CLEANED – Validation Workshop
Pork Value Chain Uganda

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CLEANED Validation Workshop: 16th and 17th March
Welcome

• Introduction and Objectives – Jess
• Opening remarks – Pius
• Program overview
• Introduction + Expectations
• Start of Workshop
Objectives

**Verify** and discuss preliminary model results of the model CLEANED model to reflect intensive dairy livestock systems

To **assess** the relevance of CLEANED results and key decision **identify** makers/experts

**Develop** future best-bet integrated packages and scenarios to be modelled in CLEANED
Opening Remarks
Project goal

To improve incomes of pig value chain actors through marketing arrangements and sustainable integrated technology package in Uganda
Motivation/setting

- Best-bet interventions pilot tested singly since 2012
- Low uptake due to financial constraints and market inefficiencies
  - Dione et al (2020) – Training of smallholder pig farmers on biosecurity: impact on KAP
  - Asindu et al (2019) – Farmer demand and willingness to pay for sweet potato silage-based diets as pig feed (60:40 ration)
  - Ouma et al (2018) – ASF control and market integration and ex-ante impact assessment
MorePork II approach

- Project focusses on supporting stronger and more profitable market linkages between pig market aggregators (buyers) and pig producers through market arrangements;
  - to incentivise uptake of an integrated package of productivity and climate-smart options
- Heavy focus on private sector involvement
- Utilisation of digital platform to disseminate knowledge and information on pig production
- Elements on environment and climate change included
Integrated technological and institutional innovations

Partnerships: private sector-led

Input and service providers

Producers

Pig collectors, traders, wholesalers

Pork joints

Consumers

Manure management and adaption to heat stress

Genetics – community based pig AI model

Animal Health – capacity building and disease control

Feeds – commercial feeds and forages

Integrated technology and best practices innovations basket

Aggregators

Market arrangements through market systems approaches
- strengthened relationships
- pricing terms
- supply quantities
- supply quality
- timing

Institutional innovation in the form of market arrangements to improve market linkages and relationships to support the VC system
Project objectives

- Pilot and evaluate innovative marketing arrangements at the level of pig aggregators to strengthen pig market linkages and link farmers to inputs and service providers.

- Implement and evaluate an integrated package for improving pig productivity and performance, through a PigSmart digital platform for farmers participating in the market arrangements.

- Develop, test and evaluate best-bet interventions for reducing the environmental footprint primarily through waste (manure) management and adaption to heat stress:
  - includes environmental assessments of different packages of interventions (incl. different feed baskets) in terms of water and land, and competition with human food, while considering future climate change.
Research design

• Before-after and with-without design– to evaluate the outcomes from the piloting of the market arrangements and integrated technology & best practices
• Project intervention sites and control sites
• Entry point – pig aggregators who source pigs from farmers or middlemen/women
• Target farmers - linked to the aggregators in both control and intervention sites
• Sample size – adjusted for cluster effects (6 farmers/aggregator) and potential drop-outs
  – 438 farmers in the project intervention districts (219 per district) and 252 in the control districts (126 per district)
  – 73 pig aggregators in the project intervention districts (37 per district) and 42 in the control districts (21 per district)
  – 60 input and service providers (ISPs) in the intervention districts (feed and drug stockists) and 30 in the control sites
Project interventions

- Implemented through **5 flagships**:  
  - Livestock Livelihoods, and Agri-Food Systems (LLAFS)-Gender and youth engagement:  
    - creating market pull-through market arrangements that will provide reliable pig markets to men & women farmers  
  - Livestock Genetics:  
    - In collaboration with a public sector partner (Makerere University) & a private sector partner (Vetline Services), focuses on community based Artificial Insemination (CBAI)  
  - Livestock Health:  
    - strengthening & disseminating advisory services in herd health & best practices in biosecurity.
Project interventions

- **Livestock Feeds and Forages:**
  - Piloting & evaluating a training & certification scheme of small-scale commercial feed producers,
  - Enhancing uptake of well-selected & tested superior heat-tolerant food/feed crop cultivars for pig feeding
  - Promoting the adoption of well-balanced & least-cost rations developed through the FeedCalculator App.

