PIGGERY PRODUCTION MANUAL

How to Rear Pigs Using

Fermented Bed Technology

or

The Deep Litter System (DLS)

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Africa Innovations Institute, Kampala, Uganda

Africa Innovations Institute (www.afrii.org) is a non governmental center of excellence dedicated to research and innovations for the betterment of resource poor farmers and the sustainability of the environment.

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FOREWORD

Pig production is an enterprise that provides small scale subsistence farmers with a clear opportunity for increased household income. It does not require large areas of land; at least 16m^2 is needed to raise ten pigs using Deep Litter system or Fermented Bed Technology. The benefits of Deep Litter System or Fermented Bed Technology are many. Generally, it makes it possible for farmers to produce high quality pork more cheaply and in an environmental friendly way.

This manual has been prepared as a direct response to findings by a trans-disciplinary team of researchers from Africa Innovations Institute (AFRII) while implementing a three year Rockefeller Foundation funded project in Nakasongola and Nakaseke Districts entitled *"Securing livelihoods in the cattle corridor of Uganda".* During the livelihood profiling of the communities in the two districts, it emerged that the community in the two districts were engaged in and interested in pig production but its full potential was not being realized as a result of the following challenges: reduced land for farming; poor breeds; traditional feeding and husbandry practices; infestation by worms and poor disease management; limited technical knowledge leading to in-breeding and slow growth rates; high worm infestation, and social conflicts between pig farmers and crop communities. They requested for help in addressing these challanges.

To address some of the above challenges and expectations for knowledge and information on improved pig farming practices, better markets and increased household incomes, AFrII constituted a team of researchers to produce this manual. It is meant to guide our farmers engaged in rearing of pigs using the Deep Liter System commonly known as Fermented Bed Technology (FBT). The manual contains only basic information and is in no way intended to be a comprehensive and authoritative document on the production of pigs. Users looking for in depth information are advised to look elsewhere to meet their needs.

Chapter one introduces the piggery industry in Uganda while chapter two is about considerations before starting a piggery enterprise. Chapter three focuses more on the Deep Liter System (DLS) or Fermented Bed Technology (FBT). Chapters four, five, six, seven and eight are about feeds and feeding management; management of pigs; health and disease control; good records keeping and pork quality and marketing respectively. Chapter nine is a case study on real life experience on starting a piggery enterprise.

It is my sincere hope that this manual shall make enormous contributions to building resilience of smallholder farmers and communities and securing their livelihoods against the impact of climate change; and to enable them enjoy increasing income and food security" in line with our vision.

I recommend this book to current and future generations of farmers with the keen interest in profitable commercial pig production using Fermented Bed Technology.

Prof. G.W Otim-Nape

Chairman/Africa Innovations Institute

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We wish to recognize the efforts of the research team that implemented the project whose lessons and experiences are captured in this manual. This manual would be incomplete without the invaluable contribution of Prof. C. Rubaire Akiiki, Ms. Mukasa Beatrice, Byenek S Ogwal, Lutwama Vincent, Richard Lumu, myself and project support staff who in one way or the other contributed to the compilation of this manual. Special thanks go out to participating communities, the Local Governments and production staff of Nakaseke and Nakasongola Districts.

Drafting and technical editing of the manual has been done by S. Ogwal and W. Otim Nape respectively. This manual has been published with support from the Rockefeller Foundation. On behalf of Africa Innovations Institute, I would like to extend our deepest appreciation to the Foundation for their financial and technical support; and for a great service to humanity.

Professor Otim-Nape G.W. and
Byenek Ogwal Simon
Africa Innovations Institute, Kampala, Uganda

LIST OF ACRONYMS

AfrII: Africa Innovations Institute
ASF: African Swine Fever
FMD: Foot and Mouth Disease
DLS: Deep Litter System
FBT: Fermented Bed Technology
IMO: Indigenous Micro Organisms
AM: Anti Meridian
PM: Post Meridian
PSE: Pale Soft Exudate

DEFINITION OF COMMON TERMINOLOGIES USED

Acaricide: A chemical used to control ticks, mites and other ecto-parasites

Barrow: Castrated male pig

Boar: Mature intact male

Castrate: Removing the testicles

Colostrum: The first milk produced after furrowing (birth of piglets). It is very high in proteins, vitamin A and immunizing agents

Constipation: An abnormality in passing out feaces. It is characterized by abnormally hard feaces.

Creep feed: Baby pig feed provided in the creep area beginning at about two weeks

Creep area: Area within a sow pen so constructed that the piglets can enter and leave but the sow does not have access

Dam: Mother or female of an animal.

Disinfectant: Chemical agent used to kill microorganisms

Dry sow: Sows that are not suckling piglets

Estrus: Time during which the female is sexually receptive to the male.

Farrow: To give birth to a litter of piglets

Feed conversion rate: Amount of feed required by a pig to produce 1 Kg increase in body weight

Feeder pig: Young pigs sold after weaning for growing to reach slaughter weight

Finishing pig: Young pig generally weighing more than 60 Kg.

Flushing: Practice of increasing feed allowance around time of serving (mating with boar) to increase number of eggs produced.

Fostering: Transferring of piglets to be raised by a sow other than their own mother

Gender: A term used to describe roles of men, women and children

Gilt: Young developing female pig

Growing pig: Young pig after weaning, generally weighing less than 60 Kg

Hand-mating: Supervised mating whereby sow observed on heat is taken to boar for service

Heterosis: Phenomenon whereby the performance of offsprings from parents of two different breeds is higher than the average performance of the parents

Lactation: Period between birth and weaning when the sow suckles her piglets

Limit feeding: Weighing out a determined amount of feed to be given to each pig per day as a way of preventing them from getting too fat.

Litter: Set of piglets born to a sow at a time

Litter number: Number of times a sow has farrowed.

Litter size: Number of piglets in a given litter.

Longevity: Ability of a pig to remain productive in the herd.

Mange: A skin disease caused by mites leading to intense itching.

Pen: Room in a pig house to be occupied by an animal or group of animals.

Pen-mating: Mating in which a breeding female is housed together with a boar and mates with them as and when they come on heat.

Piglet: Young pig before weaning

Rooting: A habit among pigs where they dig up the ground using their snouts

Runt piglets: Small weak piglets within a litter, which are less than average in weight

Slaughter pig: Young pig ready for slaughter, usually 90-120 Kg.

Tethering: To tie a pig with a rope it can only move within a specific area.

Sow: Mature female pig.

Wean: Remove the piglets from their dam to end suckling.

Weaning pig: Young pig at or shortly after weaning

Withdrawal period: Time period within which if a drug is used on an animal, the animal should not be slaughtered for meat to avoid drug resistance in humans.

1. INTRODUCTION

1.1. Uganda's piggery sector

Compared to other sub-sectors within the livestock industry, the pig sub-sector is still very small but showing marginal signs of growth. Pig production as an enterprise, provides small-scale subsistence farmers with a clear opportunity for household income improvement. Most pig farmers keep 1-5 pigs tethered around the homestead. The main source of feed is kitchen leftovers, remains of food and crop residues. There are a few small to medium scale commercial farmers with 10-20 Sows. Some farmers let their pigs free to move around in search for feed. Productivity is poor mainly exhibited by low reproductive performance, slow growth rates, high worm burden, and in-breeding. Marketing is not organized and there are several slaughter slabs, some slaughter houses; and one commercial abattoir located at Nalukolongo in Kampala. This abattoir currently has capacity to slaughter 200,000 pigs per day, a quantity that does not meet the demand for pork in Kampala alone. Economic losses due to death and loss of condition caused by disease are high, especially nutritional diseases.

1.2. Common pig husbandry practices

The most common and preferred method of rearing pigs in Uganda has been raising them on concrete. This method allows for easy cleaning, removing of feces, and disinfection. Farmers most commonly use concrete because it is relatively low cost and also long lasting. Concrete pig houses are easy to clean and disinfect. Though considered ideal, concrete may actually cause many problems. Concrete's hard surface prevents any natural rooting behaviors of pigs. The hard and cold characteristics of concrete provide little comfort for the animals, leading to development of a big fat layer deposit to keep the animal warm. The management of animal waste is a challenge often creating a foul smelling environment when poorly handled. The costs involved in preparing a concrete floor makes this system un-affordable for poor rural farmers with limited land.

1.3. The pork market in Uganda

Although there is no organized marketing system in Uganda, the demand for pork and products is high. In rural areas the local markets cater for other farmers who keep pigs for breeding or raise them for slaughter. This market also has local butchers who sell pork within the community and middlemen who ferry live slaughter-pigs on trucks to urban areas. Roasted or deep fried is consumed at bars located in trading centers. Irrespective of the type of market, current demand for pork far outstrips supply, hence the need for increased production.

1.4. Challenges and opportunities

Challenges to pig farming in Uganda have been the predominance of traditional production practices characterized by lack of technical production knowledge and skills in the area of feeds and feeding practices, control of diseases and parasites, appropriate housing and sanitation; poor production management and record keeping and unprofitable production.

A new climate smart innovation technique that offers a wide range of benefits for farmers around the world is building momentum. In China this technique is called Fermented Bed Technology, whereas in Hawaii it is referred to as Inoculated Deep Litter System. In Japan it is called Bokashi-Japanese word meaning fermented organic matter. Elsewhere, others prefer to call it Living Bed Technology. We have preferred to call it Fermented Bed Technology system (FBT). In the FBT, the pigs are not the only living materials. the farmer raises a living bedding materials as well. This bedding not only feeds on the pig waste but also creates a living compost to improve soils.

Raising pigs in this environment encourages the natural behaviors of the animal such as rooting instead of suppressing them. Fermented Bed Technology offers many benefits but the core benefit is the efficient way both manure and urine are turned into finished compost. Beneficial microorganisms can actively breakdown all pig waste significantly decreasing odor and fly populations. This bedding also creates an immense amount of heat through decomposition and breakdown that can help pigs stay warm during cold weather. Rearing pigs using Fermented Bed Technology is low tech, cheap and affordable for rural farmers because materials can be got from within the environment.

The promotion of modern piggery will therefore benefit from the available markets and opportunities outlined above. This will create employment, increase rural and urban household income, diversification of foods and ensuring food and nutrition security.

1.5. Purpose of this manual

During livelihood profiling, several groups in the three farming systems in Nakaseke and Nakasongola districts selected piggery as one of the intervention areas. As is the practice in the rest of the country, the majority of households that rear pigs in the cattle corridor keep 1-5 pigs tethered around the homestead. They feed the pigs with kitchen leftovers and crop residues. During the dry season, some farmers let their pigs free to move around in search of food. This free range method is characterized by low reproductive performance, slow growth rates, high worm infestation, and inbreeding. This has led to slow growth and poor performance of the pigs; social conflicts between pig farmers and crop communities as pigs roam around looking for food. The high prevalence of diseases such as African Swine Fever (ASF), Foot and Mouth Disease (FMD), Gastroenteritis, swine dysentery and swine erysipelas result in high mortality and huge economic losses.

The challenge the communities were facing in the piggery production were poor breeds; traditional feeding and husbandry practices; infestation by worms and poor disease management; although the demand for pork and other pork products is rapidly expanding. To address these challenges and improve production, the project introduced and piloted Deep Liter System (DLS) commonly known as Fermented Bed Technology (FBT) in the project area.

This manual is prepared in response to expectations from communities in the project areas, for knowledge and information on improved pig farming practices, better markets and increased household incomes. It provides general guidance on modern pig farming using Fermented Bed Technology and is in no means exhaustive.

2. STARTING A PIGGERY ENTERPRISE

2.1. Pig production as a business

Farmers need to engage in pig production as a business with the aims of providing meat (pork) and other pig products to the consumer; earning an income through sale of pigs, meat, and compost from the fermented bed. To run a successful pig production business, the farmer has to increase the number of healthy piglets weaned per Sow per year and minimize feed costs while ensuring consistent adequate performance.

2.2. Types of pig production systems

2.21.Extensive or free-range (scavengers)

The free-range system is the traditional method of rearing pigs in most parts of the world. Each family keeps a few (one to three) pigs which are allowed to scavenger or wander freely and pick up food when and where they can. The system requires little investment and management; and there is minimum disease control. They may receive supplementary feeds such as kitchen wastes, farm by-products, and others. Local breeds of pigs pre-dominate the free range system because they are more highly adapted.

2.2.2. Semi-Intensive

In this system, the animals are restricted to a limited area and the farmer feeds them. Once in a while, the pigs are allowed into a larger area to graze, wallow and exercise. The animals are fed on kitchen wastes, food by-products, among others and some level of managerial skills are required.

