available in the bigger settlements, but expensive. Otherwise, farmers make use of shallow wells, boreholes, rivers as well as natural wells.

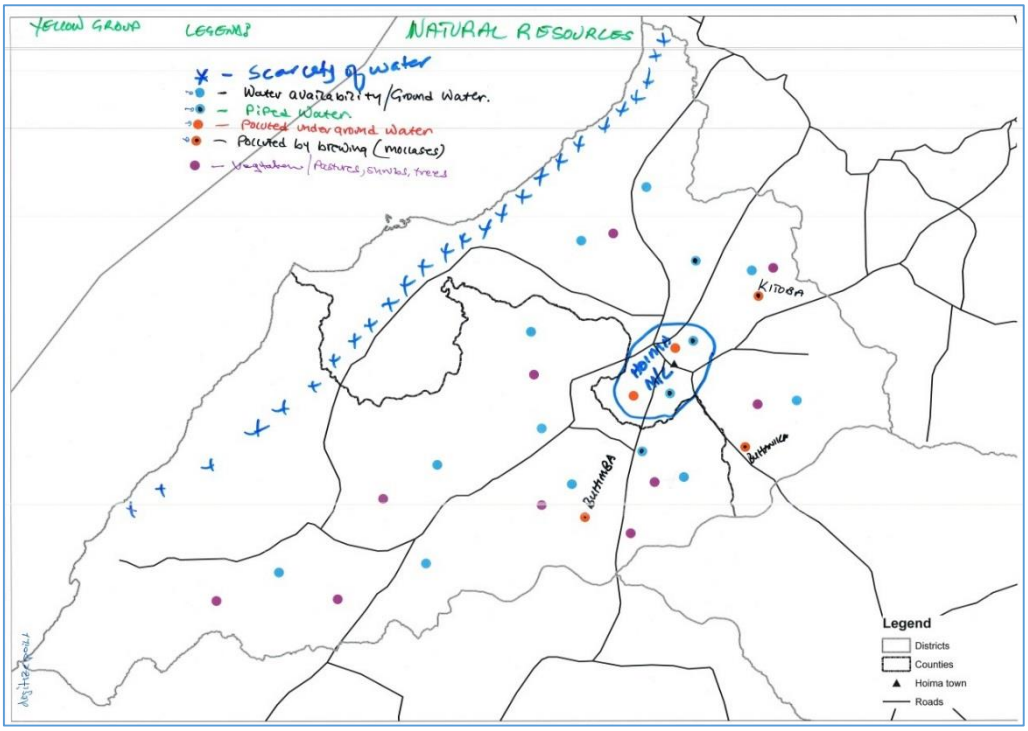

Figure 6: Key natural resources as well as areas polluted by local brewing industry in the district from the Yellow group

Water quality was also a major issue in the area particularly in livestock keeping areas water is getting spoilt because no special drinking places were set aside. As a result animals step and pollute water sources. The group in addition identified and mapped areas where ground water was being polluted by molasses from the local brewing industries.

The second most important resource mentioned was vegetation as a source of feed (natural grazing being used during the dry season when other vegetation was limited and commercial feed too expensive). Interestingly, participants never mentioned feed preservation despite having standing napier grass[1] on their farms and pastures. However, the group expected vegetation to grow scarce in future as a result of increasing human and pig population.

Orange group

The orange group was assigned to map soil health, and they identified four soil types, namely:

- Clay soil (Ibumba)
- Red soils – major type
- Black soils – along the rivers and swamps
- Sandy soils – at the lake

The group also identified water as a most constraining resource and mapped the rivers, lake, shallow wells, boreholes and wells. These are shown in Figure 6. .

Another important resource is salt that is used in animal feeds, found near the lake, as well as stone and clay that is used for construction. Forest and trees are an important resource for building low cost sheds for the pigs. Forests used to be a public good with free access. However, a few years previously these areas were given to investors for timber production. As a result, smallholders have to buy wood. Sisal was also mentioned as a natural resource that is mainly used to produce ropes used in the tethering pig keeping systems.

[1] Seen during the transect drive in September, mid-way through the long rainy season

Bulisa district was noted to be a major source of silver fish locally known as *mukene* in Hoima feed value chain and this was because of the nearby Lake Albert.

Pink group

The pink group defined water, land access and forests as the most important natural resources for the pig value chain.

Water was the most critical resource both in terms of quantity and quality. Areas within close proximity (1km) to rivers and wetlands are considered as having water access, shallow wells are found within this zone by tapping into the underground flow of both perennial and non-perennial rivers. These areas are also at risk of ground water pollution, as the surface water is often polluted by slaughterhouses, breweries and toilets. There are few boreholes where you need to go 100-150 feet.

A second important resource is forests, which are not so accessible anymore as a public good and therefore smallholders have to pay to get wood, which makes building a shed expensive.

A third limiting factor is land, as household land size is reducing due to increasing population grow and this was noted to affect the whole area.

Green group

The green group agreed that water (Accessibility and Seasonality) and Land/ soils (Land shortage, declining fertility and Stony areas) are the two most important natural resources for pig keeping.

In terms of water seasonality, the group highlighted Kigorobya sub-county as being a pig-keeping area that had a particular problem with water shortages in the dry season (

Figure 5) although water quality was not discussed.

Land in the zone around Hoima town was noted to be in short supply, with the denser population, and soil fertility has declined. The areas further away from Hoima town have larger landholdings, and the soil fertility is still high as it has not been cropped for as long. An area near Hoima town (including Kasasa and Rukoge) was also identified as being too stony for crops cultivation.

Other important resources discussed were plant production (crops or natural vegetation) for feed, and forest or woodlots for building materials. There was some question about whether climate is a natural resource, but it was agreed that in some places the temperatures become too hot for pig keeping.

Defining pig production systems

During the coffee break participants were asked to think about what the common types of pig production exist in Hoima and come up with a finite set of pig production systems. Then each participant had to find another participant and agree on the set of production system. Then groups of two were merged into groups of four, then groups of four into groups of 8 with the same task. It turned out that one half of the participants came up with 3 systems while the other one with 4. Both groups came up with the extensive, semi-intensive and intensive systems. The underlying rationale definitions were based on the level of care given to the pigs: in the extensive system, the pigs were left entirely free to feed themselves, find food, water and shelter on their own; in the intensive system, the owners provided all food, water and shelter. The semi-intensive system implied that the owner provided partly some food, water and shelter. However one group had split semi-intensive into tethered pigs and paddocking, whereas the first group referred to semi-intensive system to represent only the tethered system, with the debate being whether there are two levels of partial care associated with the level of investment in shelter. Many participants had never heard of the paddocking system, as it seems that only one or two farmers in the region had implemented it. After some negotiation it was agreed to keep the four pig production systems.

Figure 7: Examples of tethering (top left, top right, bottom right) and intensive (bottom left).

Each group was then assigned a system to work with for the rest of the morning session. The green group was given the intensive system, the orange group was given the extensive system, while the yellow group was given semi-intensive tethering, and the pink group was given the semi-intensive paddocking.

Mapping pig production systems and feed sources

In the same groups as before, participants were asked to map where their assigned pig system is happening. Each group had a flip chart to describe the system infrastructure, pigs per households, breed, feed base, manure management, market and other challenges. Each group also had a set of base maps and blank transparencies on which to describe and map the system spatially as required. In the appendix, Table 1 records the description of each system according to each of the parameters.

Tethering system - yellow group

In the tethering system, households keep 2 to 4 pigs and tether them with a rope. The system is mostly practiced by the poor and represents about 80-90% of pig keeping in Hoima District. Most smallholders keep indigenous pigs whose live weight reaches about 40-60kg liveweight, however more and more households also keep crossbreeds that weigh between 100-150kg.

Figure 8: A large white cross-breed sow, tethered by a rope tied to her front right leg

The level of care required for pigs in the tethering system is low; the pigs are tied by a rope to a tree or a peg on the ground under a tree and left to forage for themselves for most of the time with some extra feed and kitchen waste provided. As the pigs are kept in the shade of the canopy or under banana trees, no shed is needed. Manure is just left where the pigs are, which is very good for the banana trees.

Pigs are fed on locally and seasonally available feeds, including Napier grass, potato peelings, sweet potato vines, cassava, green leaves, grass, banana peelings, yams, jack fruits and other fruits. Commercial feeds are sometimes provided for supplementation purposes, typically rice and maize bran.

Periodically, the pigs are moved and tethered in another place, depending on available forage, which also spreads the manure so that it is incorporated and needs no further management. Poor people with smaller land have limited ability to move the pigs around, which restricts availability of non-commercial feeds and can lead to accumulation of manure and the need for management. Commercial feed is often too expensive. Pigs are mostly sold at farm gate when the smallholder needs money. Some trade is “farmer-to-farmer” or directly to the butcher, but most of the time a trader plays an intermediary role.

In terms of location, tethering is mainly practiced in urban areas, and in most rural areas, except for the area along the lakeshore where all pigs are on free range (Figure 9).

