CLEANED Training
Nairobi 21st – 23rd
November 2018

CLEANED Tool

1

a minimum data tool for rapid ex-ante impact assessment of productivity, nitrogen balance, soil erosion, GHG emissions

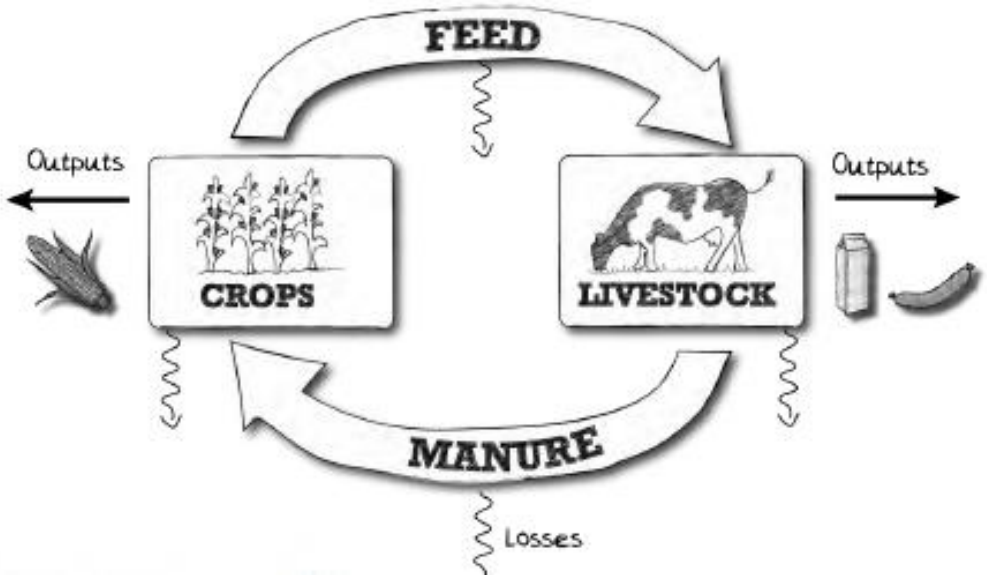
SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Objectives

(i) Understanding CLEANED model

(ii)Model a livestock enterprise system

(iii)Model a livestock enterprise system under different scenarios



Program

Day 1

- Environmental assessments
- Understanding CLEANED
- Hands on with the tool

Day 2

- Data
- Conversions
- Parameters
- Your own farming systems

Day 3

- Scenarios
- Final Presentations

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Introduction

- What's your name?
- Where have you travelled from?
- What's your job?
- Describe briefly what you expect from this training

CLEANED Tool

2

a minimum data tool for rapid ex-ante impact assessment of productivity, nitrogen balance, soil erosion, GHG emissions

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Environmental assessments

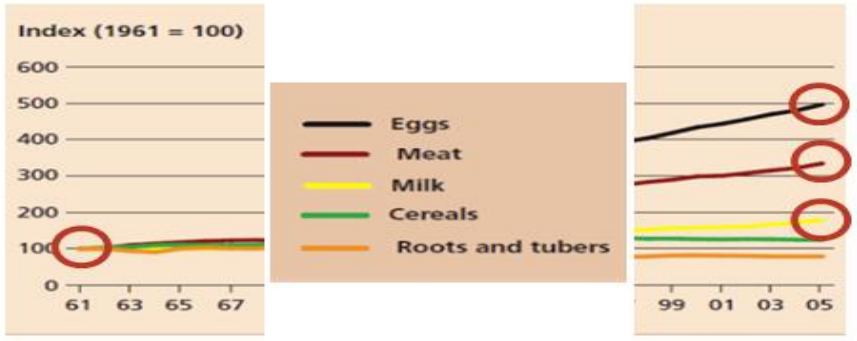
- Why this tool
- What is CLEANED
- Who is it CLEANED for?
- What questions can you ask CLEANED?

Why this tool

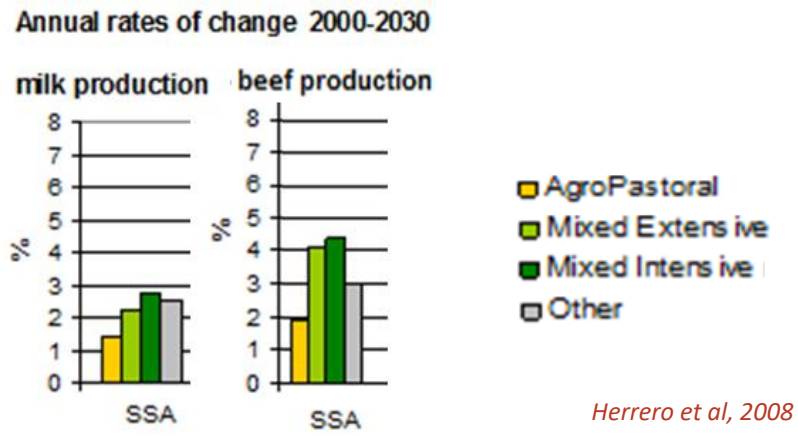
- Why do we need to look at the environmental impact of livestock systems?
- What problems can we encounter when trying to evaluate environmental impact of livestock systems?
- Who does this matter to?

Rising demand ~ ready market

Africa's Livestock revolution



Since 1962, consumption of milk 2x, meat 3x and eggs 5x (developing countries)



Herrero et al, 2008

By 2050 the demand for meat, milk, eggs will have doubled

Meat and milk in developing countries is predominantly produced in mixed crop-livestock systems, although productivity is still low

Opportunities & Challenges

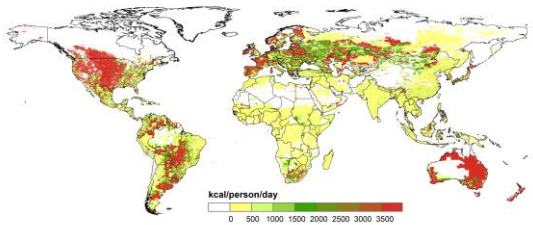
Livestock is important

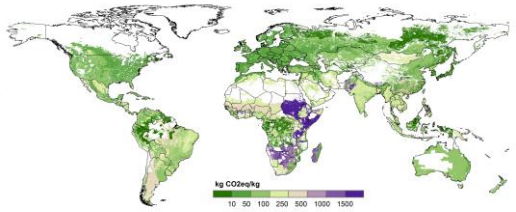
For PEOPLE

- Employment, income
- Economy
- Food and nutrition
- Cultural value
- Resilience and risk management

And the PLANET

- Biggest land user
- Natural resources:
  - Manure, SOC, biodiversity, energy, …
  - GHGe, water use and pollution, fishmeal





17 billion domestic animals
1.3 billion people employed in livestock VCs
600 million poor livestock keepers (2/3 women)
70% demand increase 2005-2030

Sector value >1.4 trillion USD; growth rate 2.5%
Constitutes about 40% of agricultural GDP

Food for at least 830 million food insecure people
17% of kilocalorie and 33% of protein consumption
Vitamin A, B-12, riboflavin, calcium, iron and zinc

26% = rangeland, 33% of cropland for fodder
32% of global water consumption

60% of cropping area receives manure application
14.5% of human-induced GHG emissions

FAO 2016; Gerber et al. 2007; Herrero et al. 2008; Herrero et al. 2013; LID 1999; Thornton et al. 2002; Thornton and Herrero 2008; Rosegrant et al 2009; Worldbank 2009

What is CLEANED?

Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development 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."

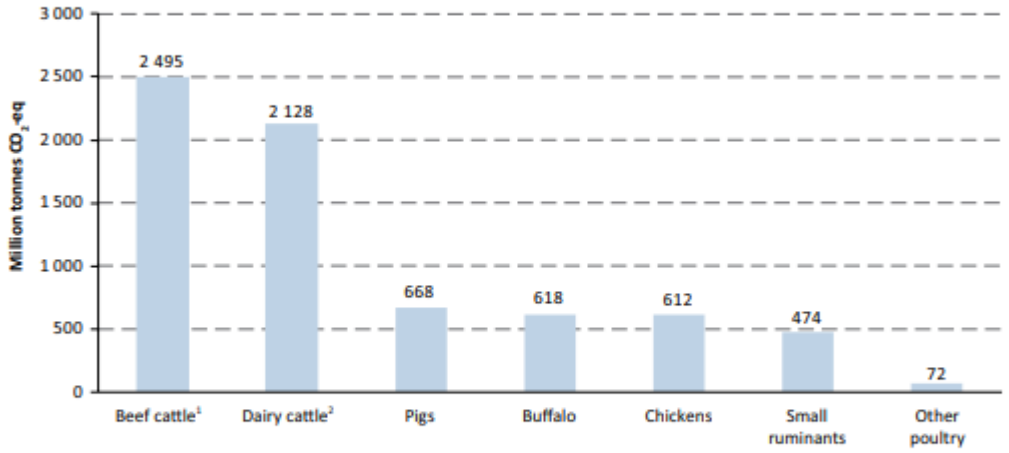
What is CLEANED

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

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

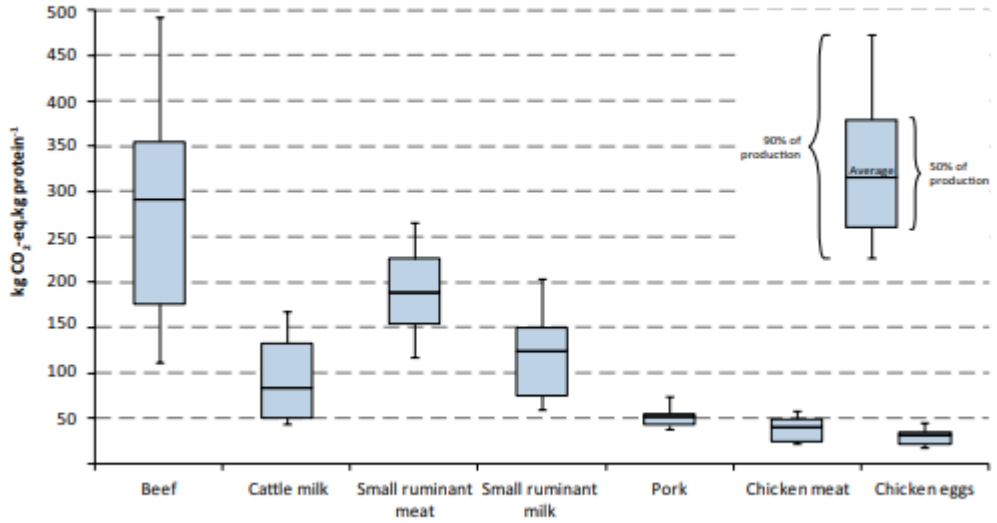
FIGURE 2. Global estimates of emissions by species*



*Includes emissions attributed to edible products and to other goods and services, such as draught power and wool.
[1] Producing meat and non-edible outputs.
[2] Producing milk and meat as well as non-edible outputs.