2.2.3. Intensive production system

This is the commercial method of pig production. Housing is more modern and provides shade, pen space, feed and water facilities to meet requirements of the pigs. Feeding, management and disease control are more modern. Common breeds are exotic or cross breeds. Herd sizes may be small scale (5 Sowherd or up to 100 stock/year), medium scale (10 Sow herd or up to 200 stock/year) or large scale (greater than 200 stock. year).

2.3. Types of piggery enterprises

Essentially, there are four pig production enterprises a farmer may choose from. The enterprises are:

1. Farrow-to-finish operations **-** The farmer keeps a Sow herd and produces his own growers for a finishing operation which he also owns.
2. Farrow only **-** The farmer keeps a Sow herd which produces weaners which he sells to other farmers.
3. Finishing operation **-** Farmer buys piglets either as weaners or growers and fatten them for the pork market.
4. Breeding **-** The production of breeding stock is a very specialized enterprise reserved only for the experienced pig breeders and requires heavy capital investment.

The choice of the enterprise depends on the motivation, the resources available and the markets.

Textbox1: Issues to consider when intending to start up a piggery project	
Issues	**Details**
1. Capital.	This is the amount of money required to set up the piggery project. The amount is dependent on the unit size one intends to operate. The capital is needed to construct the sties and to buy equipment and breeding stock. Working capital is also needed to pay for feed, drugs and labor for the initial phase of the business.
2. Knowledge and skills.	Knowledge on how to successfully manage a pig production enterprise is very important. In order for the farmer to avoid making costly mistakes in the running of the pig production enterprise he should receive training in pig husbandry.
3. Breeding stock	The output of a unit can be limited by the quality of breeding stock. Inferior breeding stock results in an inefficient utilization of feed and space. Farmers must be prepared to pay high prices for quality stock. Poor quality breeding stock may be cheaper in the short term but in the long run they will be expensive.
4. Market	Farmers have to identify the market for their pigs before they start producing them. Farmers should desist from the practice of hunting around for a market when their pigs are ready for sale. When the producer has identified a market he must ask himself whether the price being offered for his pigs will be enough to make the project viable. An important point to consider when one is choosing a market is the distance to the market. If the distance to the market is long the project will incur high transport costs and hence will be less viable.
5. Water	Water should be of the right quantity and quality. Inadequate water supply depresses the growth rate of the pigs. Lactating sows need a lot of water for milk production. The pigs' water requirements will vary with the weather. On a very hot day the pig will use more water than during a cold day. As a general guide a farmer should budget about 150 litres of water per sow per day.
6. Housing	The pigsties should be constructed in a way that will allow the stockman to carry out his daily duties with ease. The sties have to be designed in a manner that will help management in monitoring the pig enterprise. Poor housing designs can lead to disproportionate food sharing, inefficient utilization of space, feed wastage and poor performance of the pigs among other things.
7. Feed availability	A guaranteed supply of feed is a prerequisite for the successful operation of a piggery project. Feed account for about 80% of the production costs on a pig production enterprise. Pig feeds are compounded using maize or other small grains and concentrates. The farmer should budget about 3.4 tons of maize per sow per year if he is to operate a breeding/feeding unit.
8. Technology to use	There are many technologies for piggery production. The common ones in Uganda are (a) the traditional free range system, (b) intensive pig production system using cemented floor housing, and (c) intensive pig production system using Fermented Bed Technology. The choice of which one to use depends on the skills and resources available to the farmer. This manual is about pig production using Fermented Bed technology (FBT).

3. THE FERMENTED BED TECHNOLOGY (FBT).

3.1. Why use FBT.

The system can be used by smallholder farmers to rear pigs that produces high quality pork. It is suited for intensive management of pigs in a housed structure throughout the year; and can be used to:

- Breed Sows and Boars to produce weaners for sale (farrow to wean)
- Breed Sows and Boars to grow weaners for market (farrow to finish)
- Grow purchased weaners for market (wean to finish of feeder pigs)
- A mixture of all the three products above.

It is climate smart and environmentally friendly method of pork production. It exploits biological activity of microorganisms that decompose cellulose and lignin in the bedding materials (twigs, crop straws, saw dust, wood shavings, rice or corn husks etc.), into simple organic compounds and generates warmth suitable for prime pork production.

Key features of FBT is Sown in Table 1.

Table 1: Key Features and Benefits of the Deep-Litter Systems

Key features	More detail	Key benefits
Basic structural requirements	Barn design similar to conventional system with the addition of a deep pit. Good ventilation and air movement essential.	Simple structure results in low construction and labour costs.
Deep pit floor	Each finishing pig requires 1.5–2.0 square metres litter-bed space at a 25-50cm depth.	Urine and faeces is treated in the pen, eliminating the need for treatment elsewhere and producing good quality compost.
Manipulatable bedding material	Corn stalk topped with wood shavings (directly from wood, not furniture) and rice hulls or chopped corn cobs are recommended. Material added to ensure the water content of litter remains <40% and bedding is kept at a depth of 25–50cm. All bedding to be replaced every 3–5 years.	Provision of sufficient bedding material helps avoid problematic behaviours such as tail biting and generation of wastewater and odour. Dry bedding provides a comfortable, clean environment. No daily washing is required, thus water usage and labor reduced.
Microbial activity	Regular addition of a bacterial mixture to litter to obtain correct temperature for composting manure and for pathogen removal.	A high temperature is maintained, reducing or eliminating the need for a fat layer below the skin.

Adapted from Sheen, 2005:. http://www.thepigsite.com/articles/3464/pigs-the-deeplitter-solution/

3.2. The advantages of the fermented bed technology.

FBT offers many benefits but the core ones are:

1. FBT is highly environment friendly. It enables you rear pigs in a clean environment where there are no flies and bad smell. It is a simple and efficient way to turn both manure and urine into finished rich compost for improving soil fertility. The absorbent bedding, when healthy and designed accurately, can actively breakdown all pig waste thus significantly decreasing odor and fly populations.
2. It is cheap and effective way to rear clean and healthy pigs that give high quality pork. The bedding creates an immense amount of heat (approximately 60^0C) as the plant materials breakdown and decompose. This helps the pigs stay warm during cold weather and minimizes accumulation of fatty later below the skin which normally undermines pork quality.
3. It also allows for natural behaviors such as rooting by pigs; it helps prevents the outbreak of disease; improves pigs immunity; reduces urine and manure disposal, minimizes frequent cleaning and the need for disinfection. Further, the construction of the housing structure can be cheap and low technology. The structure can also be used for alternative enterprises such as poultry rearing.

Text Box 2: What other farmers say about the FBT

Members of Kiwendi Farmer's Society, Lwampanga Sub County, Nakasongola district emphasized that they have greatly appreciated the following aspects of the FBT:

1. Superiority of the technology. The group is fascinated by the fast growth exhibited by the pigs when they are cared for properly.

2. Disease free environment created. They appreciated the fact that using IMO created a disease free environment. This was supported by revelation that pigs in the neighborhood died while the ones at the center were not attacked at all.

3. A low cost technology system. The farmers noticed the simple requirements needed to maintain the system. It required regular sprinkling of IMO, turning the litter and weighing the pigs once a week to determine their growth and feed requirements.

4. Time saving way of rearing pigs. The recommended split serving of equal feed in the morning and evening created time for other activities between the feeding times. This attribute was particularly advantageous for the women. There was no need to fetch water from far to clean the house.

3.3 Materials needed for starting up an FBT

The materials needed to start the piggery are appropriate housing structure to provide shelter; good quality pigs with proven fertility history; adequate feed resource; equipment and tools; and reliable clean water supply.

Figure 1 Adequate quality feed resources (Source: AfrII, 2014)

Figure 2 Good quality pigs with proven fertility and littering history (Source: AfrII, 2014

3.4. Feed Selection

To be profitable, a pig production enterprise should use Sows and Boars from high quality animals from improved breeds. Farmers should choose breeds that are common in their area since it eases the process of buying and selling breeding stock. Table 2 below gives a list of pig breeds in Uganda from which a farmer can select.

Table 2: Different breeds of pigs in Uganda, their traits and average maturity age and weight

Breed	Performance traits	Maturity[1] weight (kg)
Large White or Yorkshire	White with erect ears, good mothering ability, produces many litters, fast growing and fairly hardy	Male 310 – 400; Female: 250 – 330.
Landrace	White, lopped ears, fast growth rate, high quality carcass	Male 310 – 400; Female: 250 – 330.
Duroc	Dark brown, fast growth rate, good mothering ability. It is tolerant to stress and is adaptable to various environmental conditions	Male 300; Female 250.
Hampshire	Black, good carcass quality, high meat yield	Male 300 Female 250
Comborough	Superior weaning capability, robustness, increased weaning weights, short re-breeding intervals, higher conception rates, improved farrowing rates	Male 310 – 400; Female: 250 – 330.
Local pigs	Different colors, hardiness, adaptability, large litters	100-150
Crosses	Crosses of Large white and Landrace are common. They are very good when used as Sows for breeding	200-300

Footnote – [1] - Average age or weight under recommended good feeding

Fig. 3. The different pig breeds in Uganda: Comborough Photographs (Top to bottom): (Top right); Humpshire (Top left), Large White (Middle right), Land Race (Middle Left) Duroc (bottom right)

3.4.1. Selection of right pigs for breeding.

When considering going in for pig breeding, a farmer should carefully consider the following points:

- Select good gilts from Sows of a superior breed that wean 9-10 piglets per litter and that are known to be good mothers.
- Selected gilts should have at least 12-14 teats so that a large litter can be easily nursed.
- Gilts should be healthy with strong legs and well developed body and thigh muscles
- Beginners in pig farming are advised to start with about 1-2 gilts/Sows and progress as more experience and skill is gained

3.4.2. Pig housing and equipment

The purpose of housing for pigs is to provide an environment that will enable the pig to grow or breed optimally. Pig housing must therefore aim at:

- Protection from climatic extremes e.g. direct solar radiation, rain, wind. etc.
- Allowing for inherent behavior patterns of the pigs and minimize overcrowding.
- Provision of dry bedding conditions that do not predispose the pig to diseases.

- Allowing accessibility to food and clean water.
- Ensuring easy movement of the stockman.
- Effective disposal of effluent.
- Cost effectiveness in housing construction.

3.4.3. Housing structure

In Fermented Bed Technology, pigs are intensively raised in a housing structure to:

- Make management and feeding easy. Pigs of different sizes are raised separately, it is easier to quarantine sick animals when an outbreak of disease occurs. A farmer can also effectively manage pigs at different stages of growth such as breast feeding Sows, weaned piglets, finishers, porkers and breeding stock.
- Promote maximum production. While in a housed structure, the piglets are protected from the vagaries of nature. Fewer mortalities are experienced in a litter
- Control pests and prevent disease outbreaks. The inclusion of lime and salt (see section xxxxx) in the bedding material creates a sterile environment that prevents the growth of disease causing organisms.

3.4.4. Factors to consider when selecting site for good housing

A good site

- Should drain well
- Its orientation should be in the east-west direction to allow sunlight to enter in the morning and evening
- It should have easy access points to deliver supplies using vehicles
- The roof should be made of material that protects pig from rain and direct sunlight
- The walls should allow for maximum air circulation
- It should have feed and water troughs

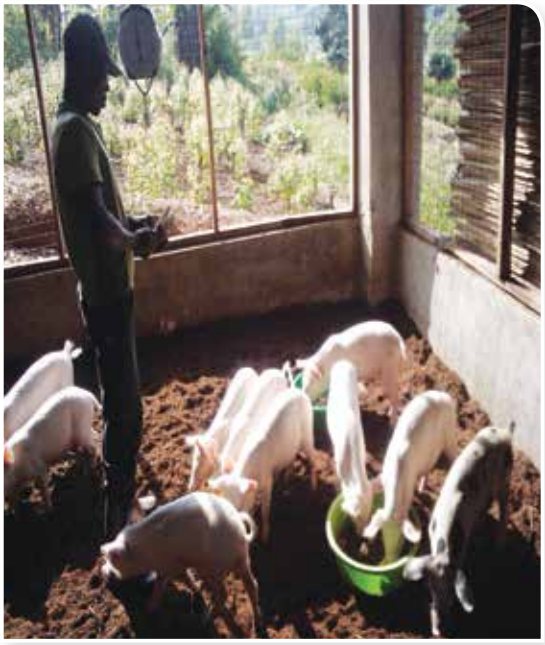

Figure 4 Well ventilated piggery housing unit

Figure 5 Orientation of the sun should allow adequate light into the unit

3.5. Components of a pig housing unit

3.5.1. The Roof

- It should be made from locally available materials such as dry thatching grass, polythene sheets, papyrus mats placed over polythene sheets, dry banana leaves placed over polythene sheet or iron sheets
- The roof should be at least three meters above the ground to create a cool environment
- Be rain and sun proof
- Collect rain water if corrugated iron sheets are used
- A minimum slope of 45^0 is recommended

3.5.2. Walls

- Use either bricks or timber off cuts. The off cuts should be nailed on the inside part of the house to prevent the pig from pushing against it easily
- The wall should be well plastered
- Use treated poles to support the structure

3.5.3. Floor

- The floor should not be cemented but left bear with a soil surface
- It should be covered by parent material of dry matter (grass, maize stalk, sorghum straws, twigs or small branches)
- The parent material should be covered by a mixture of either fine saw dust, or rice/wheat bran mixed with lime, table salt, red soil.
- The material is then maintained by sprinkling a solution containing Indigenous Micro Organisms (IMOs)

Figure 6 Farmers of Twerinde Embeera y'obudde placing dry maize stalk on the floor of a piggery unit under construction in Kapeeka Sub County, Nakaseke district.