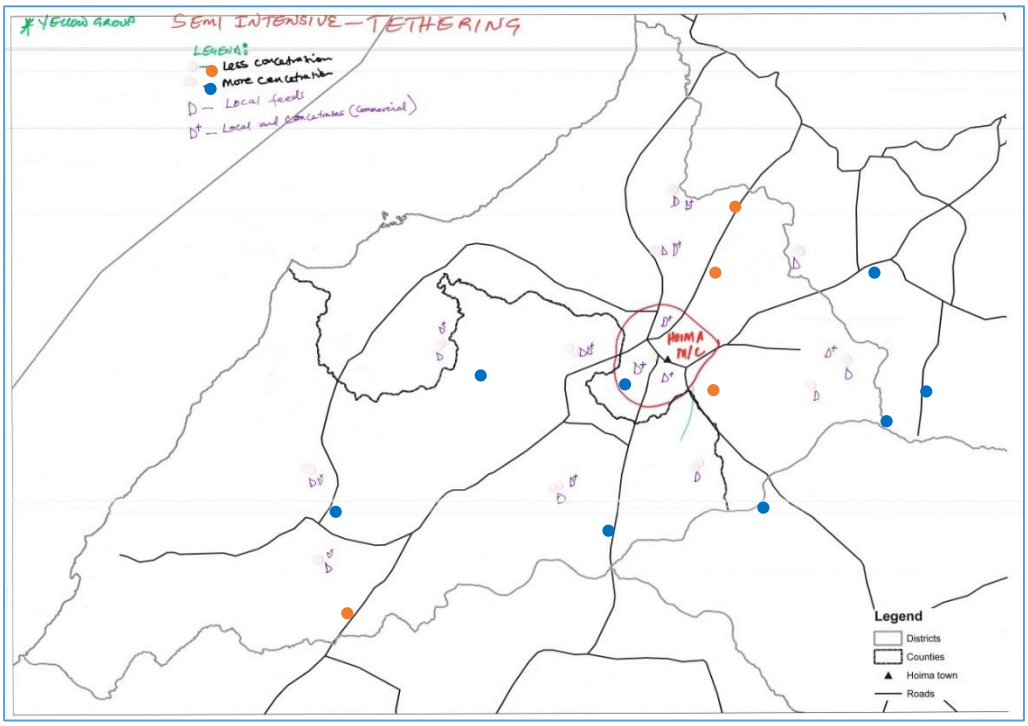

Figure 9: Location, concentration and feed type of pigs kept by the tethering system in Hoima district (yellow group). Orange stickers show lower concentration of tethered pigs, while blue stickers mark higher concentrations of tethered pigs. D indicates local feeds, D^+ indicated local supplemented with commercial concentrates

A challenge in the tethering system is that the pigs are very vulnerable to snake bites which could cause death. However, pigs that are well-fed on poor quality diets were noted to be less vulnerable to death after snake bites as the fat prevents the venom from reaching the veins. Diseases were also mentioned as a major challenge although local people used local herbs such as marijuana or papaya seeds for medication. There is also some risk of leg injuries in the pig tethering system.

Semi-intensive system – pink group

The pink group started off discussing the paddocking semi intensive system. However, the group could not really agree about the importance of the paddocking system. It was therefore decided that both the paddocking and the tethering system would be addressed within the group.

Paddocking is a system where about 5-9 pigs (about 80% of which are cross breeds) are kept enclosed by a fence so they are not tethered, yet not free-range. This is practiced by those who are somehow richer, who cannot afford the infrastructure of an intensive farm, but have enough to invest in some kind of structure (not necessarily with a roof). This is done mainly by known farmers and it was estimated that no more than 5% of the pig are in this system (

Figure 10).

In the paddocking system, pigs are feed on the pasture, which is supplemented with 50% concentrates and 30 % crop residues. About 50% of the manure in this system is left on the pasture and the rest is piled and spread upon cropland. The major challenge in this system is disease management.

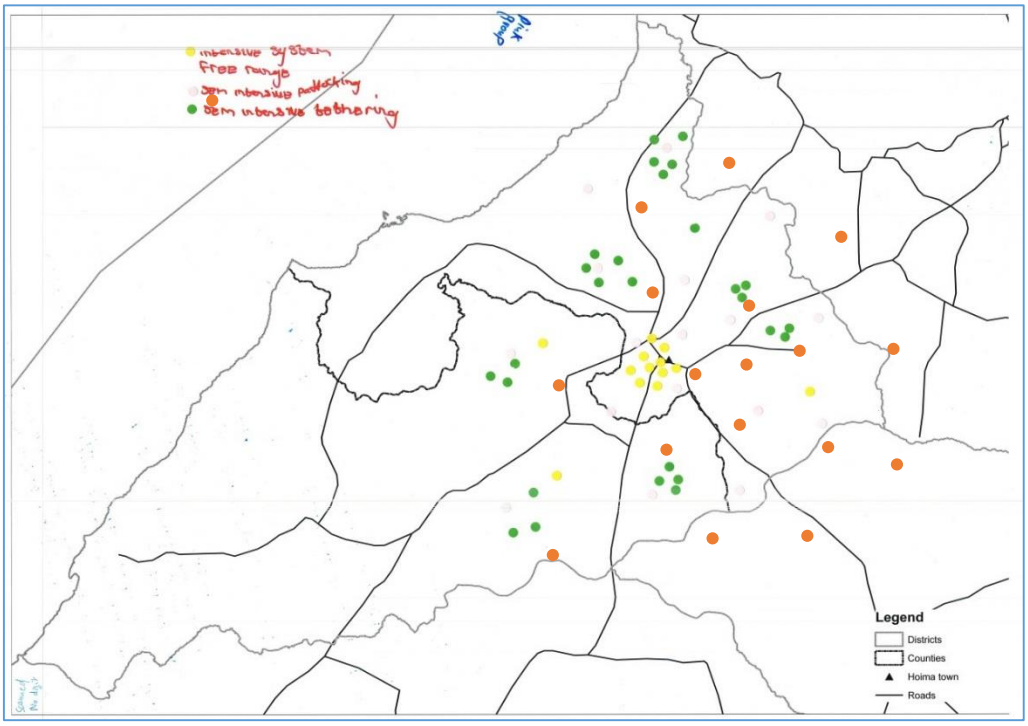

Figure 10: Location of semi-intensive and intensive systems of pig-keeping in Hoima district (pink group). Green dots indicate tethered pigs, orange dots indicate paddocked pigs and yellow indicate intensively-kept pigs.

In the tethered system, smallholders keep 3-7 pigs about 60% of which are crossbreeds that reach the weight of between 100-150 kg, the rest are indigenous pigs reaching 40-50 kg. They are fed on swill 30%, pasture 60%, and concentrates 10 % (rice and maize bran). No infrastructure is provided for these pigs, they are just tethered under trees on crop land, mostly yellow banana, where the manure improves banana production. If pigs are not tethered in the banana grove, then manure is collected and put in the banana garden.

Extensive system – orange group

The orange group focused on the extensive, free-range pig management system that is commonly practiced along the lakeshore. This system is mainly found at the lakeshore where it was said there is no cropland as the soils are exhausted and very poor. Hence there are no food crops to rely on, and the smallholders staying around this area rely mainly on fishing for their livelihood. As there are no vegetable gardens or fields, there is no danger of the free-roaming pigs destroying any crops. In addition, they keep pigs for business and diversified to other small businesses. Ease of access to the neighbouring Congo via the lake opens a market opportunity, as it was widely agreed among groups that Congolese traders offer better prices for pigs than local traders.

This system is characterised by 2-5 pigs per household, all freely roaming. The piglets are bought from neighbouring farming in Hoima, so no breeding is done in the area. All piglets are marked for identification with tags, ear notches or special paint on skin or hooves before being released. Pigs roam freely to find their own food and water (mainly from the lake), and also feed on napier grass and brachiaria species grasses. Common fruits including pawpaw, jack fruits and avocados may also

be fed to pigs when in season. In addition these pigs also feed on the leftovers from the small-scale fish industry along the shore: thanks to the high protein intake these pigs grow very well compared to the rest of Hoima, and were also reported to be healthier. They usually reach 30-50 kg live weight at the age of 6 months (compared to about 12 months for pigs reared in the tethering system to reach the similar weight).

Often the owner would only start to worry about finding the pigs when they are old enough to be sold. Farmers bother very little about diseases because they mainly own the local more disease-resistant breed. Yet disease is an important threat, also because of the close interaction with wildlife, thus hampering the adoption of improved cross breeds.

The extensive system is not found in settlements areas (Hoima municipality, Kigorobya, Buhimba, Bulema) because of the risk of losses to car accidents which can cause injuries or death, to tensions with different religious beliefs about pigs, to dogs, to being poisoned and to pigs simply getting lost. Stricter regulations on pigs in settlements are also a challenge to keeping pigs free-ranging.

Intensive system - green group

The green group discussed the intensive pig keeping system, which was defined as fully confined pigs where the smallholder needs to provide all shelter, food and water (Figure 11). Farmers in this category usually have one or two breeding units. A breeding unit consists of one male and six female animals that give birth to 6-10 piglets every six months. As slaughter age starts around 6 months, we calculate 8 times 6 to add to 48 pigs per unit at any time, therefore referring to an average of 50 pigs per unit. Large white, combrough and indigenous breeds are kept, although the group highlighted that there are no longer any purebreds. After four generations most improved breeds have been crossed so often that they return to being black, i.e. “indigenous”.

The intensive system was known mainly in the peri-urban area around Hoima town, located there for several likely reasons:

- smallholders there tend to have more capital,
- easy access to feeds, market and municipal water, and
- land sizes are small, so there is not enough space for tethering or free-ranging.

About 10% of the pig farmers are already in this system, feeding the pigs mostly on commercial feed, based on maize and rice bran about 60% of which comes from a few key areas. Kibale and Masindi produce the most maize, Kyangwali is known for soyabean. Kabuya, Kiziranfumbe, Kitoba and Bugambe are known for rice production. The proteins, silver fish, cottonseed cake, sunflower cake and blood meal mostly coming from outside the area, such as Lira District and are bought ready mixed, e.g. from Savannah feeds or VetCare,Minerals; silage from napier or lime. Most of these farmers make their own feed mix. The group emphasised that for the recommended ration of feed basket for young piglets is about 24% protein, while older pigs need less.

Pigs are sold to traders who announce on radio when they will be in the area, with large trucks that collect pigs directly from the farmers to take to Kampala. A truck can take 50 pigs at a time. Pigs are also sold to hotels and butchers/ pork joints in Hoima town, to individual farmers and to NGOS.