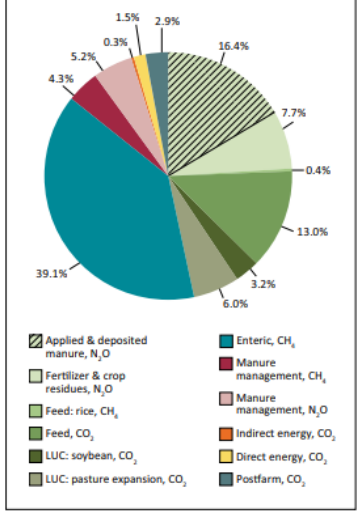
Source: GLEAM.

FIGURE 3. Global emission intensities by commodity



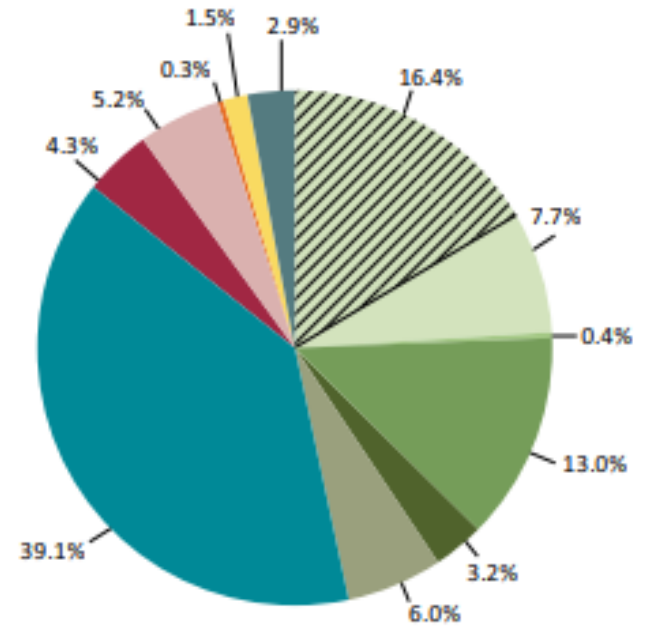
Source: GLEAM.

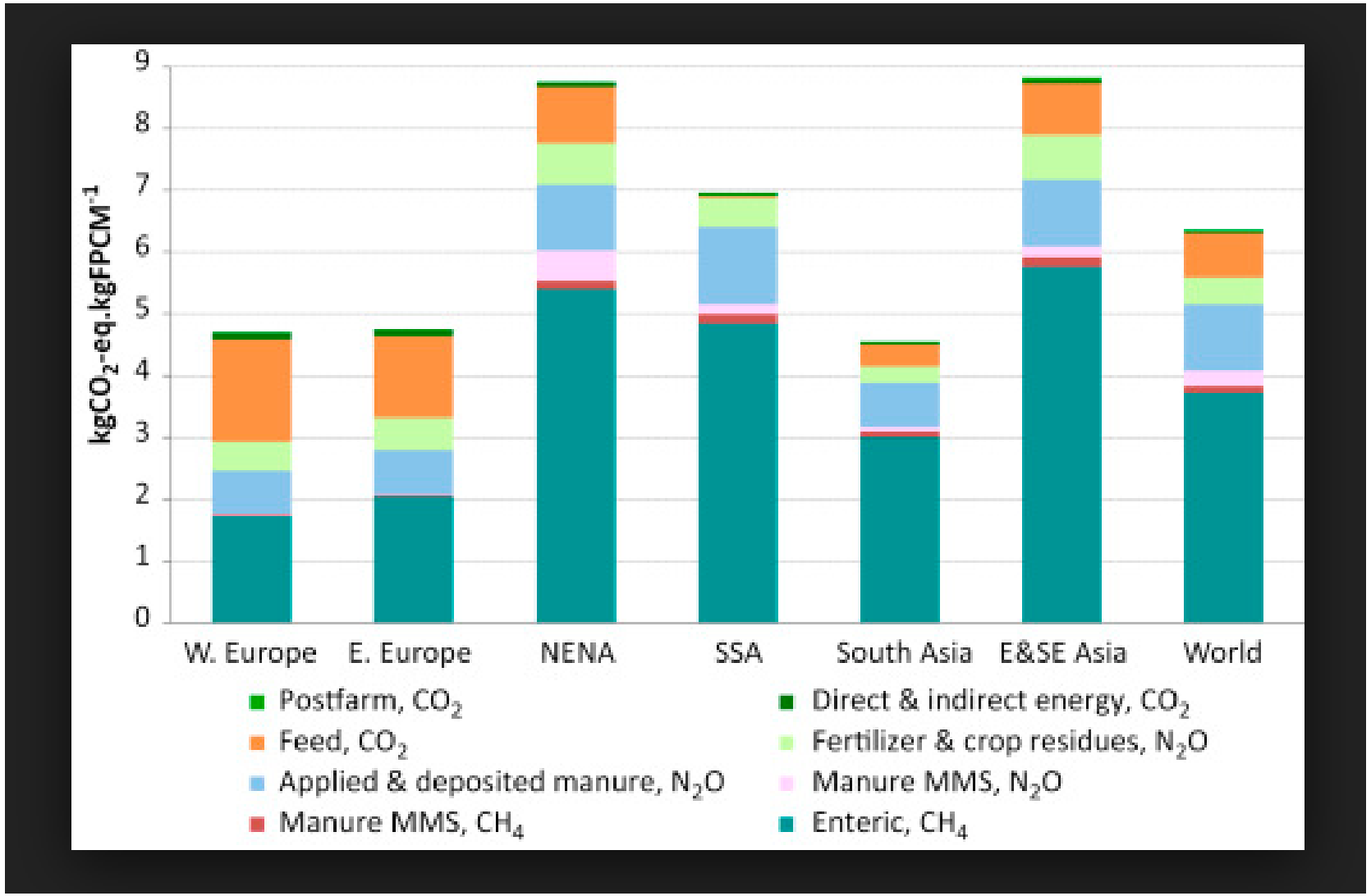
FIGURE 4. Global emissions from livestock supply chains by category of emissions



SEI STOCKHOLM ENVIRONMENT INSTITUTE
CIAT
ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
CSIRO

FIGURE 4. Global emissions from livestock supply chains by category of emissions





SEI STOCKHOLM ENVIRONMENT INSTITUTE
CIAT
ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
CSIRO

Who will be using CLEANED?

- What is their job?
- Where does it fit into the job role?
- Who will be *their* audience?

What is CLEANED?

What questions do you want to answer?

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

Feeding a productive dairy cow in western Kenya: environmental and socio-economic impacts

https://hdl.handle.net/10568/97557

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

CLEANED Tool

3

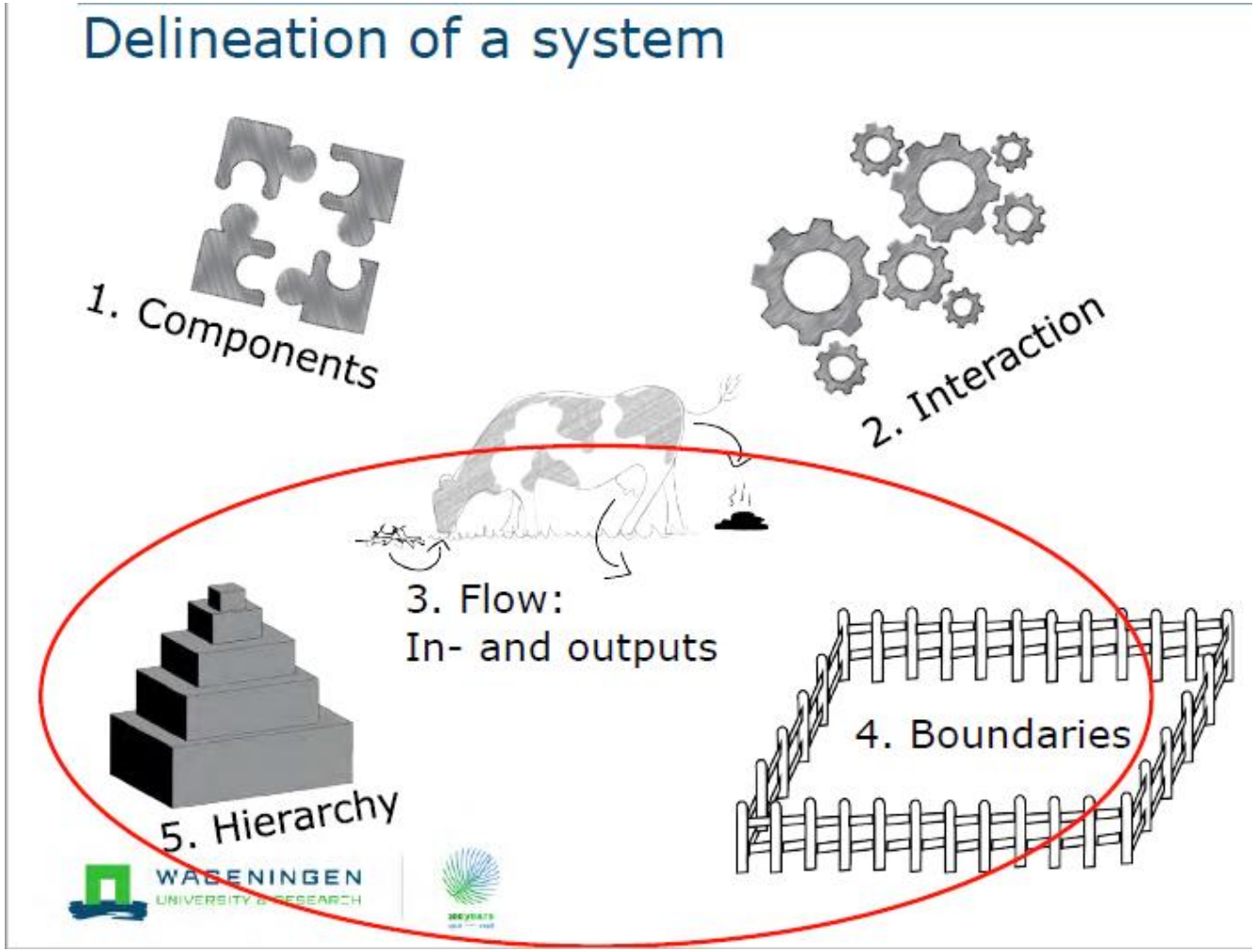
a minimum data tool for rapid ex-ante impact assessment of productivity, nitrogen balance, soil erosion, GHG emissions