3.5.4. Space requirements

The amount of space will depend on:

- Size of the animals. A housing unit should have pigs of the same size.
- Age of animal
- Physiological condition (lactating Sows, pregnant Sows)

The housing unit should not be overcrowded as this will lead to:

- Discomfort
- Increased susceptibility to disease
- Poor weight gain
- Increased cases of fighting and tail biting
- Recommended number of animals in a $16m^2$ housing unit is shown in Table 3.

Dry Sows should be housed in groups. Boars are kept in individual pens to eliminate fighting, riding and competition for feed. Boars kept separately live longer. Boar pens should be close to recently weaned pig Sow pens. This promotes fast return to heat.

Each lactating Sow should be kept in a separate pen. There should be a creep area for the piglets; the piglets can run to this area to avoid being crashed by the Sow as it lies down

Table 3: Recommended number of animals in a $16m^2$ housing unit	
Stage of growth	No. of animals/$16m^2$
Boars	1
Gilts	10
Sows	10
Lactating Sows	5
Weaners	20-30
Growers	15-20

3.5.5. Feed and water troughs

- The feed and water troughs should be placed on opposite sides so that the pigs can exercise as they move from one trough to another
- The water troughs should be shifted regularly to avoid over wetting the same spot
- It is advisable to use plastic troughs since these can be easily washed to maintain an acceptable level of hygiene
- The troughs do not necessarily have to be fixed, they should be easily moved to create more room for exercise after the animals have fed and drunk water.
- If the troughs are fixed, they should be built along the wall
- Each pig should be allowed a space of 30cm in a feed trough
- The water trough should be at least 30cm in height.

3.6. Construction of an FBT house

3.6.1. Site selection.

Under the guidance of a project staff, an extension officer, or an animal production specialist, the farmer should identify a suitable site to construct the pig house. The site should be free of shade;

have adequate air circulation and good drainage. Locate a suitable site, measure the dimensions of the structure and guide the farmer and his team in excavation, building and roofing of the structure. The Figure 6 illustrates how this was done by members of the Kyabutaika Innovations Platform, Nakasongola district.

Figure 7 Members of the Kyabutaika Innovations platform, Kakooge Sub County, Nakasongola district guides Mr Simon Ogwal (AfrII) on the site they have selected and cleared to locate the housing structure for the FMT. Mrs Mary Mutyaba, the leader of the group, shows Simon the direction the sun sets and rises so as to guide the layout of the housing structure

Figure 8 A typical housing structure for pigs under FBT. In the foreground are dry maize stalk used as foundation material for bedding

3.6.2. Setting and building up the pig house.

To construct the housing structure measure: length 4m and 4m width of the ground structure. Excavate the 16m^2 to a depth of 100cm. Build up the walls of the excavated pit using bricks up to 100cm with corner columns raised to a height of 200cm above the ground. Construct the roof with a pitch of 75cm and build it with roofing materials: grass thatched or iron sheets or any water proof material. If possible the brickworks should be cement plastered to increase the durability of the wall (Fig. 8).

Figure 9 Members of B. K. Womens' Group used reeds and grass to wall and roof their pig house. They prepare feed from sliced tender elephant grass to feed their pig to supplement commercial feeds to minimize costs.

The specific steps to take are:

1. *Site clearing.* Clear the area of all grass, bushes or shrubs. This eases the process of taking measurements, excavating and deliver of materials to site (Fig.7)

2. ***Demarcating floor area.*** With the guidance of a mason, demarcate an area of at least 4.5m x 4.5m. The internal diameter after plastering should be 4m x 4m

3. *Excavation works.* Using hoes, pike axes and shovels, remove the soil within the demarcated area up to a depth of 1m (100cm). The edges of the pit should be straight and even

4. *Construction of wall.*

    1. Raise a wall using mortar of 1:4 (cement: sand) mix and clay bricks arranged head to head
    2. Raise the bricks up three courses above the ground
    3. Raise corner pillars up to 2m (200cm) above the ground
    4. The corner pillars should be strong enough to support the roof
    5. Plaster the bricks to a smooth finish.

Alternatively,

1. Dig holes up to a depth of 50cm in each corner and place wooden posts
2. The wooden post should be 3.5m (350cm) tall, straight and as smooth as possible.

3. Then nail wooden off-cuts on the inside part of the wall from the bottom of the pit up to one foot above ground level

4. The off-cuts should be as close as possible to prevent the pigs from farrowing into the soil behind the off-cuts

5. Avoid protruding nails as they will injure the pigs or workers/farmers.

Figure 10 The different materials (maize stocks, saw dust, soil, salt, and lime) that make up the bedding material is heaped, mixed to uniformity and turned using the garden fork to over lay the foundation material (e.g. maize stover).

3.6.3. Introduction of bedding material and fermentation.

Bedding material consists of dry grass, maize or rice straws or small tree branches laid firmly on the floor. A majority of the houses use dry maize stocks as bedding material since maize is the most commonly grown crop by the community. The bedding materials are placed in the pit up to a depth of 30cm. This is immediately overlaid by another 40cm of fine sawdust (65 bags) or rice husks mixed with loam soil (100kgs or 3 wheel burrows), lime (10kgs), and table salt (10kgs) (Fig 10) and moistened using water having Indigenous Micro Organisms (IMO) to start the fermentation process. The procedure for preparing the IMO is outlined in Text Box 2.

The steps to follow are:

1. Place either dry grass, maize stalk, rice straws or small branches on the floor up to a height of 30cm.

2. Immediately after maize stalk or small tree branches are placed on the floor, bedding materials are put up to a height of 40cm.

3. This bedding material consists of fine sawdust (70 bags), 100Kgs of loam soil (or 3 wheel burrows), lime (10kgs), and table salt (10kgs).

3.6.4. Preparing IMO and inoculating the bed.

To prepare a solution of the IMO, and use it to ferment the bed, follow the steps outlined in Text Box 2. Micro-organisms decompose and convert complex organic materials such as dead plants and animals tissues, excreta and other organic materials into simple organic compounds such as organic manure, anti-biotic substances, enzymes and lactic acids which suppress diseases and worms and promote environmental hygiene- no smell, no flies, no run-off

Figure 10 Mr. Byenek Simon demonstrates to farmers at how to prepare liquid IMO for inoculating the deep litter bed. In his hand is a bottle of solid IMO from which he scoops 20 spoonful for the mixing with 200 liters of water contained in the plastic drum.

Text Box 2: Preparing The Imo And Inoculating The Bed

1. Step 1. Purchase 1 Kg of solid IMO from a pig farmer already using the organic/IMO system of pig rearing
2. Step 2. A plastic drum of 200 liter capacity is filled with 10 jerry cans of clean water. Each jerry can has a capacity of 20 liters. Place the drum in a cool place protected from rain and direct sun rays since microorganisms do not grow well when put under direct sunlight.
3. Step 3. Add solid IMO into the plastic drum; 2 table spoons per 20 liter jerrycan; without dipping the table spoon in the drum. This is to avoid contaminating the remaining solid IMO in its original container. Total of 20 table spoons are placed in the drum.
4. Step 4. Five Kilograms of pure maize bran are weighed and added to the drum. In the absence of a weighing scale, to use hands/palms. Two full palms per 20 liter jerry can be added into the drum. In total, 40 handfuls are added into the drum. The maize bran acts as the food for the microorganisms. Cover the drum with a mosquito net to avoid contamination and insects falling in. The liquid is ready for use 24 hours later
5. Step 5. Liquid IMO is sprinkled on the litter and thereafter mixed using a combination of hoes and garden forks. Only the first 30cm of the litter is mixed with liquid IMO until a moisture content of 60% is achieved. This is achieved by sprinkling an initial 150 liters of liquid IMO.
6. Step 6. Starter culture. The balance of 50 liters remaining in the plastic drum is used to culture more liquid IMO following the steps explained above. The liquid IMO in the drum should not exceed six days before preparing new liquid IMO.

Figure 12 Members of St. Kizito Farmers Group receiving instructions from project team on how to maintain a healthy fermented bed. Left to right: Mr Samuel Lutwama (animal production specialist), Beatrice Mukasa (Gender specialist), Prof Otim-Nape (PI) and farmers Mr and Mrs Serunjogi practice management of the fermented bed.

3.7. Introducing the piglets to the bed.

The bed should be turned daily and allowed to ferment for eight days before the pigs are introduced into it. The pigs should be transported either early in the morning or at night to minimize exhaustion and possible death. A 16m^2 floor structure can hold between 10-15 three to six months old pigs. Once in the housing structure, the pigs should be given multi-vitamins and dewormed one hour before feeding.

3.8. Management of the bed.

Use a garden fork to turn the bed for the entire period the pigs are in the structures. Turning the bed using a garden fork helped in burying waste and loosening the bed to encourage the pigs to root. This practice reduces fly populations and odor in the structure which is one of the benefits of the technology.

You should turn the litter at least twice a week. The liquid IMO should be sprinkled each time the bed is turned (Fig 12). Adding the solution to the bedding once a week ensures a high level of micro-organism activity which will keep the bedding healthy and free from smell.

3.9. Maintenance of the pig house.

The following maintenance activities should be carried out when using fermented bed technology for pig production.

3.9.1. Maintaining a healthy fermenting bed

- The bed should be sprinkled with a solution containing Indigenous Micro Organisms at least twice a week.
- Concentrate the IMO in the corner where the pigs excrete their waste
- Turn the litter using a garden fork each time IMO is sprinkled.
- The garden fork should reach where the maize stalk starts
- Care should be taken not to over wet the litter as this will drop the temperature in the litter to less than the desired 60^0C

3.9.2. Cleaning and disinfecting

- Wash plastic water and feed troughs daily using detergent
- The walls/ off-cuts should be inspected for any cracks as these may harbor mites and other parasites
- Remove any food remains such as banana peelings or potato vines. The bed should be only fine saw dust
- Whenever a pen is emptied, start the fermentation process afresh before introducing a new litter of pigs (see text box 2)

3.9.3. Repair works

- Paint all wood works once a year
- Pour termicide around the poles every year
- Inspect roof for any leakage

3.9.4. Water sources

- Pigs require water for drinking while some is used to maintain hygiene of the house. Water can be from natural springs, harvested rain water, boreholes or piped water.
- Among the above, harvested rain water is the most abundant. It can be stored in metallic or plastic tanks, or concrete underground tanks. Storing harvested water reduces costs and saves time and labor that women and children would have spent in collecting water

4. FEEDS AND FEEDING MANAGEMENT

4.1. Importance of Feeds and Feeding

1. Feed accounts for at least 70% of the cost of commercial pig production. Therefore, it is the most important operational cost item in a pig enterprise. To maximize profits, a pig farmer must minimize feeding costs. Feed must contain the nutrients in the right quantities

2. Pigs require feed for body maintenance, growth and reproduction. Feeds supply nutrients which are used to meet these biological needs.

3. There are six classes of nutrients required by the pig: water, energy, protein, vitamins, minerals and lipids. These nutrients can be supplied by a wide variety of feedstuffs.

4. Feeding pigs for optimum production requires that feedstuffs be combined in proportionate amounts that will provide the quantities of nutrients needed by the animals.

4.2. Nutrients required by pigs

1. Water: Sixty-five percent of the pig's body is water. The pig requires water to enable all body functions such as digestion, excretion, blood circulation and maintenance of body temperature. Lack of water quickly leads to a rise in body temperature and death. Also less water will have a major effect on food intake and pig performance. A Sow needs 20 liters of drinking water daily. A farmer should supply clean fresh water all the time.