Housing in the intensive system was agreed to be about 50% concrete, and 50% wooden. It was noted that it is not worth investing in poor quality concrete, as it will be worn away by the pigs within four months. Manure management is relatively basic, as it is wash out every day and collected in a pit or piles. However, it is hardly processed, and only seldom spread to the field.

Challenges identified by participants included expensive feeds and the risk of interruptions of municipal water supply.

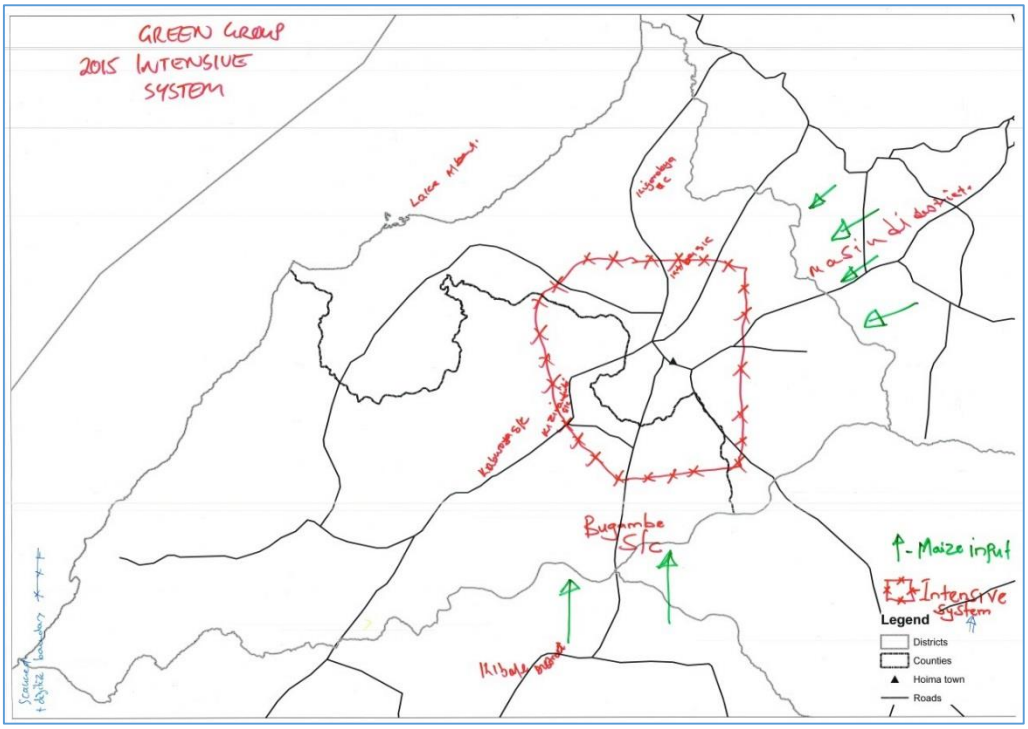

Figure 11: Location of the intensive system in Hoima district (green group).

Future pig production systems

To understand how the evolution of the pig value chain could look like, we asked participants to project themselves into the future. In order to do so, we asked participants to board our “time ship” with which we flew to 2025, where in their imagination they visited a very successful farmer, the neighbour of that very successful farmer as well as the farmer who was the poorest in back in 2015.

From the images created in the imagination of the participants, likely future pig production systems were identified. In terms of current farming systems, the extensive system will have disappeared, semi-intensive pig farming will still exist, but most farmers will shift to intensive systems. A new system was also identified, the high level integrated pig keeping system, where pig rearing, the slaughterhouse, packaging and cold chain are in the same location.

Each of the participant groups was assigned one of the systems. The exercise was the same as in the morning, namely to describe and map out the new system.

Figure 12: Taking the time ship, with Catherine at the helm, leading the meditation exercise.

Mapping the 2025 pig production systems

The groups were kept similar to the morning ones and future production systems were assigned to groups depending on their interests. Then people who felt that they would prefer to switch group so that they could work on their vision where allowed to move groups. The exercise was of system characteristics.

High-level standardised intensive - Yellow group

The group was composed of those participants who had the vision of this system in the time ship exercise. They believed that there would be a robust evolving of systems into a new system which would have very high standards. This system is characterised by a super intensive pig production unit, with a large amount of pigs (visions ranged between 500 and 2000), next to a slaughterhouse and a processing plant with a cold chain facilities (Figure 13).

In terms of waste management, the participants envisioned an environmentally friendly manure management system that could result in the refinement and packaging of the manure as fertilizer to be sold to farmers who could then attain higher production for more feeds and food. In addition, a bio-digester would reduce greenhouse gas emissions and at the same time provide the necessary energy for the slaughterhouse and the processing plant, and maybe even for some other players in the surrounding area.

Such an enterprise will be viable as new markets will have been unlocked, namely export to Congo and maybe even further away such as China. Indeed, with the new airport flights delivering material for the oil industry from China could fly back with pork. Also Kampala and Hoima will be important markets. In order to ensure constant supply, these high intensity farms will play the role of market coordinators who will contract smallholders to produce for them.

These new high level farms will not be located in Hoima town, as land is too expensive and small to be expanded into; however they will be located in what are today the other major villages, namely Kiziranfumbi and Kitoba. Those who are now farming in Hoima town centre will have moved out to the periphery, where land is cheaper and spacious but where access to Hoima town (for feeds and sales) will have been improved. The farms near Hoima will remain as model farms, where smallholders can come and buy piglets and learn, whereas the new intensified locations in the periphery will be closed to visitors (for disease control).

In terms of land dynamics, population growth will lead to smaller landholding sizes, but better yielding because of the use of more, and more appropriate, fertilizer. Yet feed will not be enough to fulfil the demand from the increased pig population, and the big farmers might contract farmers from outside Hoima to grow feed and out-grow pigs. Some feeds will be locally produced, especially as some smallholders will be focusing on fodder production, but better quality maize and rice as well as quality pig feeds will still be imported from Kampala or elsewhere.

In terms of farm management, these farms will have a resident vet, and hired labour. Skilled labour such as farm managers will be imported from outside the area. These farms might also have a research station with laboratory.

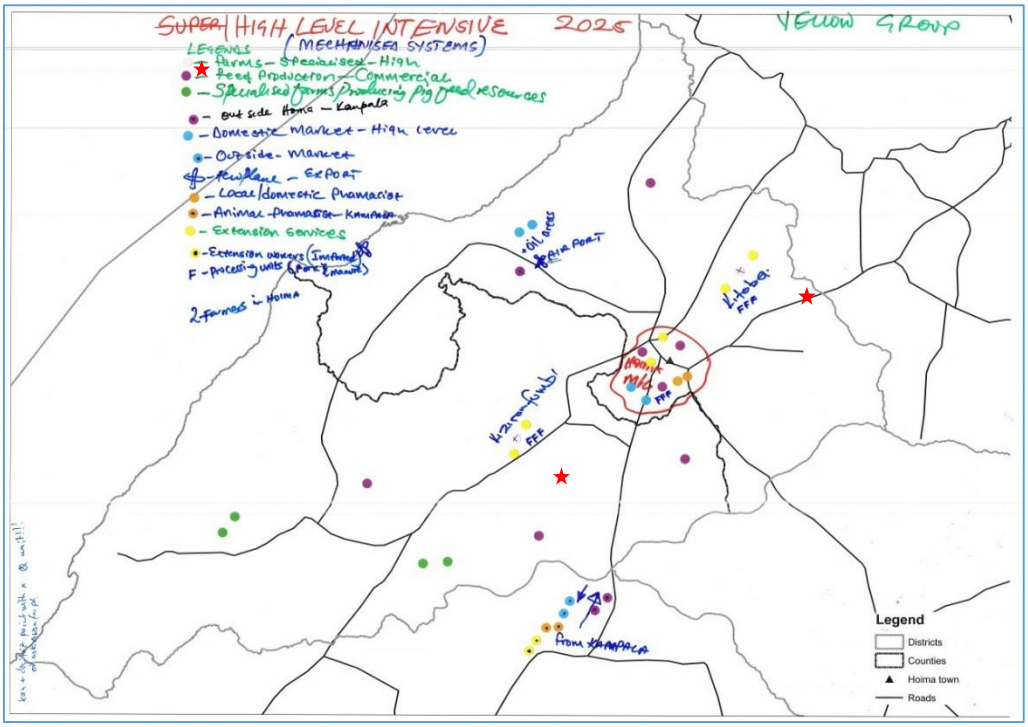

Figure 13: Location of future high-level standardised intensive system in Hoima district (yellow group)

Free-range and tethered systems moving to Intensive systems - Orange group

The orange group looked at the future intensive system, envisioned to be the most common, which will have an average of 10 pigs with a maximum of 50 pigs, moving away from free range and tethering into fully confined pigs, with concrete floor infrastructure (not wood, but may have grass or iron roofing). The breeds will be both the indigenous and the large white cross-breeds, as these are preferred.

In terms of feeds, smallholders will be producing their own crops for feed, using fertilizer and the manure from pigs to increase yield. There will be a huge increase in productivity hence clearing bush and forest will not be needed. However, they will still buy 60% commercial feed. These smallholders will stop buying piglets from elsewhere; they each will own their own breeding unit. The group foresaw an increased role of cooperatives in coordinating sales to processors and to Juba and Congo. A new market will be the oil companies and NGOs. Smallholders will also add value to their pork before sale, by packaging different meat cuts. Smallholders may invest in other income activities, since they will have more capital, such as having shops and keeping other livestock such as cattle, goats and poultry.

The major challenge will be labour as everyone will own a breeding unit and will be growing their own crops, so no one will be available to work on other farms. As such, it will also be an opportunity to get a fair agricultural labour market and get people into the area. A second challenge identified is that feed prices are expected to rise due to increased demand, and the risk of adverse weather conditions causing reduced feed availability due to climate change.