- **Livestock and Environment:**
  - i) estimating & mapping the potential future heat stress of pigs in Uganda,
  - ii) reducing the environmental footprint through improved pig manure management &...
Part 1: Intensive livestock enterprise
Why is the livestock Pork value chain is important in Uganda: The facts

- $6.4 million
- $6.4 million
- 70% from traditional systems, 30% improved pig systems.

17.8% households engaged in pig production

>1,000,000 people

3.9 Million Households with Livestock

4.3% GDP

The value of livestock sector accounts for some
Current Environmental impacts

**Negative environmental impacts:**

- **EMISSIONS**: of greenhouse gases
- **LAND**: degradation and deforestation
- **WATER**: pollution and depletion
- **BIODIVERSITY**: threatened

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**Global fresh water use**
- Livestock 3330%
- Others 6660%

**Global crop land**
- Livestock 3330%
- Others 6660%
- Grains 130%
- Forage 230%

**Global agricultural GDP**
- Livestock 4000%
- Others 6000%

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*Herrero et al., (2013)*
Part 2: CLEANED
What is CLEANED?

C omprehensive
L ivestock
E nvironmental
A ssessment for Improved
N utrition, a Secured
E nvironment and Sustainable
D evelopment along Livestock and Fish Value Chains.

“A rapid ex-ante environmental impact assessment tool that allows users to explore multiple impacts of developing livestock value chains.”
What is CLEANED

The CLEANED tool lets users explore multiple impacts of developing livestock value chains in explicit ways. It models the impact of intensifying livestock along multiple pathways:

- Land requirements
- Productivity
- Economics
- Soil Impacts
- Water impacts
- GHG emissions
The Architecture

User → CLEANED tool → INPUT tab

- Reports: Summary and individual (Multiple tabs)
- Parameter: Model parameters (Multiple tabs)

Calculations: Back end calculations (Multiple tabs)

Inputs Outputs Group
RUSLE (Revised Universal Soil Loss Equation) is widely used for estimating the rate of soil loss by water.

$$A = R \times K \times L \times S \times C \times P$$

A: annual soil loss per acre
R: rainfall erosivity
K: soil erodibility
L: slope length
S: slope steepness
C: vegetative cover
P: erosion control practices

Land Requirement =

Feed requirement + Feed quality ==> feed amount

Feed amount + crop yields ==> land size
Water Using -> Evapotranspiration (ET)

\[ ET_O + \text{grass reference crop} = ET_O \]

\[ ET_O \times K_c \text{ factor} = ET_c \]

- **Climate:** Radiation, Temperature, Wind speed, Humidity
- **Grass Reference Crop:** Well watered grass
- **K_c Factor:** Optimal agronomic conditions
N Balance → NUTMON

<table>
<thead>
<tr>
<th>CLEANED</th>
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</thead>
<tbody>
<tr>
<td>IN1</td>
<td>OUT1</td>
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<tr>
<td>IN2</td>
<td>OUT2</td>
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<tr>
<td>IN3</td>
<td>OUT3</td>
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<tr>
<td>IN4</td>
<td>OUT4</td>
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</table>
GHG

Tier 1 and 2
The process

The CLEANED tool process comprises of 2 stages:

1. Collect and input the baseline data
2. Generate reports for different scenarios of how the livestock production systems might change
Step 1 
Location Define location
Livestock Describe system

Describe Practices and Value Chain e.g. grazing

Calculate environmental baselines

Describe interventions

Describe likely changes in inputs and parameters and
Calculate environmental impacts
Water
Land
Greenhouse gases
Economic
Methodology
Study Area
## Study Area

<table>
<thead>
<tr>
<th>Site</th>
<th>GPS coordinates (Lat; Long)</th>
<th>Mean Annual Rainfall (mm)</th>
<th>Mean Annual Temperature(°C)</th>
<th>Land area (sq.km)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masaka</td>
<td>-0.29152 31.67208</td>
<td>1064</td>
<td>24 to 27</td>
<td>1603.3</td>
<td><a href="https://www.besttimetovisit.co.za/uganda/masaka-3796466/">https://www.besttimetovisit.co.za/uganda/masaka-3796466/</a></td>
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</tbody>
</table>
## Types – Livestock system