2. Energy: Provides the body system with the power to function. The energy requirement of the pig is supplied by carbohydrates and fats. The main sources of carbohydrates are cereals, root crops and fruits (Table4). Fats commonly used in pig feeds include groundnuts and soybeans oils, among others. The pig requires very small amount of linoleic acid, an essential fatty acid required for the body's normal functioning.

Table 5: Sources of energy

Cereal grains	Cereal processing by-products	Roots and tubers	Fruits
• Maize • Sorghum • Millet • Wheat	• Maize bran • Wheat bran • Rice bran	• Cassava • Sweet potatoes • Yams	• Banana • Jack fruit • Avocado • Pine apple
• Animal fat is also a good source of energy			

3. Protein: Provides the primary blocks for body building and repair i.e meat, collagen, hair and nails. The most commonly used plant and animal protein containing feedstuffs are shown in the Table 5.

Table 6. Sources of animal and plant proteins

Animal protein	Plant protein
• Fish including Mukene • Blood meal • Poultry and fish processing wastes	• Soybeans, Beans • Groundnuts • Cotton seed cake • Sunflower seed cake

4. Minerals: These are the nutrients found in bones. Minerals are required for strong bones and normal body function. There are 13 essential inorganic minerals known to be required by the pig. The minerals required in sizeable quantities are calcium, phosphorus, sodium, and chlorine. Iron is very important to the piglet. The common sources of minerals include: lake shells (Obusonko), bone ash, common salt, brown salt, soil and commercial vitamin-mineral premix. Bonemeal, oyster shell and limestone are the most common sources of Calcium and Phosphorus in pig rations.

5. Vitamins are required for maintenance of normal health. Common sources of vitamins for pigs include green leaves and vegetables Table 6.

Table 6: Common sources of vitamins for pigs	
Name of forage	Local name
Sweet potato vines	Oboke Icok
Elephant grass	Ebisagazi, ebiyat,
Wondering jew	Ennanda
Amaranthus	Dodo, eboga
-	Kafumbe
-	Ekoropot
Others: Vitamins are vitamin-mineral premix	

4.3. Feedstuffs: The Source of Nutrients

Most natural feedstuffs contain more than one nutrient. A knowledge of feedstuffs locally available to the farmer or pig feed producer is therefore most useful. The list of ingredients and their nutrient composition is shown in Table 7.

Table 7. Nutrient composition of commonly used feed stuffs in Uganda						
	Percentage (%)					
Feed stuff	Dry matter	Crude protein	Crude fiber	Calcium	Phosphorus	Metabolizable Energy (Kcal/Kg)
Maize	88	8.0	12	0.17	0.55	3,000
Maize bran	88	9.4	13	0.04	1.03	2,200
Rice bran	88	13.5	6.5	0.06	1.43	3,000
Cassava	88	2.8	4.0	0.30	0.05	3,000
Molasses	75	3.0	-	0.75	0.08	2,330
Millet	88	10.5	2.0	0.05	0.40	1,392
Sorghum	88	9.0	2.1	0.08	0.20	3,250
Fish meal	88	60.0	1.0	0.40	2.53	2,310
Blood meal	88	80.0	1.0	0.20	0.22	1,177
Cotton seed cake	88	40.0	14	0.53	1.20	968
Soya bean meal	88	43.0	6	32.00	0.64	2,800
Bone ash	89	-	-	35.00	18	-
Lake shell	98	-	-	-	-	-

Source: Department of Animal Science, Faculty of Agriculture, Makerere University, 200?

It is important to recognize that growth rate on feeds made from low quality feedstuffs is often less than that obtained on feeds formulated from conventional ingredients as shown in Fig. 13. The farmer must therefore carefully consider the economic benefits of using one feedstuff or the other before using them. The nutrient requirement for exotic breeds reared under Ugandan conditions are given in Table 8.

Table 8: Approximate proportions of feed ingredients to meet pig nutrient requirement for conventional diets		
Nutrient type	Kgs	%
1. Energy Sources	65	73
2. Protein Sources	20	23
3. Calcium, Phosphorus	2	2
4. Minerals, vitamin, salt	1.5	2
Total	89	100

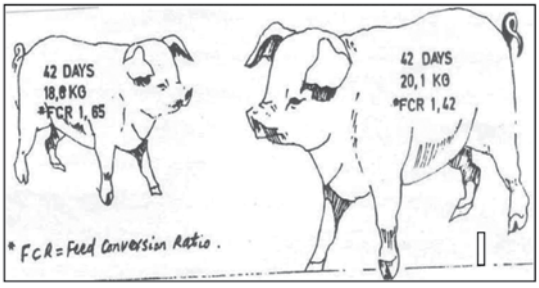

Fig. 13: Good quality feed makes the difference

4.4. Ration formulation

To formulate a ration, the farmer needs information on the nutrient requirement of the animal and the nutrient composition of the feedstuffs available (Table 8). In general, the approximate proportions of feed ingredients to meet pig nutrient requirement, based on own data from Nakaseke and Nakasongola districts are shown in Table 7. This was adapted from standard formulation provided in annex 1.

Table 9. Example of feed formulation for complete diets for pigs in Nakasongola and Nakaseke districts, Uganda (Project source, 2014)				
Ingredient	Inclusion%	Inclusion%	Inclusion%	Inclusion%
	Creep feed.	Weaner feed.	Grower feed.	Finisher feed.
Maize bran	45	44.5	55	57.5
Whole maize	15	16	10	10
Cotton seed cake	11	10	8.5	8
Fishmeal	7	6	8	6
Cassava meal	8	8	8	8
Premix	0.5	0.5	0.5	0.5
Sodium chloride	0.5	0.5	0.5	0.5
Brown salt	0.5	0.5	0.5	0.5
Shells	6.5	7	5	4
Sweet potatoes	6	7	4	5
Total (Kgs)	100	100	100	100

4.5. Care in feeding pigs.

Farmers should be aware of the importance of good feeding to pigs. They should take great care in ensuring that the pigs get timely and adequate quality feeding. A single feed stuff cannot provide all the nutrients required for all body functions of the pig.

A farmer should therefore mix the different feedstuffs in proportions that satisfy the requirement for a particular type of pig (weaner, piglet or Sow). Table 9 has been developed to guide on this matter.

Although expensive, feedstuffs from animal sources are better than feed stuffs from plant sources since they have better balance of nutrients. Whenever possible, a farmer should include both plant and animal feedstuffs in the ration. S/he should whenever affordable supplement local feed formulation with commercial feed if available. The different feed types are summarized below.

4.6. Types of feed types

Pigs need different types of feeds as they develop because their nutritional needs vary with age and stage of production. There are four types of feeds used in Fermented Bed Technology system. These are: Creep, Weaner, Grower and Finisher feeds.

The choice of which type of feeds to give to your pig depends on the stage of growth of the pig. When to use the different types of feeds and their quality characteristics is summarized in Textbox 3.

Text Box 3. Feed types and quality characteristics
Creep feed: **1.** This is introduced to piglets from the third week up to 8 weeks when they are weaned. **2.** Creep feed is given to supplement Sow milk **3.** It must be high in protein (20-22%) and , highly digestible
Weaner feed: **1.** This is fed to pigs after weaning from 2-4 month **2.** It contains 14-20% protein
Grower feed: **1.** This is feed to pigs that are between 4-6 months **2.** It is given to breeding animals (gilts, Sows and Boars) **3.** It contains 14-16% protein
Finisher meal: 1. It is given to animals after 6 months 2. It contains 11-13% protein

4.7. Sources of pig feeds

1. Purchased from a commercial feed mill or agent.

- These are expensive and require transportation to the farm
- There is no guarantee that the feed contains the nutrients in the correct proportions; so care is needed to check for quality.

2. Made at the farm.

- The feed stuffs are either bought from neighbor home or produced within the farm
- It is formulated at home.
- Prior knowledge of what feed stuffs to use and their nutrient composition is required
- A farmer should know the prices of the different feed stuffs; so s/he can use the cheapest
- A farmer has to know how to remove anti nutritive factors that inhibit proper feed digestion/ utilization if they exist

Figure 14 Farmers from Kyabutaika village-Nakasongola district practicing how to mix pig feed stuffs obtained from local sources.

4.8. Practical feeding basics

Plastic feed troughs are used to feed the pigs. Give the pigs feeds amounting to 4% of their body weight daily. Weigh the pigs every seven days so that you can adjust the feed accordingly. The feed should be given in two equal parts: one half in the morning (9am) and the other half in the evening (5pm). The commercial feed should be supplemented with grass and crop residues which provide vitamins and some minerals. Practical feeding tips for different types of pigs is summarized in Text Box 4 and Text Box5.

Figure 15. Women of Basooka Kwavuula Womens' Group in Nakasongola district sprinkle liquid IMO in the pig house to minimize odour and fly populations.

Text Box 4. Practical feeding tips for feeding pregnant and lactating Sows and her piglets
1) Feeding during pregnancy
1. For the first two and a half months of pregnancy the daily allowance for the Sow is 3 Kgs
2. The feed intake should be increased gradually by 0.25 kg in the 11th week of pregnancy through to 0.75 kg in the last week of pregnancy. This is called Steaming up
3. Do not over feed. Fat Sows tend to have problems at farrowing
4. A day before farrowing, cut the feed down by a half to avoid constipation
2) Lactating Sow and her piglets
1. The amount of feed given to a Sow depends on the number of piglets in her litter
2. The basic maintenance ration is 3 kg of Sow meal
3. Add 0.25 kg for every piglet in her litter.
4. As an illustration, if her ration is 3 kg and she has 10 piglets in her litter, her daily allowance will be 3+(10 x 0.25) = 5.5 kg per day
5. Divide the feed in two equal parts. Feed one part in the morning and the other in the afternoon
6. Feed greens and roughage in between the two meals
7. From the 6th until the 8th week of lactation, reduce the daily allowance gradually, so that by weaning she is getting just 3 kg.
8. This gradual reduction helps to dry up the Sow in preparation for weaning
9. Inject piglets with iron on the second or third day after birth
10. Provide creep feed to the piglets 10 days after birth

Text Box 5. Practical feeding tips for feeding pigs at growing and finishing stages
Growing and finishing stages
1. Piglets should average 12 kg at weaning
2. Growing stage is identified as the stage from weaning to about 5 months (60 kg). Such a pig is called a baconer when slaughtered
3. The aim is to maximize lean muscle production and minimize fat deposition
4. Over feeding increases the proportion of fat and this may be un-acceptable to the market
5. The amount of feed will depend on weight of the pig
6. Each pig should receive feed equivalent to 4% of its body weight. For example, if a pig weighs 60 kg, it will get 60 x 0.04 = 2.4 kg daily
7. Since growing animals are kept in groups daily feed is obtained by multiplying the feed per pig by the number of animals in the pen
8. For example, a pen holding 15 pigs of 60 kg body weight on average will require (15 x 60) x 0.04 = 36 kg daily
9. Divide the feed in two equal meals to be given in the morning and afternoon
10. Measure the pigs every 7 days to determine new feed ration corresponding to weight gained the previous week.

Figure 16 An animal production specialist demonstrates how an iron injection is administered to a one month old piglet at Bugaala village in Kapeeka Sub County

5. MANAGEMENT OF PIGS

5.1. Management of the Boar

Developing Boars. Young Boars should be reared in groups so that they can develop normal sexual behavior. Group rearing presents an opportunity for physical contact and interaction with other pigs during development

Feeding. Young Boars should not be underfed, otherwise their libido and fertility will be reduced. Depending on the age and condition, a young Boar should be fed 2-3 kg of Sow and Weaner meal daily

How to use a Boar for service. A farmer can use one or both of the following mating methods

1. Pen mating. In this method, one Boar is reared with a group of 8-10 Sows. The Boar is left to mate with Sows as and when they come on heat. Pen mating requires less labor. The Boar should be removed from the pen once it is confirmed that all the Sows have been served.

2. Hand mating. In this system, a Boar is kept in a separate pen. Sows on heat are taken to it for service. It ensures that each Sow is mated twice and the exact breeding date is known.

A farmer has to know the signs of a Sow on heat such as the following:

1. Aggressively seeking out a Boar
2. Restlessness
3. Vulva swells and reddens
4. Frequent urination and vaginal mucus discharge
5. Mounting others or when mounted it stands still
6. When pressed on the back by the farmer they stand still

5.2. Management of the Sow.

5.2.1. Key points to note

1. A Sow is a mature female pig. They are the basic units in pig production and therefore should be looked after very well. Sows that are efficient in reproduction make profitable pig herd.
2. Well managed Sows reach puberty between 4.5 – 6 months. They should be exposed to a Boar at 4 months. Boar smell and noise is known to induce puberty.
3. Delay serving Sows until they are 7 to 8 months old. Serving young Sows impairs their development and productivity
4. Feed adequate quantities of well-balanced diet to Sows for maximum production and delivery of healthy piglets.