Poorest farmers moving to semi-intensive system – Pink group

The starting point for the pink group was the visit to the poorest farmer in 2015 and see where she/he will be in 2025. The pink group imagined that this farmer will own between 25 – 50 pigs, housed in a simple structure, not concrete as this farmer is still too poor to afford concrete.

Feed will be produced mainly by the farmers themselves as they will still be too poor to afford commercial feeds, which will lead to land use changes. Farmers will encroach upon the aquatic vegetation for rice and the forest, grazing land and bush land for other crops. Areas set aside for the oil company will not be used for agriculture anymore (Figure 14).

There will be a set market day for smallholder pig farmers, on which they can sell their pigs, mostly to commercial farmers. These farmers are very unlikely to be contracted as they would be too small.

Manure is managed similarly to today, without any infrastructure and proper management– it will be piled and spread to crops in order to get better yield. There may be some farmers able to invest in biogas. Manure will be complemented with inorganic fertilizer.

A long discussion took place around which breeds will be kept by the poorest people. The debate tended to an agreement that 100% of the poor will have crossbreeds, as indigenous breeds will not be productive enough in 10 years from now.

Disease was identified to still be a challenge, as well as theft and limited labour.

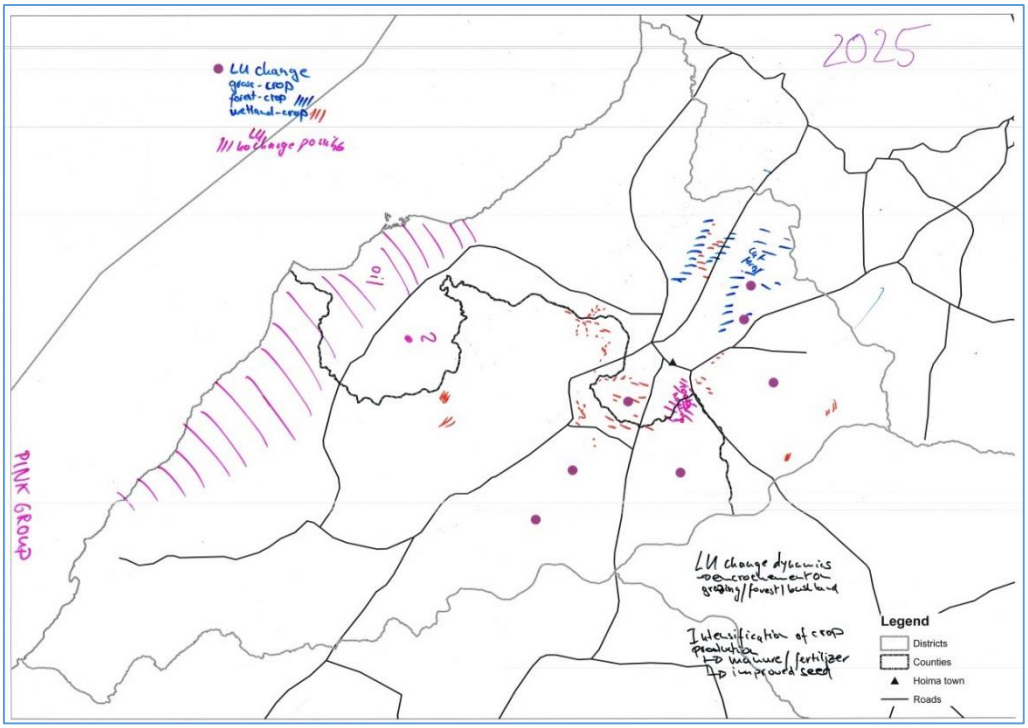

Figure 14: Location of future semi intensive systems locations map in Hoima district (pink group)

Expansion of intensive 2015 system - Green group

The green group imagined that the intensive farmers from 2015 will have expanded both in numbers and in stock size, such that in an intensive system in 2025 the farmer would be keeping 500- 700 with a maximum of 1000 pigs, all improved breeds, housed in modern structures. As land availability for expansion in Hoima town is constrained, most of the new intensive system will be located in four hubs on the periphery of Hoima town (Busisi sub-county) and in what are currently the other main growth centres (Kiziranfumbi, Kitoba and Bugambe sub-counties) (Figure 15)

Feed will be both grown on farm and bought from outside, through Devenish's new feed mill, other processors and neighbouring districts. Increased crop productivity will be achieved by improved crop varieties and better manure management in the form of producing a bioslurry for crop fertilization. Improved soil management will also improve soil fertility. However, land will be used to its maximum, bushland and hills will be gone, and forest and aquatic vegetation will be encroached. Most of the imported feed will come from Kibale and Masindi. Some farmers will grow and produce their own soybean cake to reduce dependence on imported concentrates, and some will have their own feed processing plants.

In terms of markets, the farmers will be contract suppliers for hotels, the new oil camps, local processors and packagers, and for Fresh Cuts (main Ugandan fresh meat company) sending packaged meat to Kampala – via the new expanded cold chain. Some farmers will also have their own pork packaging plant.

In terms of constraints, water will even be more constraining than today and there will be an increased use of water harvesting technology. Labour and access to energy will also be challenging.

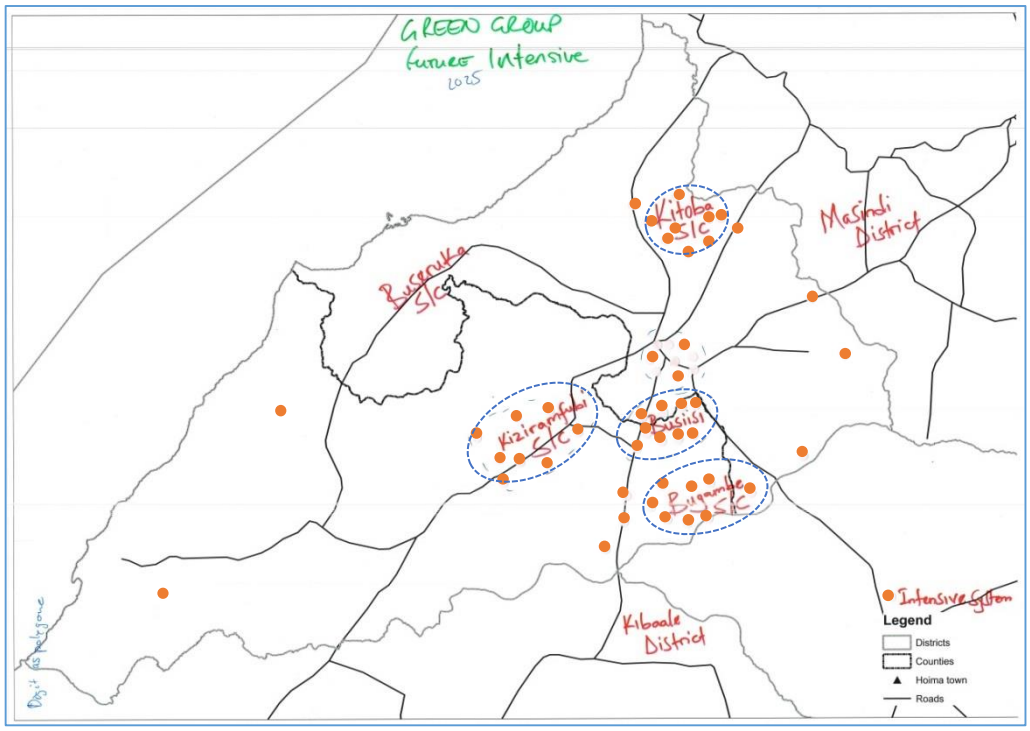

Figure 15: Location of future intensive system – expansion from current intensive system - in Hoima district (green group). Note that after placing the Bugambe sub-county dots, the participants noticed that the sub-county should actually be further west, to the left of the main road leaving Hoima district.

Closing and synthesis

In order to close the workshop each participant was given 10 stickers in the colour of his/her group to assign how many farmers they personally thought would likely be in each of the future pig systems. The views of participants about the distribution of pig farmers across the systems, was more or less consistent (Figure 16). Mostly, participants saw between 40-60% of farmers in the intensive system. Opinions on the spread of farmers in the semi-intensive and highly intensive systems were more diverse – ranging from 10-60% for both systems. Orange and Green groups tended to see a future with few semi-intensive farmers left (10-30%) and slightly more intensive than super intensive farmers. By comparison, the Yellow group tended to see very few super intensive farmers (10-30%) and slightly more semi-intensive than intensive farmers. The pink group tended to see an even distribution of farmers across the three systems.

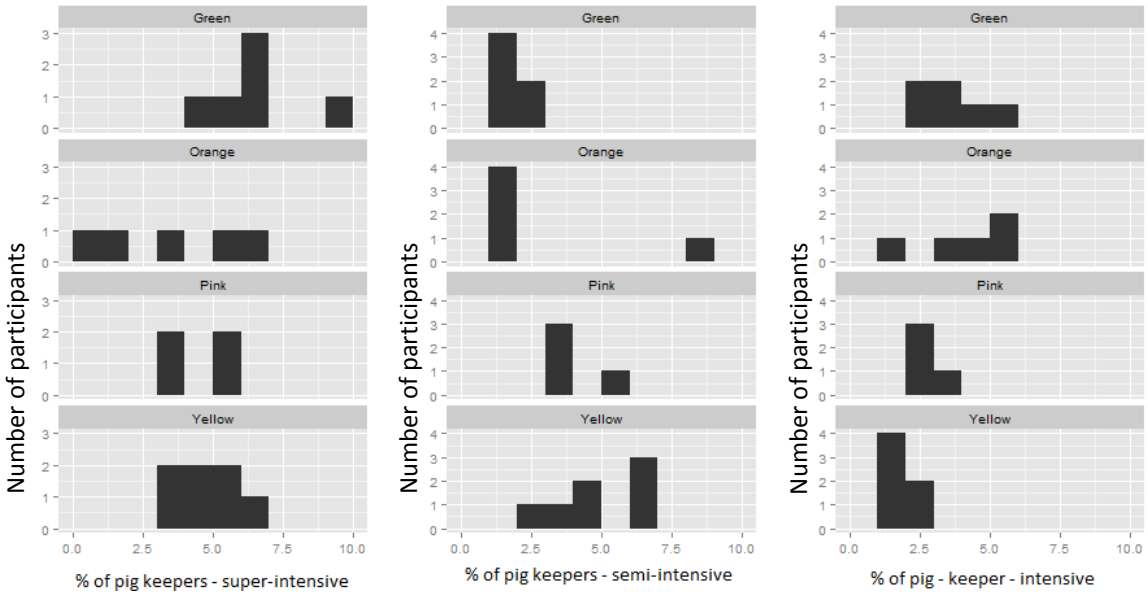

Figure 16: Frequency distribution of individuals' perceptions about what proportion of farmers will be part of each future pig production system, presented according to their groups.