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

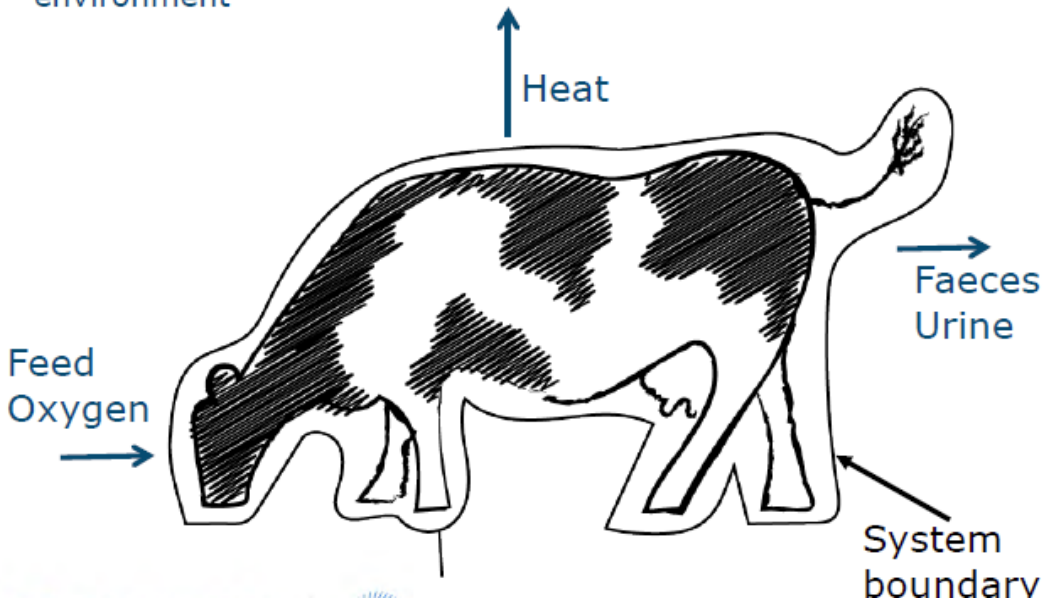
Understanding Systems

- What is a system

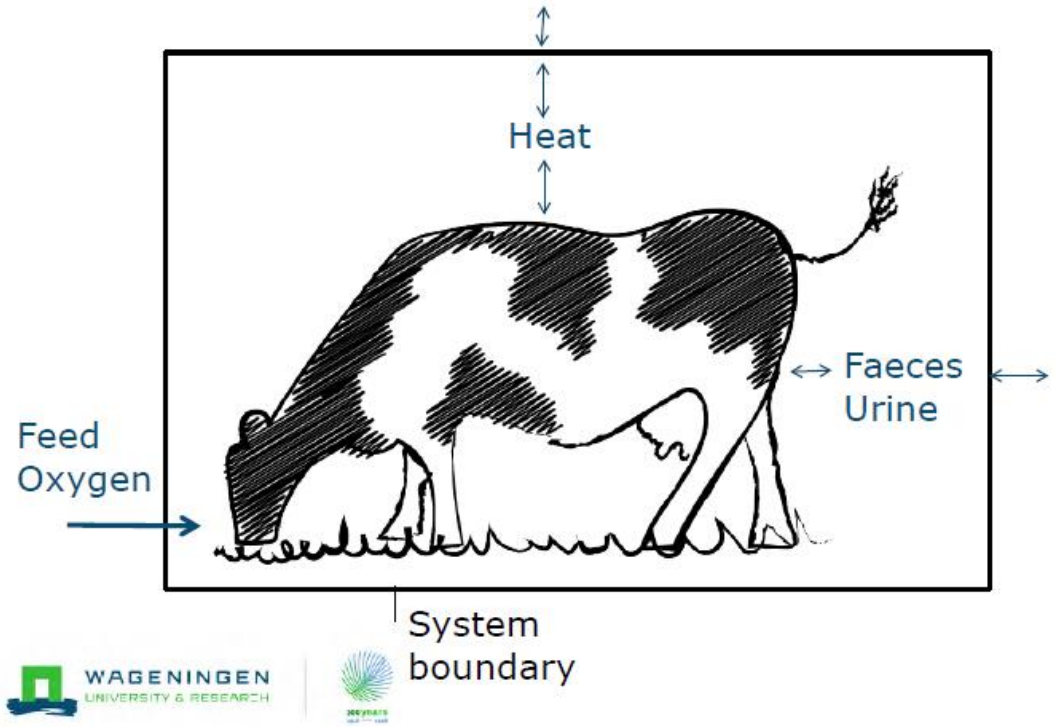
What is a system



Chose in such a way that the environment influences the system, but the systems has (almost) no influence on the environment



Boundary affects results



WAGENINGEN UNIVERSITY & RESEARCH

SEI STOCKHOLM ENVIRONMENT INSTITUTE

CIAT

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

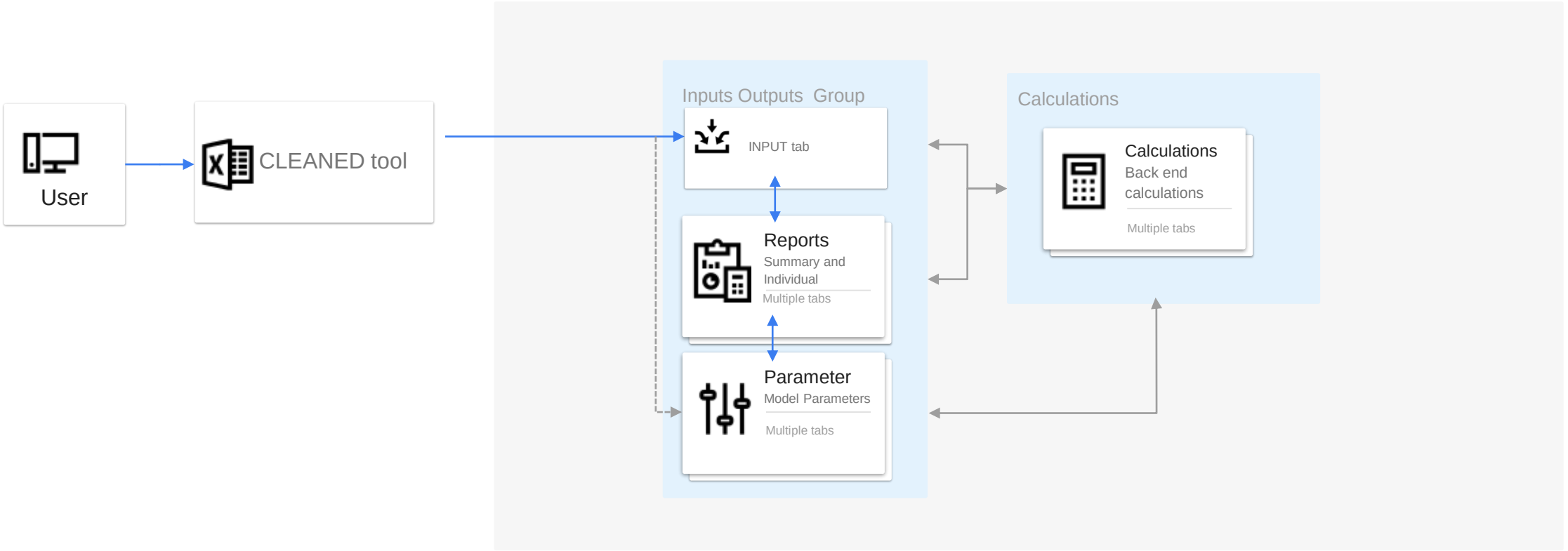
CSIRO

Understanding CLEANED

- The CLEANED process
- The architecture

The Architecture

Architecture: CLEANED tools



The process

The CLEANED tool process comprises of 2 stages, the first stage is to collect and input the baseline data and the next step is to generate reports for different scenarios of how the livestock production systems might change

Location Define location

Location Define location

Livestock Describe system

Location Define location

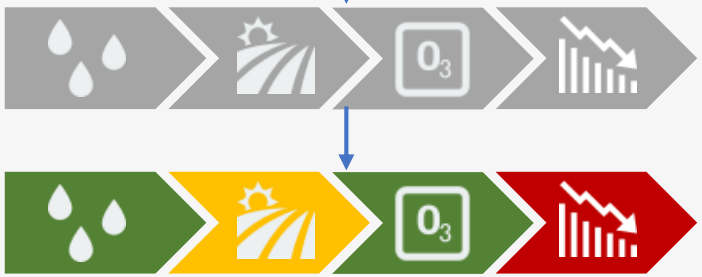
Livestock Describe system

Describe Practices and Value Chain e.g. grazing / rural to rural market

Step 1

Location Define location

Livestock Describe system



Describe Practices and Value Chain e.g. grazing / rural to rural market

Calculate environmental baselines along value Chain

The Calculations

N Balance

- NUTOM

Soil Erosion

- RUSSLE

Water

- Evapotranspiration (ET)