5.2.2. Care before a Sow is served

Prior to serving, a farmer should:

1. Allow her a lot of exercise
2. Increase feed allowance to maximize the number of eggs released. This is referred to as flushing

3. Return to the normal ration after mating
4. Allow them to see a Boar at least twice a day
5. Observe for signs of heat at least twice a day

5.2.3. When to serve a Sow on heat.

The AM-PM rule. The farmer should strictly observe the AM-PM rule below:

1. Sows observed on heat in the morning (AM) should be mated in the evening of the same day (PM)
2. Sows detected in the evening (PM) should be mated in the morning of the following day
3. A Sow should be brought back for a second mating twelve hours after the first mating.

5.2.4. Management during pregnancy

1. Ensure good health by maintaining proper hygiene and administering multivitamins and deworming
2. Provide enough space and keep the bedding moist all the time
3. Do not keep more than 10 Sows in a pen
4. A pregnant Sow must not travel long distance.
5. Avoid excessive feeding which makes them too fat. Fat pigs experience difficulties during farrowing
6. Farrowing is expected 114 +/- 3 (three months, 3 weeks and 3 days) days from when the Sow was mated.

5.2.5. Signs of farrowing

The farmers should observe the Sow for the following signs of farrowing:

1. The Sow becomes restless about 24 hours before farrowing
2. There is a distinct swelling of the vulva
3. The teats are turgid and produce small amounts of milk when pressed
4. The Sow begins to dig a hole in the litter as it builds a nest
5. It lies down and abdominal contractions may be noticed
6. A bloody fluid will come out from the vulva

5.2.6. Management during and immediately after farrowing

Day of farrowing. Many piglets may die at this time. Up to 35% of your pigs born alive may die before weaning. The commonest causes of death at this stage are outlined below. These losses can be minimized by having somebody present at farrowing to address the challenges. Although most Sows farrow on their own, others may need to be assisted under the following circumstances

1. When piglets are born with membranes. Such pigs will not start breathing. To induce breathing, the farmer has to clear the membranes away, massage the chest area of the piglet gently while holding the hind legs
2. Sows may kill the piglets by lying on them. Remove the piglets to safety or give “kiss of life” to the piglet if it has been slept on to start breathing
3. Some piglets may be too weak to suckle or fail to locate a teat. The farmer should show and guide such piglets to a teat.

4. The length of the navel cord may be excessively long. Shorten such navel cord by cutting off a piece, and dip the end attached to the piglet in an iodine solution to prevent infection.

Table 11: Important events in Sow management after farrowing
1. First week after weaning, breed the Sow (put the Sow to the Boar)
2. From 111 days to farrowing, observe the Sow for signs of parturition (farrowing)
3. Two weeks before farrowing, treat for internal and external parasites
4. Provide special care for weak or small or small pigs and large litters
5. Cull Sow at weaning on basis of productivity, temperament and other economic factors
6. Recording of events after farrowing. Use a calendar to show these events. • record the number of piglets born alive and those born dead • Record the number of female and male piglets • After identification, weigh the piglets and record the weight of the litter at birth • At 3 weeks of age weigh the piglets again. Weight at 3 weeks of age gives an indication of the milk producing ability of the Sow and her mothering ability.

5.2.7. Problems related to farrowing and their solutions.

Table 11: Problems related to farrowing and their solutions	
Problems	**Solutions**
1. Lack of contractions of the uterus (uterine motility)	Seek veterinary help
2. Failure to expel the afterbirth (Retained placenta)	Seek veterinary help
3. Abnormal presentation of piglet within the birth canal (Mal-presentation of piglets)	A farmer should reposition such piglets using clean disinfected arm with gloves
4. Nervous or hysterical Sow/gilts. Such Sows/ gilts stand up and lie down during farrowing and may injure the piglets	Piglets should be taken away when they are born and returned later when the mother has calmed down
1.Partial or incomplete absence of milk flow from the mammary glands. This condition is referred to as Agalactia, and may be caused by: 5.1. Painful conditions of the teats 5.2. Anything, which disturbs milk ejection from the udder 5.3. Some form of poison from a non-specific infection	Treat with antibiotics and hormones (e.g. Oxytocin and prolactin). If condition persists consult your veterinary official
2. Inflammation of the udder due to infection by bacteria. A condition called Mastitis. The symptoms are: 6.1. The udder is congested, hot and painful when touched 6.2. Sow may not allow piglets to suckle due to pain 6.3. There may be no milk secretions or milk let down	Control by keeping the pen clean If the animal has a fever it requires an antibiotic injection
3.Inflammation of the uterus due to non-specific infection. This condition is referred to as Metritis and it occurs especially in cases of retained placentas, abortion and dead piglets within the uterus. The signs which are usually observed 2-5 days after farrowing include: 1. Fever 2. Sticky, white-yellow discharges from vulva with foul smell 3. Arched back due to pain when walking 4. Slow and uncoordinated movement	Seek assistance of a veterinarian to: 1. Remove placentas or dead fetus 2. Flush the genitalia with mild antiseptic 3. Insertion of uterine tablets of antibiotics (pessaries) 4. Injection with antibiotics

5.3. Management of piglets.

The points outlined in Table 12 are crucial in the management of piglets. A farmer should therefore follow them closely.

Table 12: Crucial Points in the management of piglets
1. Once farrowing is completed a farmer should make sure all piglets are nursing. Any excess piglets for the number of functional teats should be transferred to another Sow. If there is no other Sow, bottle feed the piglet with cow's milk sweetened with glucose. Transfer at 3-4 days of age while masking odours.
2. Clip the needle teeth, cut the navel cord leaving about 2.5- 3.5cm (1-1.5 inches) of which should be dipped in a 7% iodine solution.
3. After 2-3 days treat piglets for anemia with 2-3ml of injectable iron. Provide creep feed at 7 days of age. Change feed daily. Treat with iron again after 2 weeks.
4. Deworm after 3-5 weeks and then move Sow and piglets to nursery. If litters are mixed in a nursery, litters should not be more than one week difference in age and do not mix more than four litters per pen.
5. Identify the pigs by giving them names (e.g. Tom, Dick, Harry etc) or numbers using tattoos, ear tags and ear notching
6. Wean at 56 days (8 weeks). Remember to remove the Sow from the piglets and not vice versa. Deworm piglets regularly. Spray them for lice and mange mites prior to moving them out of nursery at 7-8 weeks.
7. Replace the Sow after the 6th litter or after 4-5 years of age. If its production is still good, leave it until its production falls below the average of the herd.
8. Seek advice from your extension worker/veterinarian wherever possible.

5.4. Other important points in the management of piglets

5.4.1. Castration.

Male piglets are castrated when they are not to be used as Boars. This makes them docile for easy handling. Castration also removes the male smell from their meat. It is important to seek the services of a veterinarian to castrate piglets.

Castration should be done early before piglets grow to 3 weeks of age because:

- The piglet is small and easy to hold
- At this age piglets recover quickly with little impact on growth
- The piglet is well protected with antibodies

5.4.2. Fostering piglets to a Sow.

This involves giving piglets to a Sow other than its own mother. It may become necessary in the event that:

- A Sow dies during or after farrowing
- A Sow falls sick at farrowing and cannot produce milk
- A Sow produces more piglets than the number of teats she has
- A Sow produces an excessively large litter and has poor milking ability

If there is a Sow that has farrowed within 3 days and has more milk and teats that her own piglets:

- Adjust litter size for the number of functioning teats or milking ability of the Sow
- Move the affected piglets to the foster Sow, before they are three days old
- Make sure they have received colostrum from their mother before transferring them

To ensure that the foster Sow does not recognize and reject the fostered piglets, cover the smell of the piglets by:

- Smearing all the piglets including her own piglets with a strong smelling substance like iodine
- Soaking all the piglets thoroughly in a salt solution
- Observe the foster Sow as you go through this process to ensure that it is not battering the fostered piglets

5.4.3. Weaning.

This is the process of separating the Sow from the piglets or removing the piglets from suckling the Sow's milk. It can be done early (early i.e. 3-5 weeks) or late (i.e. 6-8 weeks).

Under production conditions in Uganda, weaning should not be done early because it requires an expensive diet for the weaners and high management standards, which are a challenge to most of our ordinary farmers.

To avoid exposing the weaners to undue stress, remove the Sow from the farrowing pen and leave the piglets in the pen they are used to for some time. Weaning should be done gradually, probably over a four day period. Cut back the daily feed allowance to just 3 kg. This helps to dry the Sow off conveniently

Split weaning. This is when piglets are weaned in lots. As an alternative, a farmer may practice split weaning as follows:

1. At the end of week five, remove the piglets that are above average in size from the litter
2. Allow the small piglets to suckle for an extra 4-5 days. This gives them a chance to take more milk and add extra weight. They should not be allowed to suckle beyond 8 weeks
3. Split weaning reduces the intensity of suckling and allows a Sow to come back to heat early after weaning

Rebreeding the Sow after weaning. A healthy well-fed Sow will come to heat within 4 to 7 days after weaning. A farmer should observe such a Sow at least twice a day for signs of heat.

5.5. Recommended targets to achieve.

A good farmer should aim to achieve the targets in the Table 13 below

Table 13: Key targets to achieve in piggery management
1. Reproduction rate – Each Sow should produce 10-11 piglets born alive per litter
2. A Sow should have at least 2 litters each year – i.e. 20-22 pigs born alive per Sow each year
3. Survival rate – At least 85% of pigs born alive should be reared to weaning (17-19 piglets weaned per Sow each year.
4. Growth rate – Aim at 90kg live weight in 170 days with a carcass yield of 77% or 500gms/ day over a life time
5. Aim at achieving a food conversion efficiency of 3.5kg
6. Aim at marketing the pigs for slaughter as porkers at the age of 4-6 months when they will have attained market weight 65-100kg
7. Strive to ensure a production life span of at most 5 years for the Sows.

5.6. Monitor the growth of your pigs

5.6.1. Pig weight estimation methods

1. The weighing scale method. A commercial weighing scale is the most convenient and accurate method for recording pig weights. As the animals get bigger, weighing with a weighing scale gets more difficult, especially by women. At an appropriate stage, a farmers should shift to the girth method for weighing mature pigs.

2. The girth and length method. This is accurate to within 3% of actual weight. To estimate the weight of the pig in pounds:

1. Measure the heart/girth in inches (marked G)
2. Multiply this measurement by itself (G^2)
3. Measure the length of your pig (ears to beginning of tail) in inches (marked L)
4. Then multiply the heart/girth by the length of your pig (ears to beginning of tail) (G^2XL)
6. Divide the product (G^2XL) by 400 and you will have the approximate weight of the pig in Pounds. Then convert to kilograms by multiplying by 0.4536
7. Summary: **Weight (lbs) = {(girth)² x length}/400**

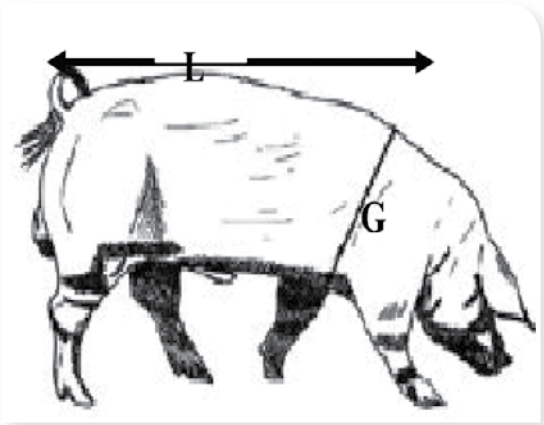

Figure 17 a: Measuring growth (G) and length (L) of a pig.

Figure 17 b: A farmer takes girth measurement of the pig to estimate its weight.

3. The girth only method – metric. A farmer can use the girth only method to get the approximate weight of the pig. If we take the girth measurement in cm the weight (kg) will be calculated by: **Weight (kg) = ({4.07 x girth} - 333)**

To convert into metric: 1 pound =0.453.59kg; 1 inch is 2.54 centimeters.

5.6.2. Measuring growth of your pigs

Measure the growth of your pigs regularly. This is important so that you know how the pig is growing. Give the pig adequate feed and detect any signs of ill health and treat it.

A farmer should have a record book to capture information such as weekly weight on individual pigs, amount of feeds given, diseases and pest incidences, for each pig. The record book should also indicate how the feed was split between the morning and evening schedules.

Take measurements (girth method or weighing scale) of the pigs weekly. Plot the growth of the pigs on a convenient surface so you can spot out any slowdown.