It is interesting to note that the yellow group, who also developed the standardized high intensity system in which they expected to find only 2-3 farmers, more consistently put fewer farmers in this system than the other groups.

Reflections on the PGIS

About the process

Due to the tight schedule for the day's activities some important components were forgotten. Firstly, we forgot to plan for a group photo, and secondly, no formal feedback session was organized. Nonetheless, participants gave us informal feedback as they were leaving. The tenor of the day was that they had really enjoyed the interactive character of the workshop. In particular, the "time-ship" session was appreciated, where they were guided to think about their own future: to actively project and think about where they would want to go by the year 2025, and then to consider and debate the means and ways of how to get there, and what the consequences might be. For many participants this was a new experience. Also, some participants mentioned that they were expecting to sit in a room with presentations and they were positively surprised that they were actually shaping the day and actively contributing. The success of the "time-ship" exercise has shown that creative facilitation techniques can lead to interesting results and lead to participant reflection and social learning as a group. We also noticed the interest in the base maps (land-cover, soil, elevation) at the end of the workshop, and noted that for up-coming PGIS exercises we will print a set of base maps for each participant to take home.

About the content

The morning sessions gave a clear picture about the current situation. Group work on natural resources and current pig production systems are quite consistent with each other and therefore the information can be used for modelling.

The "time-ship" was used to look into the community's beliefs about participating in a positive future development, and was therefore focused on their aspirations. Different groups developed very different visions of the future, which were much less consistent with each other. The diversity encountered in the second part of the day will define the range that CLEANED needs to be able to address. For example, it will need to include two or three land use change scenarios, and at least four pig production systems.

Not all ideas that participants have are consistent or feasible when bringing in outside knowledge; for example, exporting pigs to China is unrealistic, as China already today produces pigs at lower cost than Uganda. An approach to make scenarios consistent and plausible is still needed.

Transect walk/drive

Rice

CLEANED includes a greenhouse gas emission pathway that models rice separately, as submerged rice is a great source of methane emission. ImpactLite surveys from the area suggested that Hoima is a rice growing area, and therefore one focus of our visit was to understand where rice grows. We discovered that most of the rice in Hoima is rainfed upland rice, i.e. not submerged. In addition, surpassing all imaginations, most small scale farmers in the Hoima district intercrop rice with maize. New rice varieties are being grown by small scale farmers, which in some cases are organized in groups for collective farming options and for better marketing targets strategy.

The new variety of rice will most likely lead to encroachment into current wetland areas, as small scale farmers are opening new lands for upland rice cultivation. Despite any negative impacts, the new variety gives more yields and matures quicker, as explained by one of the small scale farmers we visited. The farmers cultivate it for human consumption (the grain) and pig feed (the bran) as well as selling the surplus.

According to the farmers we spoke to, no one uses fertilizer, except on tobacco, where the fertilizer is provided by the contractor. No crops are irrigated. However, herbicides are used, as applying herbicides once is cheaper than hiring the labour to weed three times. We met a farmer who successfully mixed his own herbicide, which together with it being rain-fed, means rice is one of the crops in Hoima that requires very little labour in management.

Figure 17: Rice and groundnuts near Kiziranfumbi, on a pocket of black soil (Photographs: E. Githoro, C. Pfeifer)

Tobacco

Tobacco, although a major crop grown in Hoima district, was not in any way related to the pig value chain despite competing with other crops in land use. The tobacco crop seemed to be preferred by some famers mostly because of its organised production and marketing system through contract farming. Benefits of the tobacco crop for small scale farmers that put it in competition with other crops, is: the quick money, ready market as well as receiving farm inputs, especially fertilizers. According to the farmers we spoke to, tobacco is only grown for one season per year, meaning that despite the crop using a lot of fertilizers during its growing season, the soils still remain fertile for the next rotation crop in the season hence giving high yields.

Figure 18: Tobacco drying shed (left) and the collection truck doing the rounds to fetch the dried tobacco from the farmers (right). (Photographs: C. Pfeifer)

Observable landscape dynamics

Another important component in CLEANED is to define land uses for the future scenarios. It is therefore important to understand the currently existing landscape dynamics. We identified 3 interesting dynamics during our drive:

First, we crossed the area where the government has expropriated smallholder land in order to set aside land for the upcoming oil processing plant, as well as for the airport. This area is now slowly transforming into grazing land, yet some cultivation could still be seen. Smallholders who refuse to leave are the living proof of an ongoing land conflict.

Figure 19: Smallholders protest having their land taken without fair recompense (left), and herds of cattle being grazed in the set aside land where construction is not yet due to start until at least late 2016 (right).

Second, mostly the hills around Hoima are still covered with natural forests, suggesting that they are protected. We discovered that the area has strong informal institutions regarding the use of the hills, which belong to the local "king" and cultivation is forbidden. Despite the limited access rights, the question remains as to whether these informal institutions will survive the rising pressure for land, both the intensifying value chain as well as the population growth. Already in some places cultivation was observed creeping up from the base of the hills.

Third, for long stretches of our road trip we crossed planted forests, where our land use map (Africover, based on 2000-2001 satellite images) still showed grazing or bush land. In 2015, we found planted forests or trees that are between 2-10 years old, showing that timber production is becoming a more and more important business and land use competitor in the area. However, it may also prove a more resilient protection of the hills against encroachment by crop cultivation.

The Hoima landscape and land use was observed validated and understood better by taking a long one day transect drive and walk around Hoima as shown in Figure 20.

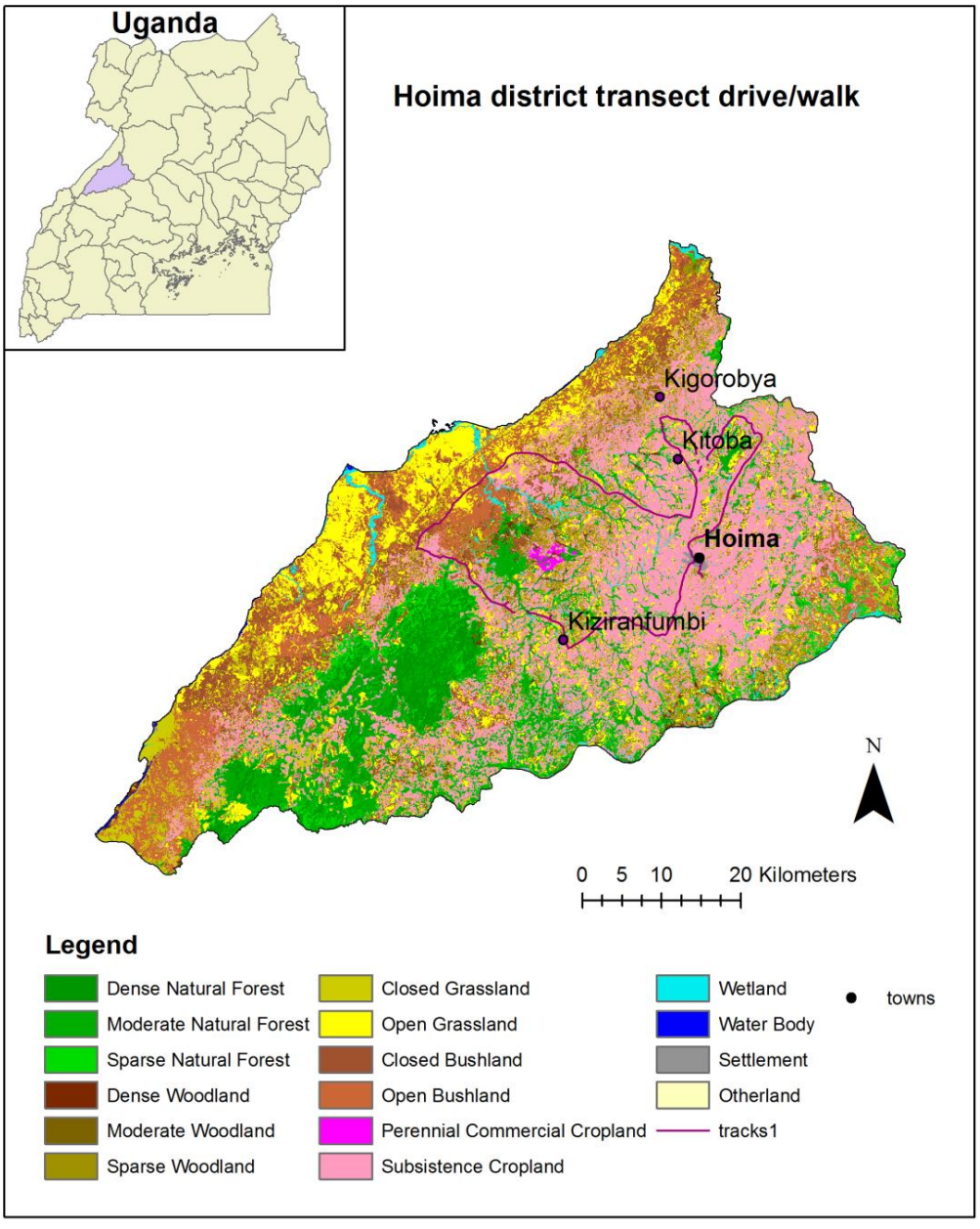

Figure 20: Route of the transect drive around Hoima District

Insights into intensive pig farms

During the transect drive, we also stopped to visit some pig farmers that our guide thought were progressive and innovative front-runners to help us better understand what are the feasible pig intensification pathways that CLEANED needs to be able to account for.