Economics

- ROI/ IRR
- Payback period

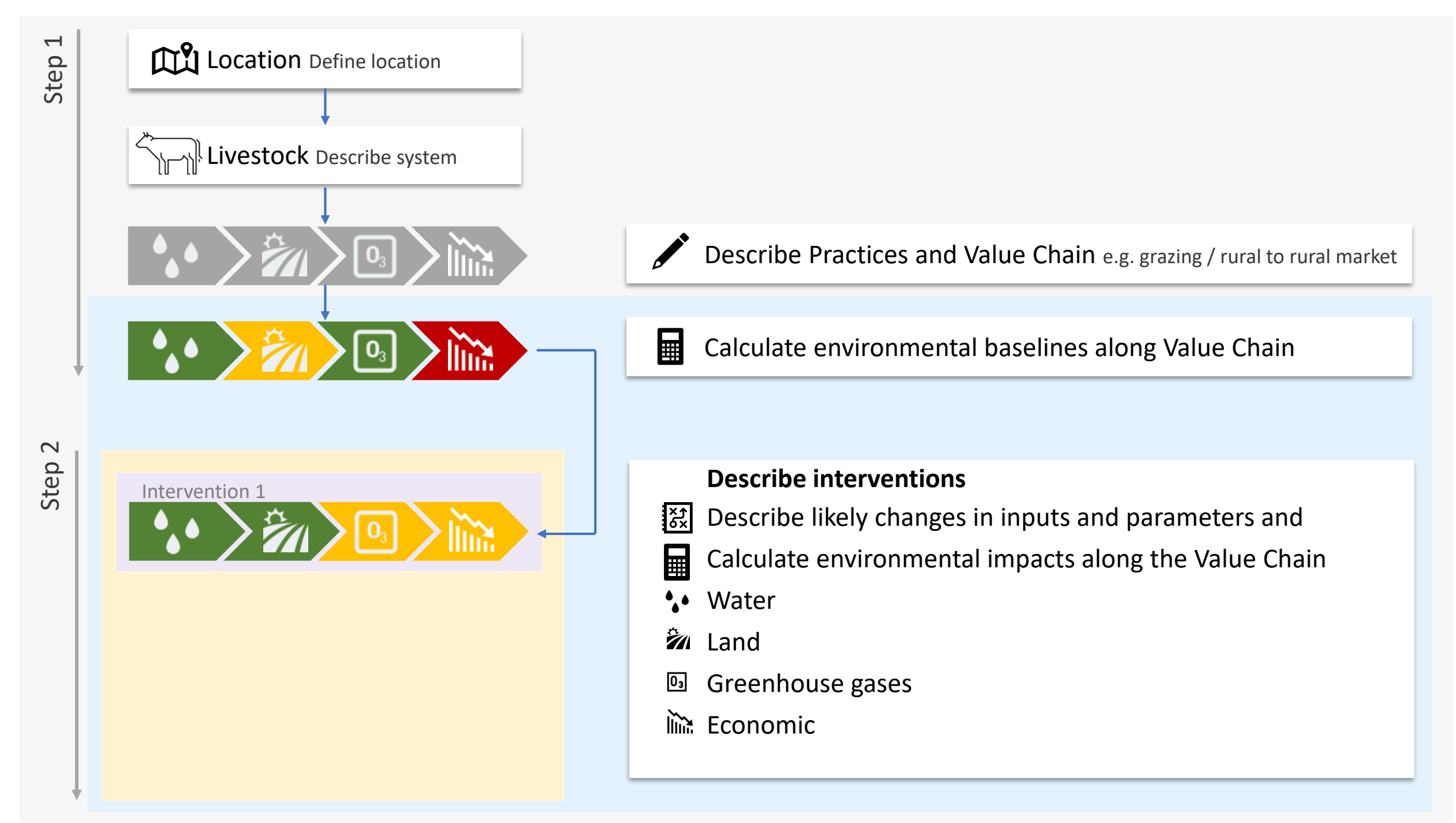
Productivity

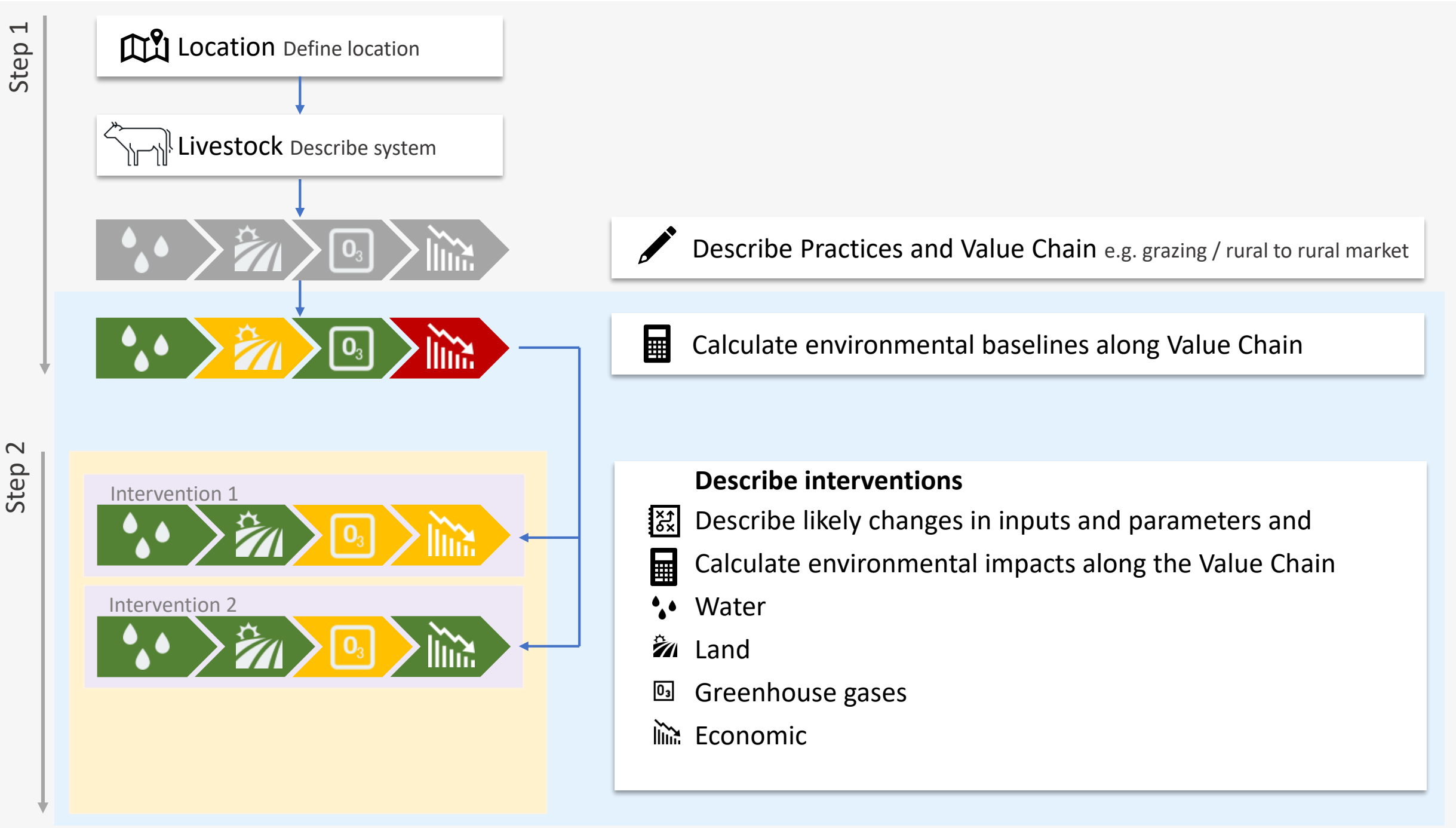
- $Productivity = \sum crop\ Energy * crop\ prod. + \sum Liv.\ Energyj * liv.\ prod$