Figure 18 Members of Basooka Kwavula Womens' Group in Nakasongola District take measurements of the growth of their piglets in the polythene bag).

5.6.3. Growth performance of your piglets

Good record keeping can make you see how your pigs are growing, so that you can correct any setbacks. Figure 19 shows growth performance of piglets from innovations farm of St Kizito Farmers' Group in Kakooge Sub County Nakasekke district in 2014.

Rate of weight gain varied from 1-7 kg per week depending on the piglet. The male piglet KGE 10K put on 3-4 kg but sometimes up to 7kg of weight per week. Therefore under good management practices, piglets reared using FBT are capable of putting on 5-7kgs of weight per week, resulting in huge gains in profit and time.

If any pig appears to slow down, examine the pig in detail to find out the cause of the slow growth. If necessary feed the pig separately. Treat the pig promptly if there is any signs of ill health. In this case poor performers were isolated and fed separately to minimize bullying for feeds by bigger ones.

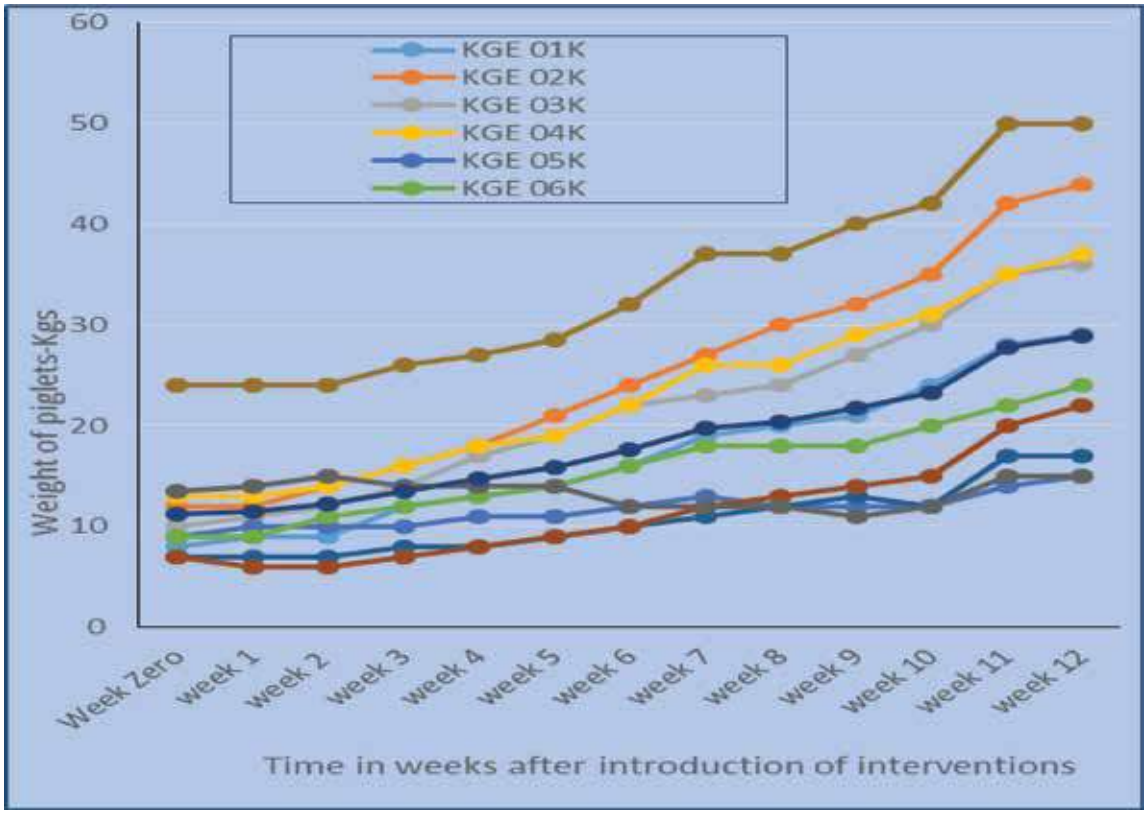

Figure 19 Growth performers of piglets at St. Kizito Innovations Center Nakaseke district, 2014

6. HEALTH AND DISEASE CONTROL

6.1. Introduction

Diseases and parasites are a major cause of deaths and loss of condition in pig production. An outbreak can have disastrous consequences. A farmer should thus regard disease as a potential economic threat. To minimize this threat, the farmer should keenly monitor the pigs for any signs of disease, maintain close contact with veterinary personnel for advice and emergency cases, and report suspected disease conditions early for quick diagnosis and treatment.

A healthy pig and diseased pig will always show signs of good or ill health (Table 14). A pig can be sick from a bacterial, viral diseases and parasites. To know whether a pig is sick or healthy a farmer should always look for signs listed in Table 14 below.

Table 14: Distinguishing signs of a healthy and sick pig

A healthy pig will:	A sick pig will show:
1. Move about steadily	1. Loss of appetite
2. Breath steadily and easily	2. Difficult and abnormal breathing
3. Eat well	3. Dull animal
4. Have a loose shiny skin	4. Defecation of excessively hard or watery feaces
5. Have bright eyes and moist nose	6. Feaces are blood stained or contaminated with worms
	7. High temperature (fever) and abnormal heart beat
	8. Rough hair coat and loss of condition
	9. Coughing, lameness, diarrhea, nasal discharge, abortion and skin discoloration
	10. Rubbing against hard objects (signs of irritation or itching)

6.2. Types and main diseases of pigs in Uganda

A basic knowledge of the main diseases which may affect a pig herd is necessary so that the farmer can diagnose the condition and implement control measures as quickly as possible. Some of the common pig parasites and diseases in Uganda are summarized in Table 15. Some highlights on the most important ones are given below:

Table 15: Major disease causing organisms among pigs

Major Parasites	Major viral diseases	Major bacterial diseases
1. Mange mite (common local name)	1. African Swine Fever	1. Swine dysentery
2. Lice (common local name)	2. Gastroenteritis	2. Swine erysipelas
3. Jiggers (common local name)	3. Foot and Mouth disease	3. Anthrax
4. Fleas (common local name)		4. Pneumonia

6.3.Controlling diseases in pigs

6.3.1 Prevention is better than cure.

The saying *"prevention is better than cure"* is very relevant in the pig industry. A farmer should strive to prevent disease outbreak than struggle to cure it. A clean, sanitary environment provides the best prevention for internal and external parasite which can be serious problems. Confinement prevents pigs from contaminated fields and dirty lots.

Some drugs e.g. wormicides, when properly used, aid in elimination of parasites. Antibiotics also protect pigs against disease proliferations and reduce disease outbreaks. They can also promote growth in pigs when given at recommended levels. For diseases that can be prevented through vaccination, a Veterinarian should be contacted to provide such services routinely.

Types and diseases of pigs in Uganda

1. Parasites and worms:

These are organisms which live on and obtain food from the body of another, known as the host. They can live on the body (external parasites) or within the internal tissues and organs (internal parasites) of the animals.

- **External parasites:** mainly cause irritation to the skin surface, often leading to wounds and increased susceptibility to other infections. Some of the common external parasites are flies, ticks, lice, mangemites, etc.
- **Internal parasites:** are more common to pigs on free-range.. An example is the round worm *(Ascaris Lumbricoides)* which causes lots of damage to pig herds. The round worm can grow up to ***300mm*** long and 6mm thick in the small intestine. Heavy infestation leads to inherit in piglets, weakness and loss of weight. The other harmful worms include tapeworms, e.g. *Taenia Solium,* which has the pig as its intermediate host, while the adult worm lives in man. Pigs become infected by picking up eggs from human faeces and the larvae then encyst in the pig's muscle.

To prevent worm infestation in pig herds, avoid contaminated water and feeds. Deworm with broad spectrum antihelminthics as recommended by your Veterinarian.

2. Viral diseases.

- **African swine fever:** This is also the most contagious and deadly in Uganda. It can cause up to 100% mortality within a very short time. The disease is spread by bush pigs and warthog which are carriers of the virus though are themselves immune to the disease. Infection occurs by contact with other sick pigs or through contaminated food or water. There is no effective vaccine as at now. Infected pigs should be killed and properly disposed of.
- **Swine Dysentery:** This is a highly contagious and acute viral disease of pigs and is frequently fatal. The spread is by animal contact, contaminated urine and faeces or other body secretions. There is no effective treatment except vaccination programs to be instituted if there is danger of pig cholera infection. Avoid contact with infected animals.
- **Swine Influenza:** This is a respiratory disease that is highly contagious, caused by the influenza virus. Stress due to rapid changes in temperature triggers off the disease. Mortality is normally low but it is of great economic importance due to stunting and reduced live weight gains. There is no treatment or preventive vaccine available, but good farm management and avoidance of stress can limit outbreak.
- **Transmissible Gastroenteritis (TGE):** This viral disease is characterized by acute diarrhea, vomiting and early death in young piglets. The disease can also affect older pigs but rarely results in death. There is no known effective treatment, but infected pigs can be isolated or killed and buried. The herd is normally immune after infection.

3. Bacterial diseases.

- **Swine dysentery:** This is the most common cause of death in baby pigs, especially within the first ten days. The bacterium, commonly found in the intestinal tract, causes the disease. It produces toxins which stimulates a massive fluid loss into the small intestine leading to scours, dehydration and death.

  To control it a farmer should avoid stressful condition for pigs; immediately give oral administration of antibiotic to sick pigs; and ensure good farm management and proper feeding of balanced ration. Piglets must be given colostrum.

- **Salmonellosis:** It is a disease of the intestinal tract caused by Salmonella bacteria. Pigs of about two months are most affected. Heavy worm infection triggers it off. To control it a farmer should ensure good management, practice high level of hygiene and sanitation and provide antibiotics and sulphur drugs in feed.
- **Erysipelas:** This is caused by a bacterium agent which lives in the soil. Pigs can pick up the agent from soil or by animal contact and even humans. In the acute form, sudden death is common. Routine vaccination programme is recommended and once the disease is diagnosed treat immediately with antibiotics.

6.3.2. Treatments of diseased pigs.

Sick pigs suffering from any of the diseases mentioned above can be treated and cured through use of veterinary drugs and other measures. The main diseases, their symptoms, treatment and control measures are summarized in Table 16. A farmer should always consult beforehand, his or her nearest veterinary personnel for better diagnosis and recommended treatment

Table 16: Common diseases of pigs

Disease	Clinical signs	Treatment	Control
African swine fever	Fever, dullness, loss of appetite, huddling together, incoordination, coughing, discolouration of skin to bluish, fluid eye and nose discharges, vomiting and diarrhoea	Attempt control measures only	Restrict movement of pigs or meat from affected areas. Slaughter of all pigs on the affected farm followed by disinfection.
Worms	Poor performance of the pigs with low growth rate, coughing in case of lungworms	Antihelmintics like Levamisol and Piperazine	Deworm pigs every three months after weaning
Mastitis, Metritis and Agalactia (MMA)	Sow fails to release milk after farrowing. The udder may be swollen and painful	Use antibiotics and oxytocin	Good hygiene in the pig pen
Piglet anaemia	Signs appear mostly in piglets of 3 weeks of age, pale mucous membranes and skin, dullness and diarrhoea	Give ferrous sulphate injections or oral formulations	Put red soil in pig pen or give iron injection to young piglets
Foot and Mouth Disease	Fever and vesicles on the coronate and sometimes on the lips and tongue	Advisable to institute control	Slaughter of pigs in the affected houses Vaccination
Swine erysipelas	Sudden death, loss of appetite, red and bluish appearance of the skin and ears. Diamond shaped skin lesions which may become necrotic	Penicillin is very effective and is the drug of choice	Clean the pen and disinfect. Treat the in contact pigs with penicillin.
Mange	Itching and scratching especially at mid-day, scabs on the skin, wrinkling and hardening of the skin, loss of the hair and shaking of the head if the ear is affected	Use Ivomectin (Ivomec), tactic at recommended dosage levels	Treat the pigs whenever they are entering a new pen which has been cleaned and disinfected
Lice	Lice will be seen in the folds of the skin especially in the neck and at the base of the ears	Use insecticides like Ivomec and tactic-acaricide	Routine spraying with tactic or treatment with tactic
Parakeratosis	Similar signs to those of mange but with no itching and scratching	Give zinc formulations like zinc carbonate or zinc sulphate	Ensure that there is enough zinc in the diet.

7. GOOD RECORDS KEEPING

7.1. Importance of good record keeping in pig management

It is a good management practice for a farmer to keep records. A farmer who does not keep records cannot trace where he/she has been or where he/she is going. The farmer cannot know the financial position of the enterprise or how much investment is going into the enterprise.