<table>
<thead>
<tr>
<th>Site</th>
<th>Livestock systems</th>
<th>Production type</th>
<th>Season</th>
<th>Season Months</th>
<th>Management system</th>
<th>Breed type</th>
<th>Type and No. of animals</th>
<th>Type of feed</th>
<th>Type of feed</th>
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<tbody>
<tr>
<td>Mas aka</td>
<td>Intensive</td>
<td>Farrow to finish</td>
<td>Wet</td>
<td>Long rains (MAM), Short rains (SON)</td>
<td>confined</td>
<td>Cross breed</td>
<td>Pigs – lactating exotic : 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 5</td>
<td>Forages – 30% Concentrates – 35% Crop residues – 20% kitchen leftovers – 15%</td>
<td>Forages – 30% Concentrates – 35% Crop residues – 20% kitchen leftovers – 15%</td>
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<td>Dry</td>
<td>Dec, Jan, Feb, June, July, Aug</td>
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<td>Long rains (MAM), Short rains (SON)</td>
<td>scavenging</td>
<td>Local</td>
<td>Pigs – lactating : 1 pregnant - sows: 1 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 2</td>
<td>Forages – 40% Concentrates – 5% Crop residues – 20% kitchen leftovers – 35%</td>
<td>Forages – 25% Concentrates – 5% Crop residues – 25% kitchen leftovers – 45%</td>
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<td>Dry</td>
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<td>Site</td>
<td>Livestock systems</td>
<td>Production type</td>
<td>Season</td>
<td>Season Months</td>
<td>Managem ent system</td>
<td>Breed type</td>
<td>Type and No. of animals</td>
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<td>Farrow to finish</td>
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<td>Long rains (MAM), Short rains (SON)</td>
<td>confined</td>
<td>Cross breed</td>
<td>Pigs – lactating : 1 pregnant - sows: 2 Pigs - dry sows: 1 Pigs - boars: 1 Pigs - growers : 5</td>
<td>Forages – 30% Concentrates – 35% Crop residues – 20% kitchen leftovers – 15%</td>
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<td>Dec, Jan, Feb, June, July, Aug</td>
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<td>Forages – 17% Concentrates – 36% Crop residues – 25% kitchen leftovers – 22%</td>
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<td>Extensive</td>
<td>Farrow to finish</td>
<td>Wet</td>
<td>Long rains (MAM), Short rains (SON)</td>
<td>scavenging</td>
<td>Local</td>
<td>Pigs – lactating : 1 pregnant - sows: 1 Pigs - dry sows: 0 Pigs - boars: 0 Pigs - growers : 2</td>
<td>Forages – 30% Crop residues – 35 kitchen leftovers – 15%</td>
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<td>Dec, Jan, Feb, June, July, Aug</td>
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<td></td>
<td>Forages – 50% Crop residues –30% kitchen leftovers – 20%</td>
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</tbody>
</table>
Parameters Used

Livestock                              Area                     Crop                                Feed

annual_conso_transpiration
elevation_index_ET0
precipitation
soil_Organic_Carbon
bulk_density_kg_per_cubic_meter
soil_clay_content
soil_total_nitrogen_ppm
soil_Depth
soil_Type
Rainy_season
CLEANED Results
Results overview

Summary

- Land requirements
- Soil impacts
- Water impacts
- GHG emissions
For each feed item, it is indicated how many hectares of the associated crop need to be planted to fulfill the feed requirements of the animals. This encompasses land requirements for feed production for each season.

Total area used for feed production: adds up the area requirements per feed item. This is thus the total area of land that the livestock enterprise should “set aside” for feed production.

Purchased feed items will require 0 hectares of area as these are considered to be outside the system.
Soil Impacts

- **N balance**: depends on nutrient monitoring of nitrogen changes in and out of the soil (in; fertilizers, manure app, out; leaching, crop residue).

- **N balance**: A positive N balance is desired; otherwise nutrient mining might result in severe soil fertility depletion over time.

- However, a N balance of >150 kg N/ha is also undesirable as this could result in N leaching in groundwater and higher GHG emissions.

- The N balance takes into account the N for feed production used for animal production and also the N balance for food production.
Soil Impacts

- **Erosion**: Erosion is expressed in annual t of soil loss.
- **Soil erosion** is estimated using the amount of rainfall, soil type, length and steepness of slope, crop cover factor and the land management system (agricultural land).
Water Impacts

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

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

- The model is also used to estimate how much water is used to produce a kg of meat.
Water Impacts

- This indicator estimated the amount of water used for feed production.