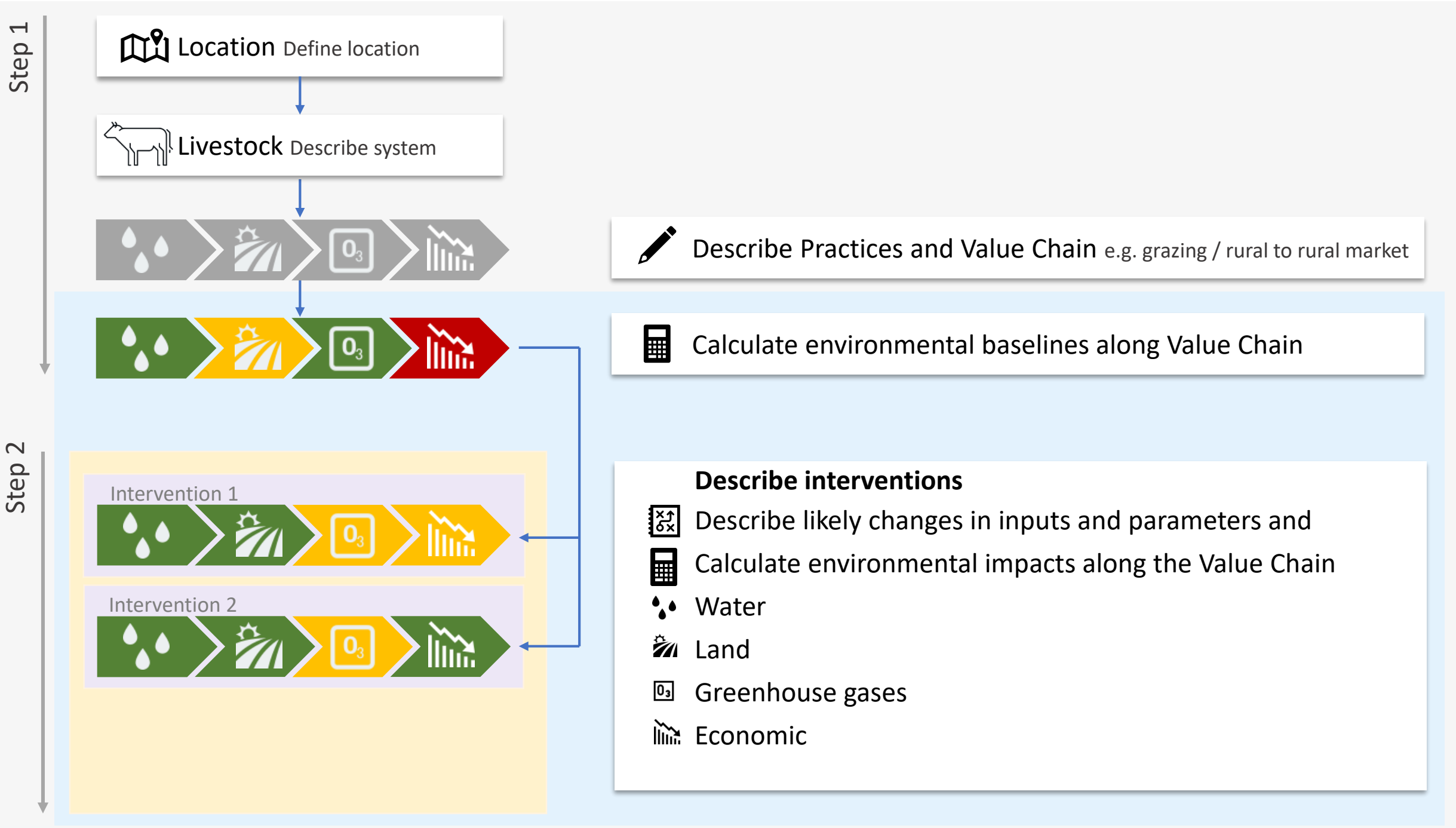
GHG

- 2006 IPPC Guidelines for National Greenhouse Gas Inventories.

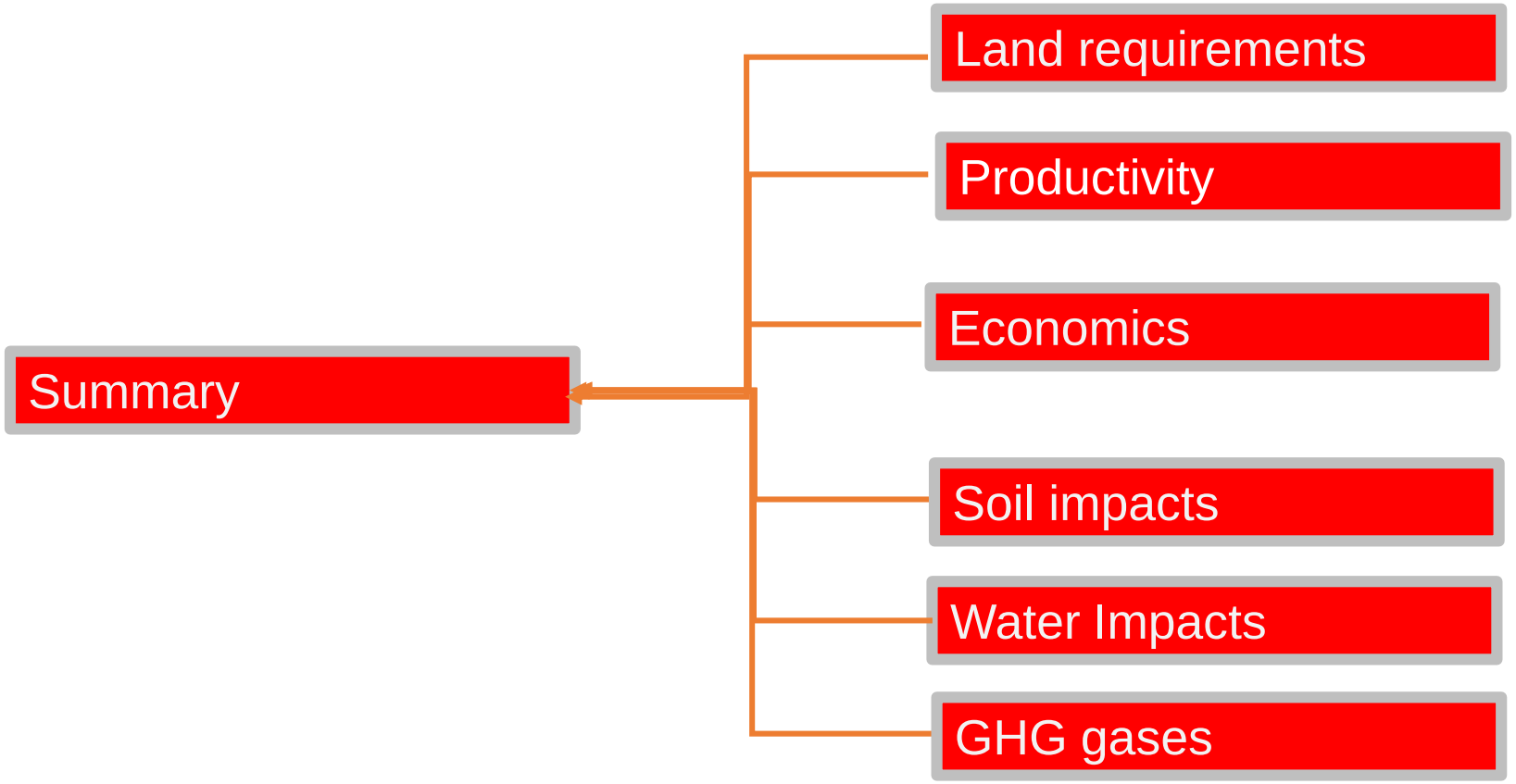
SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO


Step 1
Location Define location
Livestock Describe system
Describe Practices and Value Chain e.g. grazing / rural to rural market
Calculate environmental baselines along Value Chain
Step 2
Intervention 1
Describe interventions
Describe likely changes in inputs and parameters and
Calculate environmental impacts along the Value Chain
Water
Land
Greenhouse gases
Economic


Step 1
Location Define location
Livestock Describe system
Describe Practices and Value Chain e.g. grazing / rural to rural market
Calculate environmental baselines along Value Chain
Step 2
Intervention 1
Intervention 2
Describe interventions
Describe likely changes in inputs and parameters and
Calculate environmental impacts along the Value Chain
Water
Land
Greenhouse gases
Economic


Step 1
Location Define location
Livestock Describe system
Describe Practices and Value Chain e.g. grazing / rural to rural market
Calculate environmental baselines along Value Chain
Step 2
Intervention 1
Intervention 2
Describe interventions
Describe likely changes in inputs and parameters and
Calculate environmental impacts along the Value Chain
Water
Land
Greenhouse gases
Economic

Results **overview**



Summary

Per livestock enterprise	
Land requirement	
Total land required (ha/year)	41.952
Productivity	
Total milk produced (kg FPCM/year)	41,072
Total milk consumed (kg FPCM/year)	35,978
Meat produced (kg/year)	-
Meat consumed (kg/year)	-
protein (kg/year)	1,355
N balance	
kg N/year	-794
% area mining	100
% area leaching	0
Soil Erosion	
t soil/year	-97.69
GHG emissions	
t CO2 eq. / year	134.45
Water impacts	
m3/year	37,306
Carbon stock changes	
t CO2 eq. / year	-25.46
Productivity / Energy	
kcal/year from milk	39,839,355
kcal/year from meat	-
kcal/year total	39,839,355
AME days/year from milk	15,936
AME days/year from meat	-
AME days/year total	15,936

Per hectare	
Productivity	
Total milk produced (kg FPCM/ha/yr)	979
Total milk consumed (kg FPCM/ha/year)	858
Meat produced (kg/ha/year)	-
Meat consumed (kg/ha/year)	-
protein (kg/ha/year)	32
N balance	
kg N/ha/yr	-18.93
Soil Erosion	
t soil/ha/yr	-2.33
GHG emission intensity	
t CO2 eq. / ha/yr	3.20
Water impacts	
m3/ha/year	889.25
Carbon stock changes	
t CO2 eq. / ha/ year	-0.61
Productivity / Energy	
kcal/ha/yr from milk	*949,642*
kcal/ha/yr from meat	-
kcal/ha/yr total	*949,642*
AME days/ha from milk	*380*
AME days/ha from meat	-
AME days/ha total	*380*
number of AME/ha that could be fed on calories produced	1

Per product	PRODUCED	CONSUMED
Land requirement		
Total land required (ha/kg FPCM)	*0.0010*	0.0012
N balance		
kg N/ kg FPCM	-0.0193	-0.0221
Soil Erosion		
t soil/ kg FPCM	-0.00238	-0.0027
kg soil/ kg FPCM	-2.38	-2.72
GHG emissions		
t CO2 eq. /kg FPCM	0.00327	0.0037
kg CO2 eq. /kg FPCM	3.27	3.74
kg CO2 eq. /kg meat	0.00	0.00
kg CO2 eq. /kg protein	99.20	
Water impact		
m3/kg FPCM	0.91	1.04
m3/kg meat	0.00	0.00
m3/kg protein	27.52	31.42
Carbon stock changes		
kg CO2 eq. /kg FPCM	-0.62	-0.71
Total		
kg CO2 eq. /kg FPCM	3.89	4.44
Economics	total	per ha
production value (USD/yr)	0	0
cost (USD/yr)	592	14
balance (USD/yr)	-592	-14

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

What do the outputs mean?