The first farmer was a clergyman, and relatively wealthy. On his farm, situated next to a school, he rears 20 cross breed pigs kept intensively in a concrete and wood structure and some mixed poultry including chickens, ducks and turkeys. He feeds his pigs on school food leftovers; residues from his own farm e.g. cassava, napier, avocados, jack fruits and mangoes; as well as commercial feeds bought from Kiziranfumbi, including maize and rice bran and concentrates. The pig farmer also grows about 3-5 acres of maize, therefore supplying part of his own maize bran. For manure management, he collects the manure for distribution on his kitchen garden of kale (*Sukuma wiki*) in soil sacks, as well as in his banana garden.

Water was acknowledged to be a problem especially in the dry season. He has a water harvesting system that collected water from his rooftop leading to an underground reservoir tank. He had an expert who calculated for him the optimal size of his tank to meet his domestic water requirements (30 000 litre) and he hardly runs out of water even in the dry season. In emergencies, he can in addition access a project-drilled borehole (about 150 feet or 45m deep) that is available for the community and was drilled by an NGO operating in the area.

The major challenge he faced was finding a good market for his pigs. Local buyers from Hoima and Kampala were offering less than it cost him to buy the feed. He used to sell to Congolese and Sudanese traders, who would give him better prices, but they no longer come and his concern was on how to contact them.

Insights into intensive breeding farms

We visited another front-runner farmer, Paul, who is an agri-entrepreneur. On his fields he mainly grows pineapples. In terms of livestock he rears chickens and pigs for eggs and meat production. Until recently, he had around 100 pigs in wood and concrete housing, with drainage canals taking the manure away to a soak pit on the edge of the pineapple fields. However, he was hit by African swine fever and later disposed the surviving animals. At the time of our visit Paul had not a single pig left.

His major business was breeding and selling of piglets to smallholder farmers, and the constant "foot-traffic" from outside walking through the premises to view piglets in the breeding pens would have meant a high risk of exposure to disease. Based on this experience, he is thinking of moving more towards outgrowing himself, which means less traffic on his farm. A suggestion made during our visit was to close off the main farm, and have one pen in a demonstration area where buyers could view his piglets (for quality assurance) and keep those piglets entirely isolated from the rest of his piggery.

Due to the high cost of feeds, he buys raw materials and mills and mixes his own feeds on the farm. This also enables him to control and maintain a high standard of feed nutritional quality and is economical. As an extra, free source of protein, he used to feed his pigs also on his chicken slaughter waste.

Although Paul has one of the most advanced manure management infrastructures that we saw in Hoima district, he is aware that this is not an optimal solution and as time, capital and knowledge allows, he will be seeking to install a biogas system. He would then be able to use the gas to heat hot water to begin on-site slaughtering of pigs which would save firewood and become more environmental friendly. At the moment, the manure that is washed down to the soak pit is collected and used on some of his neighbouring fields and vegetable garden. However, it would be a better quality fertilizer after having a chance to decompose, either by composting or in a bio-digester. The

bio-digester is also especially interesting to Paul, as he has heard that the slurry from the bio-digester could be fed back to the pigs.

Paul believes that in 10 years' time from now, he will have acquired land outside of Hoima and built a more modern livestock production unit. He will maintain his current farm in Hoima town as a model farm and the sales desk of his main farm.

Figure 21: Paul's intensive pig housing units, with manure drainage canal leading to a soak pit in the nearby pineapple field.

Insights into feed milling

Goodman miller is one of the many millers located in the outskirt of Hoima town where both small scale farmers and traders take their produce for milling maize, rice and dried cassava.

In this business, maize and rice bran are a by-product that can be sold as high value feed to pig farmers. From discussions, it became obvious that the miller's main interest is products for human consumption; they hoped that in the next 10 years they will be packaging rice, cassava and maize flour for the supermarkets instead of selling from their premises and that they would have improved and standardised the quality of their cassava flour. They have little interest in animal feed, selling it only as a by-product, and do not see it as their priority growth area.

They were not really concerned about the up-coming feed mills to be installed by Irish Aid and Devenish as they see the livestock feed production as a different business.

The owner and his wife, who is the mill manager, own pigs themselves and feed them on bran as well as imported cotton seed cakes.

Wambizzi abattoir

CLEANED is intended to be an ex-ante assessment of value chain interventions, not just of production intensification. This implies that we need to understand environmental impacts at other nodes than production. As slaughtering in Hoima is still an informal backyard operation, there is no opportunity to learn about the processes that occur at the slaughterhouse node, and what impacts the introduction of formal slaughter houses in Hoima might bring and therefore, we visited the slaughter house in Wambizzi near Kampala.

Wambizzi slaughter house is a shareholding cooperative of pig farmers which started in 1971. At the time of our visit, it was situated on the outskirts of Kampala town in Mutundwe area in Lubaga

division about 7 km from Kampala town, in the river floodplain. The upcoming construction of new highway will force them to relocate to a new area, halting any further development on site.

The slaughter house has a board of committee members who oversee the management and operations activities. The slaughterhouse operates in two ways: by housing traders on the one hand and acting as a service provider on the other, where farmers use the facilities for a fee. The shareholders, who are all pig farmers, enjoy the benefit of paying 50% less than the set fee for non-members, which is UG Shs 6000 per pig slaughtered.

The slaughterhouse's location in the floodplain means that flooding is a frequent occurrence during the rainy season, regularly flooding to 30cm to 1m. This was a highlighted as a major threat to being able to guarantee and control the hygiene of the premises.

Disease surveillance was also raised as a major problem, as they keep the pigs alive for some days while waiting for slaughter and were worried by the African swine fever outbreaks. Feed resources were also noted to be a constraint as the pigs have to be fed to maintain weight, which is constraining both in terms of cost and feed accessibility.

Waste management was a major concern for the abattoir, as they did not have any formal disposal infrastructure. One of the waste management systems being investigated is a flexible balloon biogas system, being trialled in conjunction with Makerere University, comprising 3 bio-digesters of $10m^3$ each, of nylon-reinforced PVC canvas material, that lead to three gas rings for heating water. The bio-digester is fuelled with the gastral contents from about 42 slaughtered pigs per day[2] and in that way contributes in part to reducing the excessive amount to be disposed (about half of what slaughter house currently processes). The bio-digester can take more material, this is the minimum

[2] Each digester takes a minimum of 2 buckets per day of gastro-intestinal contents + 2 buckets water; each bucket is about ~ 20kg, and 1 pig produces approx. 3-5kg gastrointestinal contents, therefore requiring ~7 pigs per bucket, ~14 pigs per digester, and ~42 pigs per day.

requirement. At the moment, the blood cannot be added to the bio-digester, as it gets mixed with soap which can kill or harm the bacteria in the bio-digester. The pigs' intestines are extracted, cleaned and collected for dog feed – but the contents that are being washed out also cannot be added to the digester as they have been mixed soap during cleaning.

The rest (hair, trotters and hard skin) is thrown on the disposal heap and accumulates over time or gets burned, but not yet in a proper incinerator. Over the 45 years since starting, 20 feet (about 6.5m) of hair has accumulated at their disposal area. Nonetheless, since starting the bio-digester experiment, the committee members showing us around have noticed a decrease in marabou storks that frequent the area, waiting for entrails and other waste from around the abattoir.

The slurry produced from the bio-digester can be taken away in jerry cans by farmers to apply direct to gardens, which is easier to apply than raw manure. Slurry is produced overnight and in the late afternoon and released into a soak pit but not yet used – at the time of our visit, they were just starting to promote its use, preparing a training manual and promotion materials.

The committee also hope that the bio-digester will help to save energy costs for boiling the hot water that is a key part of the slaughter process, used for removing pigs' skin fur (de-hairing). Currently, this process uses a large amount of firewood, amounting to UGX 30,000 per day, which is about one 3 tonne pick-up per day. Hence the biogas will enable them to save both costs and the environment. Unfortunately, at the time of the visit the biogas was not yet being used for heating the water, because the gas pressure would only remain sufficient for burning for 40 minutes, although they had already ordered a gas pressuriser to solve the problem. Every cubic meter of gas can burn for 2 hours – so with about 3 m^3 per bio-digester, the cooperative would have the capacity to burn more than 5 hours per stove. Keeping the water sufficiently hot would not require all three stoves burning the whole time. However, the cooperative also want to use the gas for lighting and refrigeration, which needs higher pressure and potentially more gas. The gas quality could also be improved; for example, bio-digesters using cow and pig manure produce better quality gas that burns hotter than from gastrointestinal contents – because gastrointestinal contents are still in the process of being broken down to manure – so the cooperative has been advised to prime the bio-digesters with a truck load of manure every 1-4 months or so.

A final environmental challenge that was not yet addressed was wastewater. Despite being aware of the negative impacts that waste water has on the ecosystem, the water from the slaughterhouse was being released directly into the stream running past the slaughterhouse, with little treatment beyond diluting the blood and mixing it with detergent before releasing it into the river.