- This indicator is not only expressed as absolute value but also as the fraction of the total rainfall and per kg of proteins produced on the livestock enterprise.
GHG Emissions

Sources and Sinks CO2

Pig System Types

- Mukono_E
- Mukono_I
- Masaka_I
- Masaka_L

liv. Manure
Soil
off farm emissions
GHG Emissions

GHG emission intensity

Pig System Types

- Mukono_E
- Mukono_I
- Masaka_E
- Masaka_I

(t CO2e/ha/yr)
GHG Emissions

GHG emission intensity meat

Mukono_E
Mukono_I
Masaka_E
Masaka_I

Pig System Types

GHGe (kg co2e/meat)
GHG Emissions

GHG emission intensity per kg protein

- Mukono_E
- Mukono_I
- Masaka_E
- Masaka_I
### Results Verification

<table>
<thead>
<tr>
<th>Environmental Impact: CLEANED results</th>
<th>Validate</th>
<th>Reasons for yes/no answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this what is expected on the ground</td>
<td>Yes</td>
<td>What information is needed to further verify the results</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Total area under feed production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N nutrient mining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil erosion per ha</td>
<td></td>
<td></td>
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<tr>
<td>Soil erosion per ha</td>
<td></td>
<td></td>
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<tr>
<td>Total water Use m3/ha/yr</td>
<td></td>
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<tr>
<td>Total water use meat</td>
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<td></td>
</tr>
<tr>
<td>Total water use to produce a kg of Protein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources and Sinks of CO2</td>
<td></td>
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</tr>
<tr>
<td>GHG emission intensity</td>
<td></td>
<td></td>
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<tr>
<td>GHG emission intensity per kg protein</td>
<td></td>
<td></td>
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<tr>
<td>GHG emission intensity per meat</td>
<td></td>
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</tbody>
</table>
## Type Verification

<table>
<thead>
<tr>
<th>Type</th>
<th>Validate</th>
<th>Population involved in Pork VC in Project Area</th>
<th>Reasons for yes/no answer</th>
<th>What information is needed to further verify the results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>Percentage (%) Low / Medium / High (0 -29 / 30 -60 / 61 - 100)</td>
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<tr>
<td></td>
<td>no</td>
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</tbody>
</table>
## Input and Parameters Verification

<table>
<thead>
<tr>
<th>INPUT and Parameters</th>
<th>Validate Is this what is expected on the ground</th>
<th>Reasons for yes/no answer Places to get better data?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd composition (nr)</td>
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<td></td>
</tr>
<tr>
<td>Average annual growth per animal (kg)</td>
<td></td>
<td></td>
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<tr>
<td>Average Body weight (kg)</td>
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<td></td>
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<tr>
<td>Litter size (pigs)</td>
<td></td>
<td></td>
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<tr>
<td>Feed basket/ Diet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Whereabouts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize / DM Yield tonne/ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural pasture/DM Yield tonne/ha</td>
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<td></td>
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<tr>
<td>Cassava/DM Yield tonne/ha</td>
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<tr>
<td>Sweet potato/DM Yield tonne/ha</td>
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<tr>
<td>Cocoyam leaf/DM Yield tonne/ha</td>
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<tr>
<td>Banana/DM Yield tonne/ha</td>
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</tbody>
</table>
CLEANED Application
Who will be using CLEANED?

- What is their job?
- Where does it fit into the job role?
- Who will be *their* audience?
What questions do you want to answer?

- Implementing technologies
- Soil impacts in an area
- Alternative processes or practices
- GHG emissions
- Land use
- Water impacts

https://hdl.handle.net/10568/97557
Who are the stakeholders?
## Use of Results for stakeholder x

<table>
<thead>
<tr>
<th>Environmental Impact: CLEANED results</th>
<th>Importance of Results to xxx</th>
<th>Reasons for answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high</td>
<td></td>
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<tr>
<td>Total area under feed production</td>
<td></td>
<td></td>
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<tr>
<td>N nutrient mining</td>
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<tr>
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<tr>
<td>Total water use per product</td>
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<tr>
<td>Total water use to produce a kg of Protein</td>
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<tr>
<td>Sources and Sinks of CO2</td>
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<tr>
<td>GHG emission intensity</td>
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<tr>
<td>GHG emission intensity per kg protein</td>
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<tr>
<td>GHG emission intensity per product</td>
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</tbody>
</table>
END of DAY 1
Thank you!
DAY 2: CLEANED Scenarios
Recap
CLEANED Scenarios
Challenges and for Pig value chain