Land requirement	
Total land required (ha/year)	41.952

Productivity	
Total milk produced (kg FPCM/year)	41,072
Total milk consumed (kg FPCM/year)	35,978
Meat produced (kg/year)	-
Meat consumed (kg/year)	-
protein (kg/year)	1,355

N balance	
kg N/year	-794
% area mining	100
% area leaching	0

Soil Erosion	
t soil/year	-97.69

GHG emissions	
t CO2 eq. / year	134.45

Carbon stock changes	
t CO2 eq. / year	-25.46

Productivity / Energy	
kcal/year from milk	39,839,355
kcal/year from meat	-
kcal/year total	39,839,355

Water impacts	
m3/year	37,306

AME days/year from milk	15,936
AME days/year from meat	-
AME days/year total	15,936

SEI STOCKHOLM ENVIRONMENT INSTITUTE · CIAT · ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE · CSIRO

CLEANED Tool

4

a minimum data tool for rapid ex-ante impact assessment of productivity, nitrogen balance, soil erosion, GHG emissions

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Hands on with the tool

Inputs **data input**

conversation

Descriptors

Seasons	Planting date wet season 1	Date (MM/DD/YYY)	15-05-16
	Harvest date wet season 1	Date (MM/DD/YYY)	15-10-16
	Planting date wet season 2	Date (MM/DD/YYY)	01-12-16
	Harvest date wet season 2	Date (MM/DD/YYY)	15-02-17

expert opinion or observation

Input

Seasons	Planting date wet season 1	Date (MM/DD/YYY)	15-05-16
	Harvest date wet season 1	Date (MM/DD/YYY)	15-10-16
	Planting date wet season 2	Date (MM/DD/YYY)	01-12-16
	Harvest date wet season 2	Date (MM/DD/YYY)	15-02-17

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Inputs **overview**

conversation

expert opinion or observation

Agroecology

Land, Soil & Climate seasons

INPUTS section **one**

Livestock

Numbers, Manure & Waste

INPUTS section **two**

Feeding

Feed basket

INPUTS section **three**

Production

Crop residue, inputs and rice

INPUTS section **four**

Economics

Labor hours, costs for establishment and operations

INPUTS section **five**

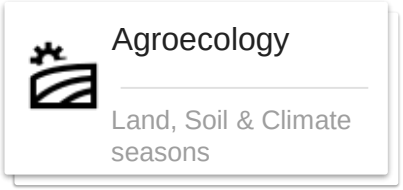
SEI STOCKHOLM ENVIRONMENT INSTITUTE

CIAT

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CSIRO

Inputs section **one**



- Planting date long rain: the day of the year when planting starts in the first wet season
- Harvest date long rain: the day of the year when harvesting starts in the first wet season
- Planting date short rain: the day of the year when planting starts in the first wet season
- Harvest date short rain: the day of the year when harvesting starts in the first wet season

Seasons	Planting date wet season 1	Date (MM/DD/YYY)	15-05-16
	Harvest date wet season 1	Date (MM/DD/YYY)	15-10-16
	Planting date wet season 2	Date (MM/DD/YYY)	01-12-16
	Harvest date wet season 2	Date (MM/DD/YYY)	15-02-17

Inputs section **two**

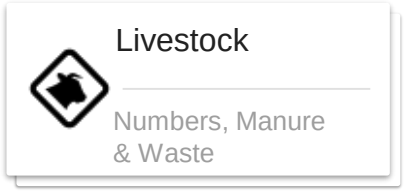
Livestock

Numbers, Manure & Waste

		Herd compostion (nr)	Annual milk production per animal (l)	Livestock leaving the farm (no/year)		Time spent in stable (fraction of day)	Time spent in yard (fraction of day)	Time spent grazing pasture/fields **on-farm** (fraction of day)	Time spent grazing **off-farm** (fraction of day)		Collection of manure in stable (fraction)	Collection of manure in yard (fraction)	collection of manure in fields/pasture (fraction)		On-farm manure used as fertilizer (fraction of total on-farm manure
Livestock numbers, whereabouts, manure use	Dairy cows - local	4	860.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Dairy cows - improved	1	1500.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Adult cattle - male	1	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Steers/heifers	1	0.00	0		0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Calves	0	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Sheep	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Goats	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Pigs	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Poultry	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Donkeys/horses	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

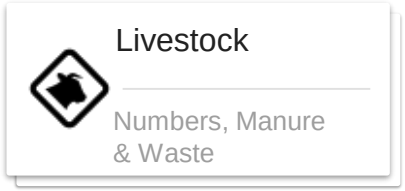
Inputs section **two**



- Herd composition: the number of animals in this category
- Annual milk production: the total annual milk production (taking into account variances due to lactation period, etc). This information is only provided for the relevant livestock types (e.g. not for the poultry or the male cattle)
- Livestock leaving the farm: the number of livestock of this type that leave the farm, through e.g. sale or gift

		Herd composition (nr)	Annual milk production per animal (l)	Livestock leaving the farm (no/year)		Time spent in stable (fraction of day)	Time spent in yard (fraction of day)	Time spent grazing pasture/fields **on-farm** (fraction of day)	Time spent grazing **off-farm** (fraction of day)		Collection of manure in stable (fraction)	Collection of manure in yard (fraction)	collection of manure in fields/pasture (fraction)		On-farm manure used as fertilizer (fraction of total on-farm manure
Livestock numbers, whereabouts, manure use	Dairy cows - local	4	860.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Dairy cows - improved	1	1500.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Adult cattle - male	1	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Steers/heifers	1	0.00	0		0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Calves	0	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Sheep	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Goats	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Pigs	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Poultry	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Donkeys/horses	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00

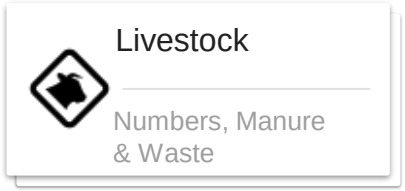
Inputs section **two**



- Time spent in the stable: the fraction of the day that an animal of this type normally spends inside a stable; a stable is any structure where there is some form of closed space, and where the manure that is produced by the livestock remains away from the outside natural elements until it is collected and displaced.
- Time spent in yard: a yard is therein defined as an enclosure or tethering area where the manure produced in that area is subject to the elements
- Time spent grazing pasture/field on-farm
- Time spent grazing off-farm: the value in this column calculated on the values you have input in the previous three columns. It is assumed that all time not spent in the stable, the yard or grazing on-farm, is spent grazing off-farm

		Herd composition (nr)	Annual milk production per animal (l)	Livestock leaving the farm (no/year)	Time spent in stable (fraction of day)	Time spent in yard (fraction of day)	Time spent grazing pasture/fields **on-farm** (fraction of day)	Time spent grazing **off-farm** (fraction of day)	Collection of manure in stable (fraction)	Collection of manure in yard (fraction)	collection of manure in fields/pasture (fraction)	On-farm manure used as fertilizer (fraction of total on-farm manure
Livestock numbers, whereabouts, manure use	Dairy cows - local	4	860.00		0.50	0.25	0.25	0.00	0.80	0.50	0.00	1.00
	Dairy cows - improved	1	1500.00		0.50	0.25	0.25	0.00	0.80	0.50	0.00	1.00
	Adult cattle - male	1	0.00		0.50	0.25	0.25	0.00	0.80	0.50	0.00	1.00
	Steers/heifers	1	0.00	0	0.50	0.25	0.25	0.00	0.80	0.50	0.00	1.00
	Calves	0	0.00		0.50	0.25	0.25	0.00	0.80	0.50	0.00	1.00
	Sheep	0			0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
	Goats	0			0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
	Pigs	0			0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
	Poultry	0			0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
	Donkeys/horses	0			0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00

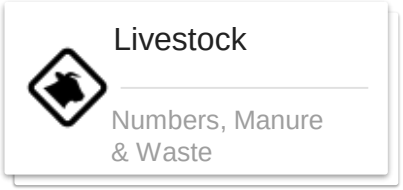
Inputs section **two**



- Collection of manure in stable: which fraction of the manure that is produced in the stable is collected vs. left on the floor
- Collection of manure in yard: which fraction of the manure produced in the yard is collected vs. left on the soil
- Collection of manure in fields/pasture: which fraction of the manure produced in the field or on the pasture is collected vs. left on the soil
- On-farm manure used as fertilizer: in many farms, the manure is not only collected and stored but also used for fertilizing crops. Here you are asked to indicate which fraction of the collected manure is used as fertilizer.

Livestock numbers, whereabouts, manure use		Herd composition (nr)	Annual milk production per animal (l)	Livestock leaving the farm (no/year)		Time spent in stable (fraction of day)	Time spent in yard (fraction of day)	Time spent grazing pasture/fields **on-farm** (fraction of day)	Time spent grazing **off-farm** (fraction of day)		Collection of manure in stable (fraction)	Collection of manure in yard (fraction)	collection of manure in fields/pasture (fraction)		On-farm manure used as fertilizer (fraction of total on-farm manure
	Dairy cows - local	4	860.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Dairy cows - improved	1	1500.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Adult cattle - male	1	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Steers/heifers	1	0.00	0		0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Calves	0	0.00			0.50	0.25	0.25	0.00		0.80	0.50	0.00		1.00
	Sheep	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Goats	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Pigs	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Poultry	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00
	Donkeys/horses	0				0.00	0.00	0.00	1.00		0.00	0.00	0.00		1.00

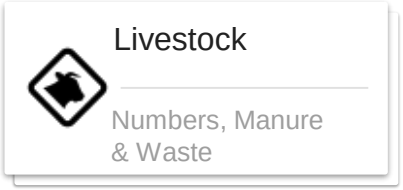
Inputs section **two**



- solid storage: The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.
- dry lot: A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.
- pasture/range/paddock: The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed.