By keeping records, a farmer is able to:

1. Track the performance of individual pigs; identifying performers from those that have problems
2. Trace how much is being spent and earned by the enterprise
3. Identify animals for use as Sows and Boars (breeding stock)
4. Compare the performance of the enterprise with that of other farmers
5. Identify which pigs have health and fertility problems
6. Identify weaknesses in management and take corrective action.
7. Compare the performance of pigs with standard production goals.

Standard production goals or targets

A pig farmer should strive to achieve the following goals:-

1. 90% of the sows served becoming pregnant
2. Producing at least 12 piglets per litter
3. Piglets weighing 1.3Kg or more at birth
4. Piglets weighing 11Kg or more at weaning
5. Daily weight gain of at least 0.5kg after weaning

7.2. How to keep records.

There are several types of records which should be kept by a pig farmer. These are briefly outlined below. By keeping these records a farmer can know whether he or she is meeting his production goals or target outlined above. A good farmer should keep the following records.

7.2.1. General record book.

This is a book where a page is assigned to each pig or litter. Keeping this record makes one know how individual pig in the farm is performing. Table 17 is a suggested layout to capture information about individual Sow performance. Please follow it.

Table 17. Sample sheet of a page in a record book for piggery management	
Sow No/Name	
Date Born	
Boar Used	
Date	Description

7.2.2. Sow record card.

This is a card where vital information on the breeding performance of a pig (a Sow) is kept. The Card is kept safe in a file. The information on the file is useful in monitoring performance of the animal and breed selection. A sample example of a record Card for a Sow is shown in Table 18.

This should show:

- Sow number or name
- The Boar used for service
- Date of farrowing
- Number of piglets born (dead and alive)
- Total weight of piglets at birth, at the end of three weeks and at weaning
- Number of piglets that die before weaning
- Dates and nature of illness and treatment

Table 18: A Sample Sow Record Card					
Sow No./Name:		Boar Used:		Date served:	
Farrowing record					
Farrowing date		No. born alive:		Female:	
		No. born dead:		Male:	
Litter weight and Deaths Record					
Piglet weight record			Piglet deaths record		
Growing stage	Date	Total weight	Date	Number (F/M)	Cause
At birth					
3 weeks					
Weaning					
Sow and litter health card					
Date	Diagnosis/Notes				

7.2.3. Growing or finishing record card.

This is used to capture information on groups of pigs kept together such as in a Pen, or similar environments. This record should show:

1. Pen number
2. Weaning date
3. Name or number of grower/finisher
4. Number of growers/finishers in a pen by sex
5. Weekly body weights
6. Total daily feed allocation
7. Dates and nature of illness and treatment

7.2.4. Boar record card.

This is a card that keeps records on Boars and their performance. It helps the farmer to know whether the Boar is doing well or not and to take appropriate measures to correct anything that is going wrong. This should show:

1. Boar number or name
2. Date of birth
3. Breed
4. Sow number or name served by Boar
5. Date when Boar served that particular Sow
6. Number of piglets born (dead and alive)
7. Number of piglets weaned
8. Dates and nature of illness and treatment

Table 19: A sample Boar record card

Boar No./Name	Date of Birth	Breed:	
Sow No./Name served	Date of service	Number of piglets Born	Number weaned
Health record			
Date	Diagnosis/Notes		

7.2.5. A Diary.

A diary is important to help the farmer capture important events on the farm. It is not recommended to use memory as a method of record keeping. This method is good when a small number of animals are kept and even then, a farmer my forget the information or lose it all together with time.

A Diary should show all events and activities that happened on the farm and should contain sufficient information for all important events relating to a pig or litter. A Diary is efficient when:

1. One person is responsible for the entry of information
2. Records are entered as soon as an event takes place
3. All records are kept in one place
4. A filing system is used
5. Records are written on a regular basis
6. Averages and totals are calculated every month

7.2.6. Keeping health record.

Health record is important because it gives the farmer some idea of the status of disease situation on the farm. It also gives an idea on the health status of individual animal and spending on treatment.

The information also helps the farmer to decide which animal to eliminate in order to avoid further disease spread to others or minimize spending on disease control.

A farmer should record down all dates and facts relevant to an animal's health. This is to:

1. Remind you when to repeat a treatment.
2. Remind you exactly how a disease progressed and how animal responded to treatment
3. Help any veterinarian who visit the farm and wants to know the health history of the animal

7.2.7. Financial records.

Financial records are important because it shows you whether your business is making profit or not. Knowing this information helps the farmer in many ways:

1. It helps the farmer to improve on his or her strategy for profit maximization or loss reduction.
2. It also helps the farmer design a strategy to expand the business or access funding from financing institutions.

Financial record keeping is a **MUST** for every enterprising farmer. Each farmer should keep records of all costs incurred and income generated from the business. This record can be captured using a simplified Cash Book (Table 20)

Table 20. A Cash Book Record

Money received (Receipt)			Money spent (Payment)		
Date	Item	Amount	Date	Item	Amount
	TOTAL				
	BALANCE				

7.2.8. Preparing a summary of records

1. This should be done on a quarterly basis
2. Calculate totals and averages
3. This will help in identification of weak areas in the production process for corrective action
4. It will help identify price trends for future planning
5. Calculate a summary of income and expenditure

7.2.9. Benefits of good record keeping.

Good record keeping can make you see how your pigs are growing, so that you can correct any setbacks. This is well illustrated in 5.6.3.

8. PORK: QUALITY AND MARKETING

8.1. Markets and marketing.

The ability to market pigs at the right time is a major determining factor to the success of commercial pig production. Ugandans eat a lot of pork. Therefore there is always ready market for pork in any part of the country. The bulk of pigs in Uganda are sold live. There are basically, three types of market outlets for pigs or pork in Uganda, as listed below:

1. **Private Sales:** These involve selling of one or more pigs to local consumers, other pig producers, butchers or middlemen. The pigs are sold live and prices are normally subject to bargaining. This method is most common among rural small-scale producers. It has the advantage of being the simplest. To ensure good prices for pigs, farmers are advised to market their pigs in groups, associations or cooperatives.

2. **Direct Sales to Butcher:** Here, the pigs are sold to the butcher directly by the producer without middle men. The method is more applicable to the large scale producers. Fluctuations in prices can be serious problem in this system of pig marketing. Quality Cuts Ltd and Nalakulongo Pork Abattoir offer huge markets for pork.

3. **Contract Sales:** Under this system, contract is entered into with an abattoir to supply a certain number of pigs over a period of time at a set price. This condition allows the producer to plan his production strategy over a fairly long period of time. Both Quality Cuts Ltd and Nalakulongo Pork Abattoir offer such opportunities.

8.2. Carcass and meat quality.

Pork quality standard in Uganda is not yet well developed. However the commercial pork industry discriminates quality based on the considerations below. Farmers are advised to aim at producing pigs with highest [pork quality. If well managed FBT produces lean and high quality pork.

1. **Conformation** - This refers to the shape of the carcass. It is desirable to have a carcass that is well developed in the more valuable meat areas such as the ham and loins.

2. **Lean Content**- The amount of lean meat is a very important quality factor.

3. **Fattiness**- Too much fat in pork is generally not valued. Fat thickness can be measured even in the live pig and is one of the criteria often used in selecting animals for breeding.

4. **Colour and Texture** - very pale watery meat is undesirable. This can occur and is associated with a condition known as pale soft exudate (PSE) which can result from a genetic cause or poor pre-slaughter handling.

5. **Flavour and Odour**- Off-flavour and odours can arise from feeding high fishmeal diets or rancid fats. Boar stench can also occur in the meat of entire males.

8.3. Meat Hygiene.

1. Meat hygiene is very important in piggery enterprise. It is important to maintain high sanitary conditions when slaughtering pigs because the products of slaughtered animals provide an ideal breeding ground for bacteria.
2. Where possible, always provide for meat inspection in order to ensure that only healthy meat is approved for sale to the public. This allows you to sell your pork anywhere without any fear.
3. Meat slaughtered on the farm should also be wholesome and measures taken that no disease is circulated from the dead to the live animals.

9. CASE STUDY: BEGINNING A PIG FARMING ENTERPRISE USING FBT

9.1. Introduction.

Mr Simon Ogwal, a pig farmer got the interest to engage in pig production as a result of my exposure to the challenges faced by pig farmers in Nakaseke and Nakasongola district in the cattle corridor of Uganda. The challenge communities were facing in piggery production were poor breeds; traditional feeding and husbandry practices; infestation by worms and poor disease management; although the demand for pork and other pork products is rapidly expanding.

As a project manager at Africa Innovations Institute working for a Rockefeller Foundation funded project entitled *"Securing livelihoods in the cattle corridor of Uganda"*, I was part of a team tasked with the duty of identifying a climate smart technology that could be adapted to the situation in the cattle corridor and use it to boost pig production as one of the strategies to realize food and income security. A literature review exercise zeroed on the Deep Liter System (DLS) also commonly known as Fermented Bed Technology (FBT), a technology used by South Koreans. We introduced and piloted the technology with farmers in Nakaseke and Nakasongola districts. We started in 2013.

In order to walk the talk and put my money where my mouth is, I made the decision to introduce the same technology on my farm at the same time it was being introduced in the project area. I wanted to share my knowledge and experience with the farmers first hand and motivate them to embrace the technology.

To start piggery production using FBT, I made plans to acquire more information about the technology, search for locations where it was being used and draw a business plan to start commercial pig production. I used the internet google search engine to learn about FBT and visited a nearby demonstration site in Mukono town to familiarize myself with the blueprints of the housing structure. Then I consulted my animal production specialist friend about pig production and sought his consent to provide technical backstopping once the plan fell in place. Fortunately, he agreed to help me since he was also engaged in the same enterprise.

9.2. Starting the enterprise.

Before I could begin the enterprise, I put my mind in the position of an entrepreneur who was presented with an opportunity for funding in pig production and all that one needed was a winning business proposal. I used this approach because my business partner wanted a written document to justify our decision to invest part of the proceeds from the tree seedling business to pig production.

I prepared a 15 page business proposal containing information about the current state of pig production in Uganda, a SWOT analysis of the pig value chain in Uganda, details of FBT (breeds, feed management, structure, IMO, bedding materials, advantages and benefits of FBT) and its costs, projected cash flow under different production scenarios and a logical framework. I shared the proposal with my partner who has a background in financial accounting and auditing. I also shared it with a friend who has a background and experience in agricultural economics. After carefully reviewing and making some changes to the proposal, my partner gave the green light for the enterprise to begin.

9.3. Executing the proposal.

9.3.1. Identifying breeder stock and building FBT structure.

Using the same contacts that supplied breeding Sows for the *Securing Livelihoods* project, I was able to identify four two- months pregnant Sows to begin with as our breeding stock. Each Sow's history was looked at in order to select the Sows with excellent mothering qualities, having at least 12 teats and whose liter survival after three weeks was 90%. A cross breed of Landrace and Comborough was selected. Once booking was made, I started excavating four pits at my farm in Bukerere-Seeta, Mukono district. Each pit that was dug to a depth of 100cm was meant to house one Sow and her liter of 7-12 piglets up to weaning. A wall was erected around each pit, plastered and support columns erected to provide one roof over the four units (Figure 1).

Figure 20 four unit FBT piggery housing structure before plastering of walls was done.

9.3.2. Cost of constructing one unit.

Table 1 below gives cost of erecting one unit of the housing structure. Structures built using clay bricks last longer and provide better protection for the animals, so we decided to go for that.

Table: 21. Cost of constructing one 4m x 4m IMO piggery housing unit				
SN	Item	Quantity	Unit Cost (UGX x 000)	Total Cost UGX (X 000)
1	Clay bricks	2,000	0.20	400
2	Cement	10 bags	30	300
3	Sand (3 Ton truck)	1	200	200
4	Treated Eucalyptus poles	10	15	150
5	Timber (Assorted)	30 pieces	9	270
6	Nails (Assorted)	10Kgs	6	60
7	Iron sheets (G-32)	20 pieces	18	360
9	Wire mesh	20 pieces	20	400
10	Labor[1]	1	500	500
11	Bedding (Fine saw dust)	60 bags	2	120
12	Table salt	10Kgs	1	10
13	Lime	4Kgs	1	4
14	IMO	2Kgs	50	100
15	200 liter plastic drums	2	70	140
16	Transport	1	200	200
17	Miscellaneous expenses		284	284
	Total			3,498

Labor[1] = digging pit, masonry work and roofing

9.3.3. Preparing and fermenting the bed.

When the walls of the units were plastered, we filled the pit up to 70cm with different bedding materials as follows: dry maize stalk up to 30cm, mixture of 60 bags of fine saw dust- (excluding that from pine tree) with100kg of red soil, 10Kg of builder's lime and 10Kg table salt making up the remaining 40cm. Then we cultured a solution containing indigenous micro-organisms (IMO) for 6 days (Fig 20). To culture the IMOs, I made up 200 liters of water in a plastic drum, added 20 table spoons of solid IMO, and 5 kgs (or scooped 40 handfuls) of pure maize bran to the drum and stirred the mixture thoroughly until a uniform suspension was achieved. I covered the drum with a mosquito net to protect it from insects and contamination. I incubated the mixture for seven days.