Challenges
• Disease control
• Low quality forage
• Low performance of A.I
• Inbreeding
• Poor Manure Management
# The Interventions

<table>
<thead>
<tr>
<th>Flagship</th>
<th>Summary of intervention</th>
<th>The interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetics</td>
<td>Community based AI and synchronization</td>
<td>1. Community AI &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Synchronization</td>
</tr>
<tr>
<td>Environment</td>
<td>Manure management options</td>
<td>1. Composting Manure</td>
</tr>
<tr>
<td></td>
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<td>2. Fertilization of crops</td>
</tr>
<tr>
<td></td>
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<td>3. Biogas</td>
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<td></td>
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<td>4. Fish feed</td>
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<tr>
<td>Feeds</td>
<td>Improved planted forages</td>
<td>Grasses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Brachiaria - Mulato</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Brachiaria – Cayman</td>
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<tr>
<td></td>
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<td>3. Brachiaria – Cobra</td>
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<tr>
<td></td>
<td></td>
<td>Legumes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Crotalaria juncea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Desmodium Greenleaf</td>
</tr>
<tr>
<td>Animal Health</td>
<td>Herd health package</td>
<td>1. Antimicrobial</td>
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<tr>
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<td>2. De-wormers</td>
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<td></td>
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<td>3. Best animal welfare practices</td>
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<td></td>
<td>e.g. biosecurity</td>
</tr>
</tbody>
</table>
Example of Scenario/ Intervention

- Packaging technical components

Pork basket of technologies & innovations

Genetics
1. _____

Feeds and forages
i. _____

Herd health
a. _____

Package
1, ii, c, A

Package
3, i

Package
2, iii, b,

Cross-cutting gender, youth, capacity building;
Environmental sustainability

Emphasis on ‘demand driven’

- Demand by entrepreneur
- Demand by farmer
- Recommendation by experts

Affected by
<table>
<thead>
<tr>
<th>Production Challenges</th>
<th>Is the production challenge affecting your pig system type</th>
<th>If Yes How important is this production challenge in pig system type and location Percentage (%) Mildly important/ Important / Very Important (0 -29 / 30 -60 / 61 -100)</th>
<th>Reasons for answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment/Manure mgmt.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Formulating the Package

<table>
<thead>
<tr>
<th>Type</th>
<th>The Package</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Community AI &amp; Synchronization/Composting, Manure Fertilization of crops, Biogas, Fish feed/Grasses: Brachiaria – Mulato, Brachiaria – Cayman, Brachiaria – Cobra &amp; Legumes: Crotalaria juncea, Desmodium Greenleaf/Antimicrobial/De-wormer/Best animal welfare practices e.g. biosecurity</td>
</tr>
</tbody>
</table>

A
How do this(these) package(s) affect the production and input and parameters in your Pig system type?

<table>
<thead>
<tr>
<th>% increase of production from baseline</th>
<th>Input</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat yield</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Feeding basket what proportion of the basket will change?</td>
<td></td>
<td>- What are the yields for the introduced feed items in the location?</td>
</tr>
<tr>
<td>- Which feed item will be utilized less</td>
<td></td>
<td>- What are the nutritional values for introduced feed items in the location?</td>
</tr>
<tr>
<td>- What feed item will be introduced</td>
<td></td>
<td>- Will there be any inorganic/organic fertilizer use? How much?</td>
</tr>
<tr>
<td>- Does this intervention change the wet and dry season basket?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- If the intervention package is successful, does the herd composition change or remain the same?</td>
<td></td>
<td>- Do the weights of the animal change or remain the same?</td>
</tr>
<tr>
<td>- If a change, is there an increase or decrease in animal numbers? Specify</td>
<td></td>
<td>- Does the birthing interval change?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- How would the manure be managed if intervention is successful?</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>- Will collection and use of manure change</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Thank you!