Manure management system	Manure origins	Select
	Stable	Solid storage
	Yard	Dry lot
	Pasture/fields	Pasture/range/paddock

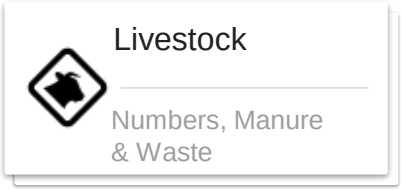
Inputs section **two**



- annual purchase of animal manure: if manure is bought, indicate here how much. This is expressed in kg N/year. E.g.
- annual purchase of compost: if compost is bought, indicate here how much
- annual purchase of other organic N additions: if any other organic sources of N are bought, indicate here how much
- annual purchase of bedding materials
- annual “sales” of home-produced manure:

		kg N/year
Additional manure inputs and outputs	Annual purchase of animal manure	0.00
	Annual purchase of compost	0.00
	Annual purchase of other organic N additions	0.00
	Annual purchase of bedding materials	0.00
	Annual 'sales' of home produced manure	0.00

Inputs section **two**



- waste – milk and meat production
- waste – milk and meat distribution
- waste – milk and meat processing
- waste – milk and meat consumption
- Total: the total loss is calculated based on your input in the four waste cells above.

		milk	meat
Waste of milk and meat at various levels in value chain (%)	waste - prod	3	3
	waste - distribution	3	3
	waste - processing	5	5
	waste - consume	2	2
	Total	12.40	12.40

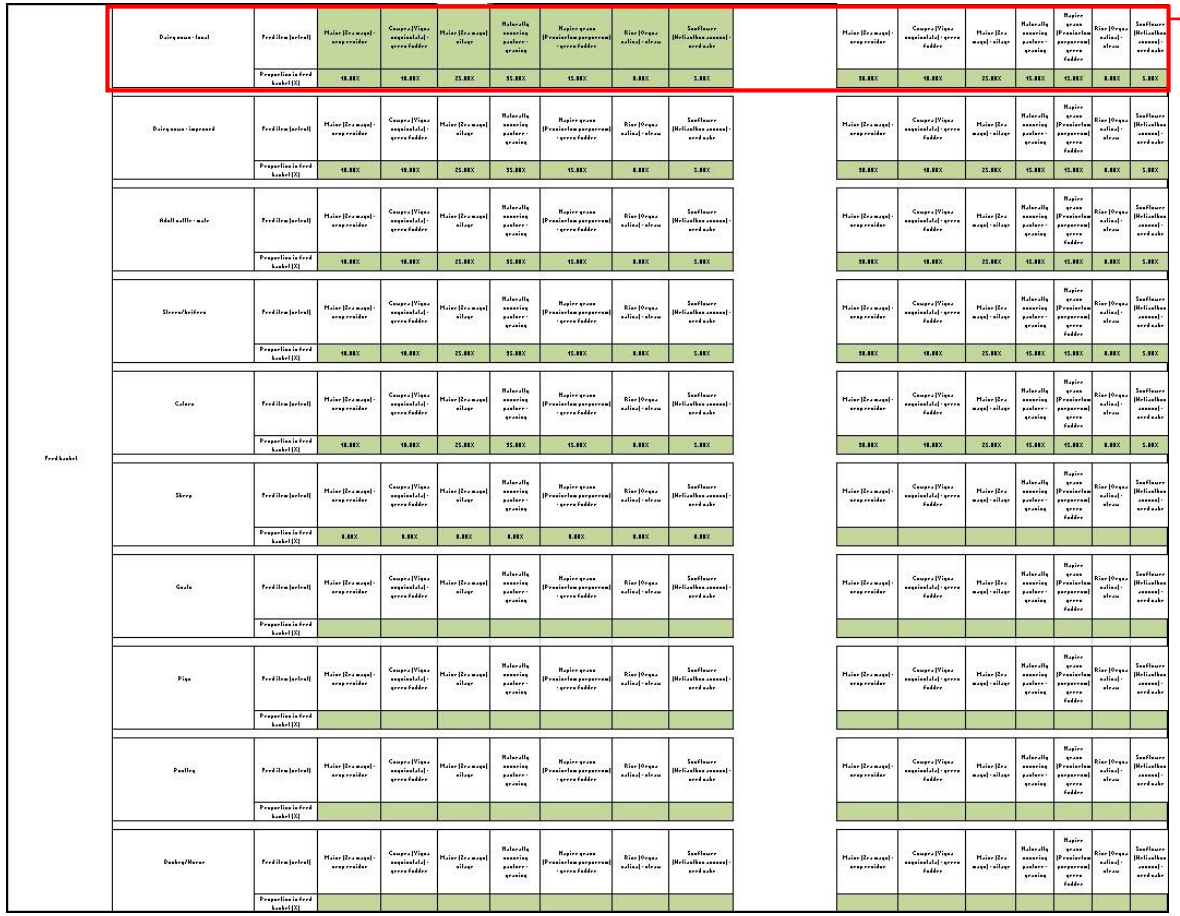
Inputs section **three**

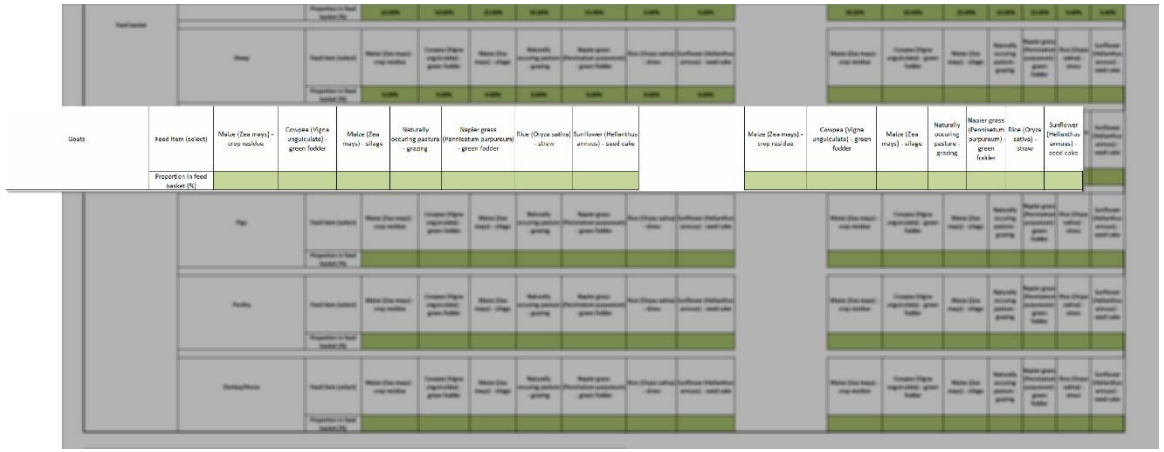
Feeding

Feed basket

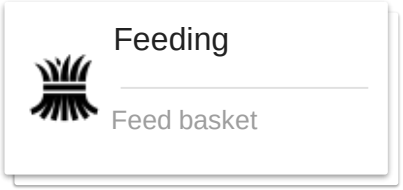
Dairy cows - local	Feed item (select)	Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
	Proportion in feed basket (%)	10.00%	10.00%	25.00%	35.00%	15.00%	0.00%	5.00%

Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
30.00%	10.00%	25.00%	15.00%	15.00%	0.00%	5.00%





Inputs section **three**



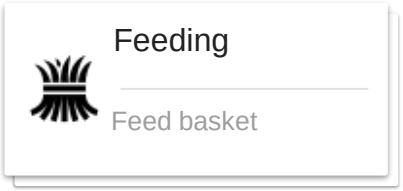
You start by selecting up to 7 different feed items. You simply pick the relevant ones from the drop-down lists that are found in the local dairy cow row (row 62). In the cell under the selected feed item, you indicate the % of the total feed basket that is made up by this feed item. This % is in terms of dry matter.

Make sure the %s add up to 100%

Dairy cows - local	Feed item (select)	Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
	Proportion in feed basket (%)	10.00%	10.00%	25.00%	35.00%	15.00%	0.00%	5.00%

Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
30.00%	10.00%	25.00%	15.00%	15.00%	0.00%	5.00%

Inputs section **three**



You start by selecting up to 7 different feed items. You simply pick the relevant ones from the drop-down lists that are found in the local dairy cow row (row 62). In the cell under the selected feed item, you indicate the % of the total feed basket that is made up by this feed item.

This % refers to the % “as fed”. Make sure the %s add up to 100%

Dairy cows - local	Feed item (select)	Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
	Proportion in feed basket (%)	10.00%	10.00%	25.00%	35.00%	15.00%	0.00%	5.00%

Maize (Zea mays) - crop residue	Cowpea (Vigna unguiculata) - green fodder	Maize (Zea mays) - silage	Naturally occuring pasture - grazing	Napier grass (Pennisetum purpureum) - green fodder	Rice (Oryza sativa) - straw	Sunflower (Helianthus annuus) - seed cake
30.00%	10.00%	25.00%	15.00%	15.00%	0.00%	5.00%

Inputs section **four**

Production

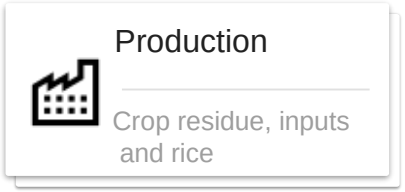
Crop residue, inputs and rice

Crop areas and residue removal

Feed item	Associated Crop	Crop product	*Land area (ha)*	Land cover	Slope	Length of slope (m)
Maize (Zea mays) - crop residue	Maize	Residue	*1.82*	Cereals	Flat (0-5%)	15
Cowpea (Vigna unguiculata) - green fodder	Cowpea	Residue	*0.49*	Pulses	Flat (0-5%)	15
Maize (Zea mays) - silage	Fodder maize	Main	*3.41*	Maize	Flat (0-5%)	5
Naturally occuring pasture - grazing	Natural pasture	Main	*0.53*	Degraded grass	Flat (0-5%)	5
Napier grass (Pennisetum purpureum) - green fo	Napier	Main	*0.28*	Dense grass	Flat (0-5%)	5
Rice (Oryza sativa) - straw	Rice	Residue	*0.00*	Dense grass	Flat (0-5%)	3
Sunflower (Helianthus annuus) - seed cake	Purchased	Residue	*0.00*	Cereals	Flat (0-5%)	1