Figure 21 Mr. Jingo Francis, stirring solution of Indigenous Micro-organisms before sprinkling it on the bedding materials. The use of plastic materials promotes hygiene because they are easy to wash.

On the seventh day, I sprinkled 150 liters of the liquid IMO on to the litter and thereafter mixed and turned it thoroughly using a combination of hoes and garden forks. I only mixed the first 30cm of the litter with the liquid IMO until a moisture content of 60% was achieved. I did this daily for 10-14 days before the breeding Sows were introduced. Fermenting the bed for two weeks was meant to raise the temperature of the bed to 60^0C. This temperature was needed to provide warmth to the sow and her liter and also enhance the activity of microbes in the bed. I kept the balance of 50 liters of IMO in the plastic drum as a starter culture for future use as and when necessary. We repeated treating the bed with IMO weekly as advised by the experts.

9.3.4. Introducing the breeding Sows.

I transported the breeding Sows from Gayaza Township to my farm early in the morning on a cool day. I had read that movement of the pigs on a hot and sunny day would make them die from heat stroke. I ear-tagged each sow with a plastic ear tag for easy identification and record keeping. My Veterinary doctor also injected them with iron and multivitamins. I introduced the Boar six months later to continue production.

Figure 22 A recently introduced breeder stock receiving a multivitamin shot. Extreme right is a drum containing solution of Indigenous Micro-organisms.

Table 22a: Production of piglets farm breeding stock at commercial							
1st litter							
	At birth			3 weeks later			
Name of sow	M	F	T	M	F	T	% survival
STS01	8	3	11	7	3	10	91
STS02	7	3	10	7	2	9	90
STS03	5	2	7	0	0	0	0
STS04							
Total	**20**	**8**	**28**	**14**	**5**	**19**	

Table 22b: Production of piglets farm breeding stock at commercial							
2nd litter							
	At birth			3 weeks later			
Name of sow	M	F	T	M	F	T	% survival
STS01	6	6	12	4	5	9	75
STS02	6	4	10	5	4	9	90
STS03	5	2	7	5	2	7	100
STS04							
Total	**19**	**12**	**29**	**14**	**11**	**25**	

Table 22c: Production of piglets farm breeding stock at commercial							
3rd litter							
	At birth			3 weeks later			
Name of sow	M	F	T	M	F	T	% survival
STS01	7	5	12	5	3	8	67
STS02	8	4	12	5	3	8	67
STS03	7	2	9	1	1	2	22
STS04	6	4	10	6	4	10	100
Total	28	15	43	17	11	28	
Overall survival of piglets							82

Figure 23 A breeder sow and her three week litter of piglets. To achieve such impressive growth, the sow was given 0.25kg of extra feed for each piglets she was suckling

9.3.5. Capacity building.

I used the period between delivery of the pregnant Sows and time of their littering to acquire as much information as I could regarding FBT and trained farm workers about management of bedding material, pregnant Sows, piglets, feed and feed management and record keeping.

9.3.6. Production of piglets.

After one month on the farm, the four Sows produced liters at different times. This occurred because the farmer who sold them did not keep records of date of serving. The records of the liter size are indicated in Table 2a-c above.

9.3.7. Sales.

All the males were castrated for easy management and sold as indicated in the table below. I got about UGX seventeen million. Some of the proceeds from the above sells were used for expansion of housing structures and introduce water nipples in some units. Three more units were built (Fig 5) to house a boar and more pigs as the business grew. I can pride myself of this money every six months. That is why I love pigs and shall devote my life for them.

Table 23. Sale of piglets from commercial farm

Litter	No. of animals	Average carcass weight (Kg)	Total carcass weight	Price per Kg	Amount
1st litter	14	56	784	7,000	5,488,000
2nd litter	14	63	882	6,500	5,733,000
3rd litter	17	53	901	6,500	5,856,500
Total					**17,077,500**

Figure 24 Part of the new extension. In the middle of the forefront is the planned unit for the boar. At the extreme left and right are the units for other pigs

9.4. Challenges which I met.

At school I was told that there is no business without challenges. Therefore for this business, I had to encounter and deal with a lot of challenges since I started operating it two years ago. The main challenges I faced are outlined below.

9.4.1. African Swine Fever (ASF) outbreak.

Ever since I started operating this farm in 2014, I had witnessed no ASF outbreak except January 2016 where it claimed a breeding boar and three pregnant Sows. I was devastated but I had no option but to accept the loss and prevent any further happening of the same. It is hard to pin point the source of infection because the bio-safety protocols at the farm are high. A veterinary officer and the farm worker suspect the virus was introduced by flies found on intestines of an infected pig slaughtered in the neighborhood. I think I sustained minimal loss at the farm because all my pigs live in different compartments in the housing structure.

We also maintain foot baths at the entrance of each unit to minimize chances of disease introduction to the units. To stop the spread of the virus, I suspended the inclusion of all animal proteins in our pig feed formula. We also stopped including silver fish in our feed formulation. We replaced these with palm kennel and ground roasted soya flour. We also sprayed the walls of the units with VIRUKILL to kill off any viruses.

9.4.2. High cost of feeding.

At the start of the business, the cost of feeds were high because a high proportion of the animal feed formula constituted maize bran (up to 70%). The cost of maize bran is variable depending on the season. In 2014, maize bran was readily available and cheap but from the beginning of 2015, the availability of maize bran was inconsistent and the price kept soaring.

Figure 25 An animal production specialist, the farm couple measuring and tagging piglets at the farm. Pigs are measured weekly to determine their average weight gain. Each pig is given daily feed equivalent to 4% of its weight (Kgs)

According to feed mill operators, the price of maize bran is soaring because well-established maize dealers from Kenya and South Sudan are exporting whole maize grain to these respective countries. Without any value addition done in the country, there is no maize bran left for the animal industry in the country.

We had to find a cheap alternative source of carbohydrates to reduce the proportion of maize bran in the feed formula. We chose to use wheat bran and included it in the new fatteners feed formula. There are more than five wheat processing facilities in Kampala. The proportion of maize bran is now 11% while that of wheat bran is 64%. The other ingredients (silver fish, white and brown salt, shells, cotton seed cake and premix) are included as well, but in different proportions depending on the stage of growth of the pig.

The other alternative feed given to the Boar and Sows is brewer's waste (spent yeast grain) bought from a local brewery located at the source of the Nile in Jinja. It is a cheap feed intended to prevent the Sows and Boars from getting obese. The pigs are also given soar milk to drink daily. Two liters of soar milk are mixed with three liters of water.

9.4.3. Tiresome routine of providing clean water.

The farm worker was always troubled about the task of giving large volumes of water to the ever expanding pig population. To solve this challenge, the farm installed automated water nipples in six of the nine units.

9.4.4. Marketing farm products.

The market for pork in Uganda is very segmented and challenging. We conducted a market feasibility survey to identify and quantity the potential market for the pigs. Two abattoirs and three pork processing facilities were identified. I made contact with each of them to acquaint myself with their volume, procurement, distribution, payment and quality control terms and conditions. The farm is making arrangements to meet all the terms and conditions of at least one pork processing facility. All the pigs are currently being slaughtered at one abattoir and the carcasses sold to middlemen who distribute them to major hotels, restaurants and retail outlets (pork joints). Compost after fermenting the beds is sold to nearby farmers. We also use some to fertilize our banana plantation.

9.5. Future plans.

FBT is an excellent technology for pig production. We at the farm plan to continuously expand our operation, apply for a license to operate a slaughter slab so that it can supply good quality carcasses to pork processing outlets. The long term plans involve making pork sausages and training interested farmer groups in pig production using fermented bed technology.

9. LITERATURE CITED

1. AfrII, 2013. Securing livelihoods in the cattle corridor of Uganda: A narrative report on detailed progress made in achieving year 1 project milestones and deliverables for the period October 1, 2012 – September 30, 2013, Grant No 2012 CSD 210, Africa Innovation Institute, Kampala, Uganda, 9th November, 2013, 91pp
2. AfrII, 2014. Securing livelihoods in the cattle corridor of Uganda: A narrative report on detailed progress made in achieving year 2 project milestones and deliverables for the period October 1, 2013 – September 30, 2014, Grant No 2012 CSD 210, Africa Innovation Institute, Kampala, Uganda, 9th November, 2013, 46pp

3. Anonymous 2011. User Guide on Pig Husbandry. August 2011. National Agricultural Advisory Services (NAADS), Ministry of Agriculture, Animal Industry and Fisheries, Kmapala. 12 pp

3. Food and Agriculture Organization of the United Nations, 2009. Farmer's Hand Book on Pig Production (For the small holders at village level). FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy. Pp. 77.

4. Ikani I.E. and I.I Dafwang 1998. Pig Production Technology for Piggery Farmers. Extension Bulletin No. 25 Livestock Series No.1. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria, Nigeria.

10. ANNEXES

Annex 1

Table 21. Example of standard feed stuff formulation to make complete pig diets in Uganda (%)			
Ingredients	Creep	Grower	Sow and weaner
Maize bran	70.5	69.7	67.6
Fish meal	10.5	7	5.4
Cotton seed cake	14	17.5	20.3
Lake shells	3.5	4.5	5.4
Bone Ash	0.7	0.7	0.7
Salt	0.4	0.3	0.3
Vitamin mineral mix	0.4	0.3	0.3
Total	100	100	100

Annex 2: Performance Standards of Exotic Pigs

No.	Performance Measure	Unit	Performance Level		
			Excellent	Average	Poor
1	Pregnancy rate	%	Over 85	75-85	Under 75
2	Farrowing rate	%	Over 85	70-85	Under 70
3	No. of live pigs born per litter:				
	Gilts	no	Over 9.5	7.5.9.5	Under 7.5
	Sows	No	Over 10.5	8.5-10.5	Under 8.51
4	Still born/litter	No	Over 0.8	0.8-15	Under 15
5	Average birth weight	Kg	14.20	1.1-1.4	Under 1.1
6	Pigs weaned/liter farrowed:				
	- Gilts	No	Over 8	6.5-8.0	Under 6.5
	- Sows	No	Over 8.5	7.0-8.5	Under 7.0
7	Weaning percentage	%	Over 90	80-90	Under 80
8	Average weaning weight:				
	- 3 weeks	Kg	Over 5.4	4.0-5.4	Under 4
	- 4 weeks	Kg	Over 7.3	50.-7.3	Under 5
	- 5 weeks	Kg	Over 9.0	6.4-9.0	Under 6.4
	- 6 weeks	Kg	Over 11.3	9.0-11.3	Under 11.3
9	Average daily gain				
	- Birth to market	kg	Over 0.57	0.45-0.57	Under 0.45
	- 18kg to market	kg	Over 0.64	0.54-0.64	Under 0.54
10	Age of 104kg	Days	Over 182	182-227	Under 227
11	Feed efficiency for the herd:				
	- Farrow-to-finish	Kg feed	Under 18	1.8-1.9	Under 1.9
	- Farrow-to-feeder	Kg gain	Under 2.0	2.0-2.3	Under 2.3
	- 18kg-to-market		Under 1.5	1.5-1.7	Under 1.0
12	Loin muscle area @104kg	Cm^2	Under 38.4	30.3-34.8	Under 30.3
13	Fat depth 10^{th} @104kg	cm	Under 2.3	2.3-3.3	Under 33
14	Average back fat @194kg	cm	Under 28	2.8-3.6	Under 3.6
15	Percentage lean meat	%	Over 56	52-56	Under 52
16	Mortality rate:				
	- Birth to weaning	%	Under 10	10.0-20.0	Over 20
	- Nursery	%	Under 4	40.0-20.0	Over 8
	- Growing-finishing	%	Under 2	20.0-20.0	Over 4
	- Sown	%	Under 2	20.0-20.0	Over 50
17	Litter female/year	No	Over 2	1.6-2.0	Under 1.6
18	Pigs weaned female/year	No	Over 18	14.0-18.0	Under 14
19	Pigs raised/female/year	No	Over 17.5	13.5-17.5	Under 13.5

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Africa Innovations Institute, Kampala, Uganda