WAMBIZZI COOPERATIVE ABATTOIR
NOTICE TO OUR ESTEEMED
CUSTOMER AND FARMER.
PLEASE TO AVOID CONMEN
FIRST REPORT / MAKE INQUIRIES
FROM THE ADMINISTRATION BLOCK
FOR ANY HELP / ASSISTANCE.
NO REGRETS / COMPLAINTS WILL BE
ENTERTAINED BY OFFICE THERE AFTER.
TAKE CARE OF THE PERSON YOU DEAL WITH
MUNGERI YO KULWANYISA ABAKUMPANYA
(ABAFFERE) MU LUFULA ENO ; SOOKA OTUKIRIRE
ERA WE BUUZE MU OFFICE
TERI KWEMULUGUNYA KWONNA
NGATEWASOOKA KWEBUUZA MU OFFICE
YA LUFULA.
WEGENDEREZE OMUNTU
GWOKOLAGANA NAYE.
MANAGEMENT
TEL: 0772-860905, 0712-949120, 0703-179018

Reflections from the field

The field trip has helped us to better understand what the participants were talking about in the workshop. It allowed us to be confident that the landscape dynamics that we will be taking into account in the CLEANED model sufficiently reflect the existing landscape dynamics.

First of all, CLEANED will need to account for double cropping, to correct for the tobacco crop in one season that does not produce any feed. Secondly, rice is not flooded and cultivated under GHG emitting anaerobic conditions, and can therefore be treated as a cereal in the model.

Thirdly, whereas small farmers with 2-5 pigs use a communal boar to serve (impregnate) their females for a small fee or by giving a female piglet as payment, commercial systems are most likely to have their own breeding unit, and therefore should maybe be modelled in terms of units rather than individual pigs. A breeding unit consists of 6 sows, 1 boar and about 45 piglets growing out for sale (maximum of 8 piglets per sow) – so 55 pigs being fed in total per unit.

Visiting Paul the farmer, who is an entrepreneur, we build a realistic vision of what a feasible intensified farm might look like, namely having about 6 breeding units which produces about 200 – 250 pigs for market every 6 months (8 piglets per sow = 48 piglets per unit, and therefore 6*48 piglets =288 piglets to market at maximum output). There will be losses, but these will be minimized over time as farmers gain experience and become more professional.

Fourth, we determined that there are three market systems – farm gate to other farmers, farm gate to traders and direct sale to slaughterhouses.

Currently, slaughtering in Hoima is quite dispersed and losses are still small as every part of the pig is consumed by humans or animals, except for the hair and blood which are burnt or piled up or washed away, yet the first pollution points are starting to appear as the concentration of pigs increase. Visiting Wambizzi has shown what to expect in terms of pollution, resource use and nutrient-cycling opportunities from a medium sized slaughterhouse and what dynamics could be introduced into the greenhouse gases and water pathway.

Conclusions

Participatory GIS combined with the transect drive has given a good overview of the pig production in Hoima that will allow us to better set up the CLEANED model and make it relevant to those who will use it.

First of all, the pig production systems will be the entry point to define the CLEANED tool, where each pig production system can be parameterized separately. Also, we will be able to integrate the expert knowledge on pig production with existing low resolution maps to produce a higher resolution expert-based pig distribution map, and therefore improve the local relevance of the global spatial models currently used in CLEANED.

Storylines from the “time-ship” exercise were not consistent across all participants, however, the user interface for CLEANED will allow users to define their own scenario. Therefore, it is important to understand the range within which CLEANED needs to be able to run in order to be able to quantify all perceived stakeholder scenarios, in order for CLEANED to be useful and relevant to a user. The transect drive and the observed landscape dynamics will also help to define *credible* land use scenarios.

In order to get a more consistent picture of the future, and support a common vision for the innovation platform to work towards, the CLEANED tool will be brought back to the participants of the workshop together with other policy and decision makers, as well as key opinion leaders for a roundtable learning and sharing session. The tool will be in the form of a software that will allow participants to investigate the impact of their personal vision and explore the impact of different strategies for achieving it. In the workshop, we envision to set up a learning environment, within which participants will not only learn about the value chain dynamics from testing the environmental impacts of their different visions and beliefs. In a second stage, participants will work in a group on their vision, test different strategies to achieve the vision within the environmental carrying capacity, and create a space for negotiation in order to come up with a consistent vision of the future. In addition, they will be able to discuss what will trigger the change, what needs to be done today to reach this vision and how to work together to achieve it.

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Annex 1: Agenda

Time	Activity	Approach
8:30	Registration and group allocation	
9:00-9:30	Opening - Objective of the meeting - Consent agreement - Introduction round	Plenary
9:30-10:00	Study area boundary: Defining ,discussions and mapping: "Study area boundaries" - What is your understanding of the boundary of pig value chain in Hoima? - Up to what extend can your decision making influence the pig value chain? - Where do the pigs come from that passes through the Hoima market?	In groups and plenary
10:00-10:30	Identify vulnerable and limiting natural resources - Discussion around most limiting and most vulnerable natural resources in the area - Map the major resource (agree on legend). Make sure that we get something like ground water and soil quality. Discuss and map	Plenary followed by one group per natural resource
10:30-10:45	--Tea break--	
10:45-11:15	Brainstorming about production systems in the area along 6 key indicators: • number of animals and breeds per production unit • feed sources (self-produced/brought from region/commercial) • Market access (sold to whom? Under what conditions?) • other activities of the production unit/contribution to livelihood • infrastructure for pig keeping (shed, manure, time) • major constraints and challenges	Give the system a name
11:15-12:30	Discussions and mapping: Production systems - draw on the map - describe the feed resources for each pig production system - map where possible the feed provenance - number of production unit and animal in each system	In groups per identified production system + world cafe
12:30-13:30	--LUNCH--	
13:30-14:00	Pathways of intensification	Time ship
14:00-15:00	Specify the new system	Groups plenary
15:00-15:30	Conclusion and thanks	Plenary
15:30-16:00	--TEA and wrap up--	

Annex 2: Participants

PGIS workshop groups facilitators:

	Facilitators				
	Name	Role	Gender	Organization	Group
1.	Catherine Pfeifer	Facilitator	F	ILRI Nairobi	Pink
2.	Grace Asiimwe	Facilitator	M	ILRI Uganda	Orange
3.	Joanne Morris	Facilitator	F	SEI York	Orange
4.	Edmund Githoro	Facilitator	M	ILRI Nairobi	Yellow

Participant list by group, role and gender (green, yellow, orange, pink)

	Group 1-		Group 2-		Group 3-		Group 4-		
Role	Male	Female	Male	Female	Male	Female	Male	Female	Total
Farmer association management	1	1	1		4	1	2		10
Farmer/ Lead farmer	1	1			1				3
Extension worker	1						1		2
Local government	1	1	1				1	2	6
Input supplier			1	1					2
Local development organisation			2						2

Group 1-			
Participants	Role	Male	Female
2	Farmer	1	1
1	Extension worker	1	
2	Farmer association management	1	1
2	Local government	1	1

Group 2-			
Participants	Role	Male	Female
2	Input supplier	1	1
2	local development organisation	2	
1	Farmer association management	1	
1	Local government	1	

Group 3-			
Participants	Role	Male	Female
5	Farmer association management	4	1
1	Lead farmer	1	

Group 4-			
Participants	Role	Male	Female
2	Farmer association management	2	
4	Local government	1	2
1	Extension worker	1	

Annex 3: Overview of systems defined by stakeholders

Table 1 : Overview of the system description for the current system

Indicator	Orange: Extensive	Yellow: Tethering	Pink: Paddocking	Pink: Tethering	Green: Intensive
Number of pigs	Average= 2 Maximum=5	Average=3 Maximum=6	Between 5-9 pigs Average=7 (~ 5% of farmers)	Average=3 Maximum=7 (~70% of farmers)	Minimum 7 (6 females, 1 boar) 60-100
Breed	Local=60% Crosses=40% Crossing with exotic breeds has started	Indigenous=70 % (40-60kg) Cross breeds=30% (100-150kg)	Local=20% Crosses=80% Average weight local=35-50kg Average weight cross=60-80kg	Local = 80 Cross breed=20	Large white (pure) – up to 200kg Large white cross -120kg land race-150kg, combrough-150kg
Feed basket (% & Origin)	No feed supplement given, 100% free range Local pastures: Brachiaria spp, napier In other s/c, Caliandra, Lucina and moringa are being planted as forage (Busisi, Kiziranfumbi, Kyabigambire). Local fruit: jackfruit, pawpaw, avocado	Local available feed=80% Commercial feeds=20% Locally available: Napier, potato peelings, sweet potato vines, cassava, groundnut leaves, grass, banana peelings, Commercial: maize and rice bran and sometimes concentrates	Pastures=20% Concentrates= 50% Garden, crop residue and weeds=30%	Swill =30% Forage and pasture=60% Maize and rice bran=10%	Maize- 60% and rice bran Silage, silver fish, crop residues, grass, soya bean cake, blood meal, premix The following areas were identified as follows: Kyangwali-maize Kabwoga-rice Kiziranfumbi-rice Lira-cotton, sunflower