Feed item		Crop residue removal from field (fraction)	Crop residue burnt (fraction)
Maize (Zea mays) - crop residue	Maize	0.5	0.25
Cowpea (Vigna unguiculata) - green fodder	Cowpea	0.5	0
Maize (Zea mays) - silage	-	0	0.5
Naturally occuring pasture - grazing	-	0	0.5
Napier grass (Pennisetum purpureum) - green fo	-	0	0.5
Rice (Oryza sativa) - straw	Rice	0.5	0.25
Sunflower (Helianthus annuus) - seed cake	Purchased	0	0

Inputs section **four**



- Land cover: the crop will determine the land cover. i.e. for beans the cover crop is “pulses”. In most cases, the user will select among “maize, cereals, pulses, dense or degraded grass”. In the case of tuber crops, it is suggested to select either “cereals “ or “pulses”.
- Slope: this in an estimation of the degree of the slope from flat to extremely steep. The steeper the more erosion there will be.
- Length of slope:

Feed item	Associated Crop	Crop product	*Land area (ha)*	Land cover	Slope	Length of slope (m)
Maize (Zea mays) - crop residue	Maize	Residue	*1.82*	Cereals	Flat (0-5%)	15
Cowpea (Vigna unguiculata) - green fodder	Cowpea	Residue	*0.49*	Pulses	Flat (0-5%)	15
Maize (Zea mays) - silage	Fodder maize	Main	*3.41*	Maize	Flat (0-5%)	5
Naturally occuring pasture - grazing	Natural pasture	Main	*0.53*	Degraded grass	Flat (0-5%)	5
Napier grass (Pennisetum purpureum) - green fo	Napier	Main	*0.28*	Dense grass	Flat (0-5%)	5
Rice (Oryza sativa) - straw	Rice	Residue	*0.00*	Dense grass	Flat (0-5%)	3
Sunflower (Helianthus annuus) - seed cake	Purchased	Residue	*0.00*	Cereals	Flat (0-5%)	1

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Inputs section **four**

Production

Crop residue, inputs and rice

- Residue removal from field: the fraction of the totally produced crop residues that is removed from the field for feeding animals or for other purposes.
- Residue burnt: the fraction of the totally produced crop residues that is burnt

Feed item		Crop residue removal from field (fraction)	Crop residue burnt (fraction)
Maize (Zea mays) - crop residue	Maize	0.5	0.25
Cowpea (Vigna unguiculata) - green fodder	Cowpea	0.5	0
Maize (Zea mays) - silage	-	0	0.5
Naturally occuring pasture - grazing	-	0	0.5
Napier grass (Pennisetum purpureum) - green fo	-	0	0.5
Rice (Oryza sativa) - straw	Rice	0.5	0.25
Sunflower (Helianthus annuus) - seed cake	Purchased	0	0

Inputs section **four**

Production

Crop residue, inputs and rice

For each crop associated with feed items:

- Fertilizer rate: this is expressed in kg N/ha and thus requires conversions

This information is used for calculating nutrient balances and N2O emissions from each field

The purchased inorganic fertilizers:

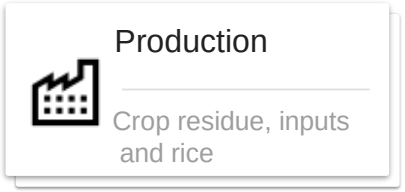
- Per type (Urea, CAN, DAP, NPK and Lime) state the total amounts of the different fertilizers per farm and year (*not* per ha, *not* per crop).

	Feed item		Fertilizer rate per crop (**kg N**/ ha)	Application of collected manure for fertilization (fraction)
Crop inputs	Maize (Zea mays) - crop residue	Maize	25.00	0.00
	Cowpea (Vigna unguiculata) - green fodder	Cowpea	25.00	0.00
	Maize (Zea mays) - silage	Fodder maize	25.00	0.20
	Naturally occuring pasture - grazing	Natural pasture	25.00	0.50
	Napier grass (Pennisetum purpureum) - green fo	Napier	25.00	0.30
	Rice (Oryza sativa) - straw	Rice	25.00	0.00
	Sunflower (Helianthus annuus) - seed cake	Purchased	0.00	0.00

Purchased Inorganic fertilizers	Quantity (kg fertilizer/year)
Urea	12
CAN	150
DAP	200
NPK	450
Lime	0

SEI STOCKHOLM ENVIRONMENT INSTITUTE CIAT ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CSIRO

Inputs section **four**



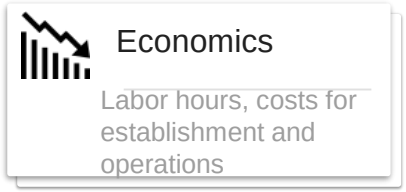
This section only has to be filled out if there is Rice in the feed basket

- Harvest area: calculated from the information provided above
- Cultivation period: number of days the rice cultivation takes
- Rice ecosystem type: select from the drop-down list
- Water regime prior to rice cultivation: select from the drop-down list
- Organic amendment inputs: select from the drop-down list
- Rate of application: filled out based on information provided above

			Field 1
Rice	Harvest area	ha	0
	Cultivation period	days	75
	Rice ecosystem type	select	Intermittently flooded-single aeration
	Water regime prior to rice cultivation	select	flooded pre-season (>30 days)
	Organic amendment inputs	select	NONE
	Rate of application	t/ha	25.00

Inputs section **Five**

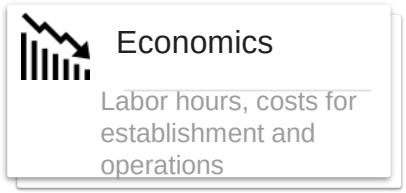
This section only has to be filled out if looking at implementing new technologies or management systems



- Herd size: calculated from the information provided above and baseline model
- Operational cost: amount needed for implementing new technology
- Extra labor: labor hours needed for implementing new technology
- Description: short description describing what cost are being calculated

Additional cost for maintaining baseline herd				
	herd size	Operational cost USD/animal/year	Extra labour (days /animal/year)	Description
Cows - local	0			
Cows - improved	15	0	0	no change
Adult cattle - male	0	0	0	no change
Steers/heifers	8			
Calves	10	0	0	no change
Steers/heifers improved	0			
Calves improved	0			
Sheep	0			
Goats	0			
Pigs	0			
Poultry	0			
Donkeys/horses	0			

Inputs section **Five**

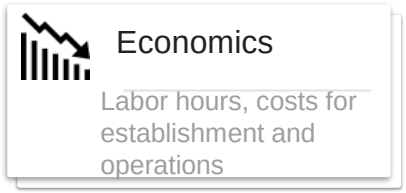


- Herd size: calculated from the information provided above and baseline model
- Establishment cost: initial capital needed for the new technology
- Operational cost: amount needed for implementing new technology
- Establishment labor: initial capital hours needed for implementing new technology Extra labor: labor hours needed for implementing new technology
- Description: short description describing what cost are being calculated

All cost associated with new animals

	herd size	One-off cost (USD/animal)	Operational cost USD/animal/year	Extra labour - one-off (days/animal)	Extra labour (days /animal/year)	Description
Dairy cows - local	-15	50				
Dairy cows - improved	5	90	100			
Adult cattle - male	-1	200				
Steers/heifers	7	60				
Calves	7	30				
Steers/heifers improved	0	70				
Calves improved	0	40				
Sheep	0					
Goats	0					
Pigs	0					
Poultry	0					
Donkeys/horses	0					

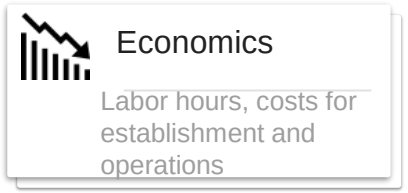
Inputs section **Five**



- Hectares Area/ Kg DM: calculated from the information provided above and baseline model
- Operational cost: amount needed for implementing new technology
- Extra labor: labor hours needed for implementing new technology
- Description: short description describing what cost are being calculated

Additional cost for maintaing Feed at					
	hectares	kg	Operational cost (USD/unit/year)	Extra labour (days /ha/year)	Description
Brachiaria hybrid (forage)	0.00	0.00	180	0	
Hyparrhenia rufa (forage)	-1.72	0.00	150	11	
Maize (Zea mays)-stover	-0.33	0.00	0	0	
Napier grass (Pennisetum purpureum) -	-0.03	0.00	300	74	
Sorghum (Sorghum bicolor) - forage	-0.05	0.00	200	77	
Sugarcane (Saccharum officinarum) -	0.00	-323.47	0.3	2	
Rice (Oryza sativa) - straw	0.00	0.00	150	0	

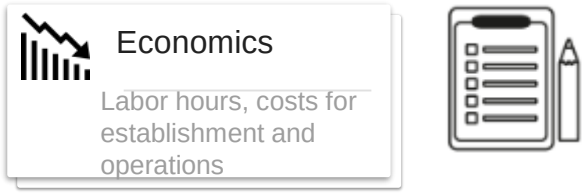
Inputs section **Five**



- Hectares/ kg DM: calculated from the information provided above and baseline model
- Establishment cost: initial capital needed for the new technology
- Operational cost: amount needed for implementing new technology
- Establishment labor: initial capital hours needed for implementing new technology Extra labor: labor hours needed for implementing new technology
- Description: short description describing what cost are being calculated

Additional cost for new feed items	Hectares	kg	One-off / establishment cost (USD/ha)	Operational Cost (USD/ha/year)	Extra labour - one-off (days/ha)	Extra labour (days /ha/year)	Description
	0.00	0.00					
	0.00	0.00					
	0.00	0.00					
	0.00	0.00					
	0.00	0.00					
	0.00	0.00					
	0.00	0.00	5	2	0		

Inputs section **Five**



- Other: technology not related to feed or herd size
- Establishment cost: initial capital needed for the new technology
- Operational cost: amount needed for implementing new technology
- Establishment labor: initial capital hours needed for implementing new technology Extra labor: labor hours needed for implementing new technology
- Description: short description describing what cost are being calculated

Other additional costs					
other	Extra one-off / establishment cost (USD/ha)	Operational Cost (USD/ha/year)	Extra labour - one-off (days/item)	Extra labour (days /item/year)	Description
extra stable	100				