Market	50-80kg Sold to Congo (DRC) Buyers come on boats and load them They give better prices compared to buyers from other areas Buy mainly from Kiziranfumbi, Bugambe, Busiisu, Kitoba, Kigorobya	Mainly farm gate to local butcheries, Middle men, brokers Hoima market was equating to 80% and the rest 20% taken by other markets elsewhere	Local market Taken to the local market	Locally sold to pork traders within the village and towns	Butcher, pork joints, NGOs, OWC –which would compose of hotels, individual farmers and external market
Infrustructure **Shed =+ manure**	Majority have no structures at household level as pigs are kept roaming Pigs are marked with ear tag, notch, painting on skin or hooves with special paint for easy identification Kept for about 6 months both male and female These pigs grow very fast because of plenty of food	No shed and manure management was not planned	Roofed structures with either iron sheet, grass or papyrus mat 50% manure is left in the grazing area With the rest left in the housing unit where it's heaped outside and not used	Open roof/ unroofed structures • Under the trees • Grass thatched sheds • Rarely use manure, used by those with bananas plantation	Housing-Timber offcuts Cement, bricks NB: wooden structures constructed /concrete Manure-Biogas production/slurry-2% Heaped and taken to gardens-80% Wasted-18%
Other activities	Fishing, bars and hotels	The farmers would mostly practice crop farming, local poultry and others would keep livestock	Crops growing –cassava, beans, sweet potatoes, maize, rice etc. Engaging in small scale	• Crop farming • Poultry keeping • Cattle/ goat	Poultry Horticulture Tree planting Banana, pineapples, bee keeping,

			business e.g. retail shops	keeping	rabbit production
Constraints and challenges	Theft as one can sell other people's pigs when a buyer approaches Pig poisoning and intentional injuries They don't own land to tether pigs or grow crops The area has sandy soils and too hot and can't grow any crops or provide shade for livestock	Manure is left as at where it was with nor management Limited number of pigs kept Decreasing land/ space Cost of ropes during rainy season Vulnerability to injuries e.g. snake bites	Lack of enough feeds for the pigs Diseases Water Low market price for pigs Theft High transport cost Lack of vet services		Diseases, water, labour, construction materials, Feeds quality, prices etc., Bio safety measures, Drugs, Poor breeds (quality), Markets

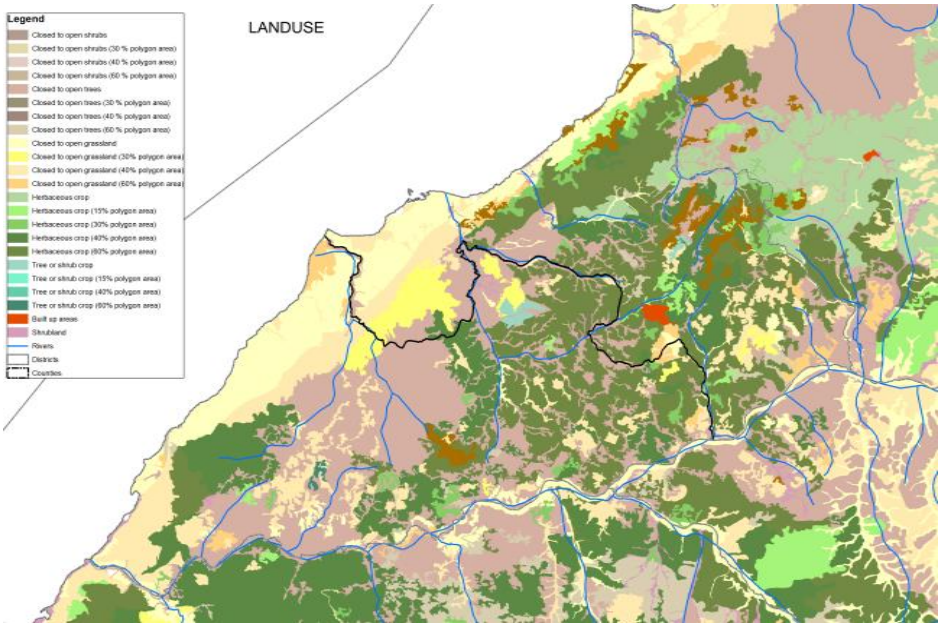
s/c – sub-county

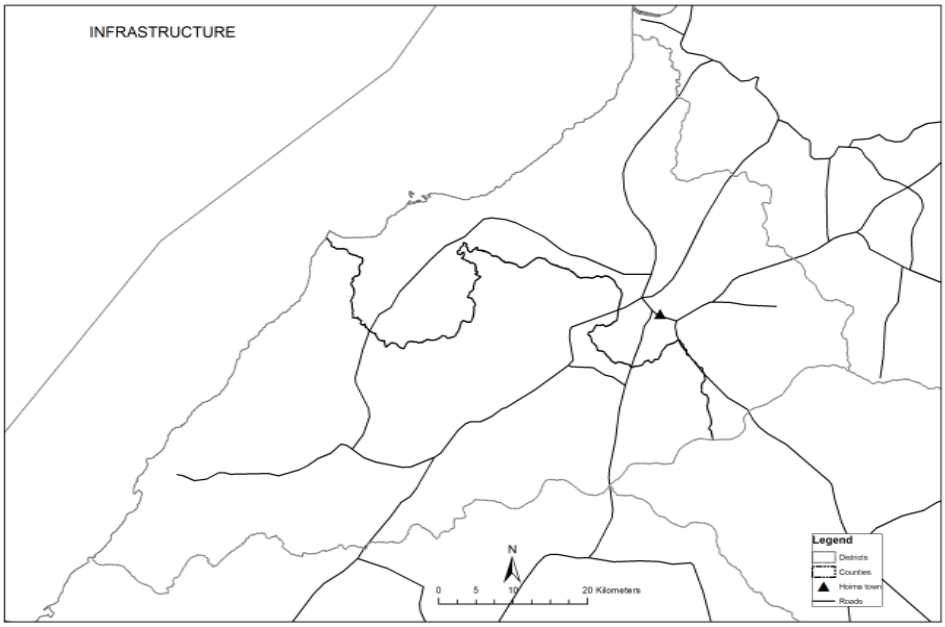
Table 2 : Overview of the system description for the future system in 2025

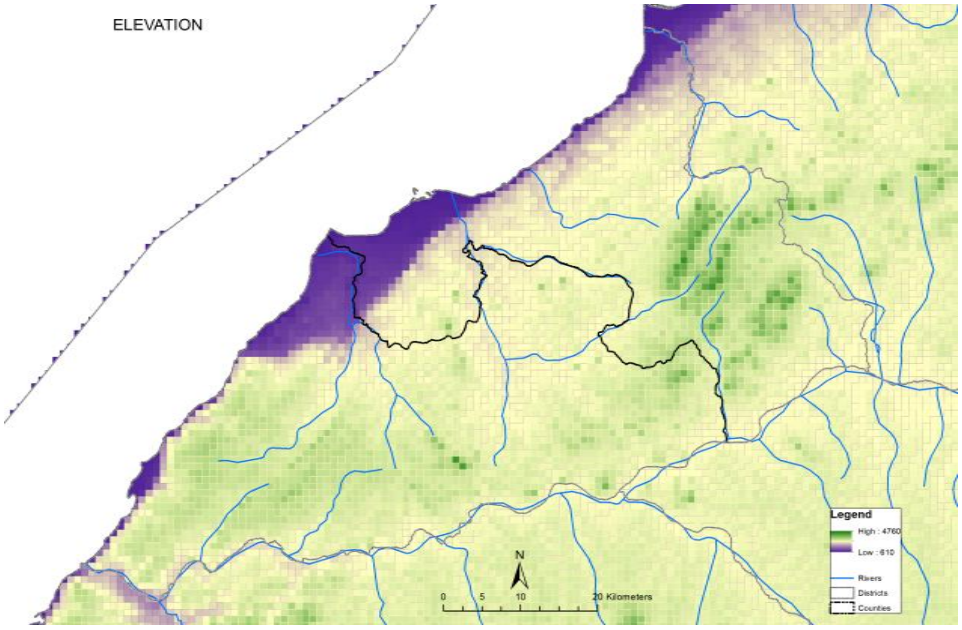
Indicator	Pink: free-range to Semi-intensive	Orange: free-range to Intensive	Green: Intensive to Intensive	Yellow: High-level Standardised Intensive
Number of pigs	25-50 pigs	Average 10 pigs and maximum= 50 pigs	60% Average 500-700 Maximum-1000	8000-10000
Breed	Cross= 100%	Land race and large white- Famers preferred the two breeds	Improved breeds	Improved/imported breeds (Large white, land race, combrough Weight between 100-130kg/6 months
Feed basket (% & Origin)	Maize bran, rice bran, fish meal, cotton seed cake =60%, crop residues=10%, swill=10%, silage=20%	Household production=40% Purchased feeds=60%	DEVENISH Own farm Other processors Neighbouring districts	
Market	Organised market for pigs Routine market days Selling to commercial farmers	Inlet- through own farm, farrows Sale-Cooperatives to processors and export to Juba and other places e.g. Congo Oil companies, NGOs	All contract farming Oil camps-processors/packers-farmers Fresh cuts- hotels	Domestic/local (city and oil area)=60 Kampala=30 Export=10
Infrastructure **Shed + manure**	Raised and cemented floor Roofed with iron sheets, papyrus mats Well managed manure to biogas system Manure and slurry used in crop fields	Concrete floor shed, roofing- grass or iron sheets Easy manure collection and preservation resulting to fertile land (banana, coffee, green vegetables, fruits garden	Modern structures Manure: Bio-slurry – crop production Increase soil fertility	Processing unit Biogas plant producing electricity

Other activities	Crop farming Diversification to businesses	Use manure in crop production Diversifying to other business as a result of enough capital Other livestock rearing e.g. cattle, goats and poultry as an alternative Value addition for pork	-Processing plants - grow more maize/rice, soya bean -Packaged pork -water harvesting	Farm laboratories-linkage training centres Corporate social responsibilities Piped water, solar Research and development activities- e.g. sports Breeding centres
Constraints and challenges	Diseases Theft Limited labour	Shortage of labour sine all farmers will have their own farm activities Fed prices will go up due to increase in demand Projection of adverse weather conditions which could cause famine and lack of feeds for pigs	-labour -water shortage -power -high taxes -potential challenge on climate change	Diseases-African Swine Fever Capital Taxes Skilled labourer Marketing Religious institutions Competition

Annex 4: Maps used for the PGIS






ELEVATION
Legend
High : 4760
Low : 610
Rivers
Districts
Counties
N
0 5 10 20 Kilometers