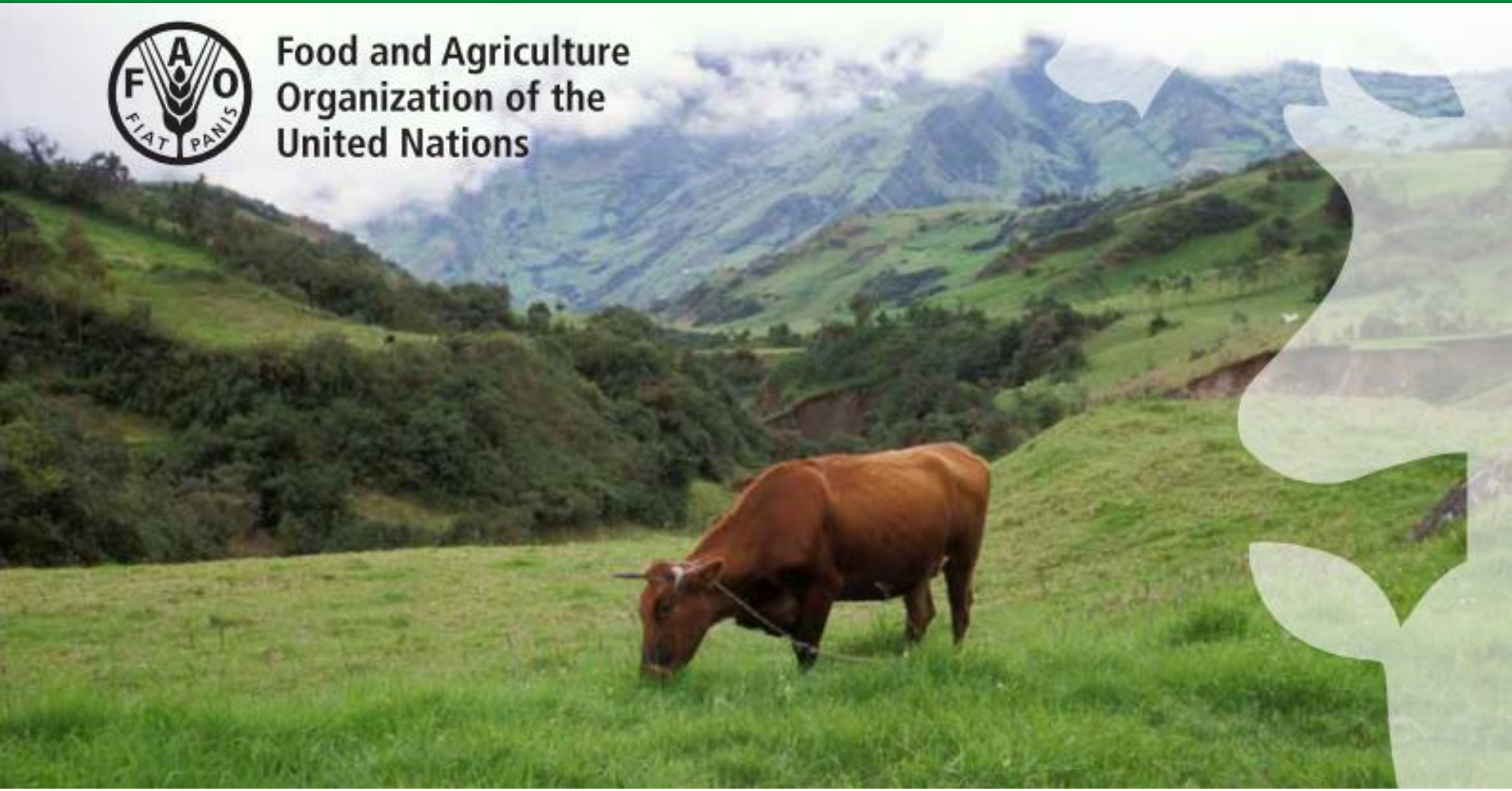
Food and Agriculture Organization of the United Nations

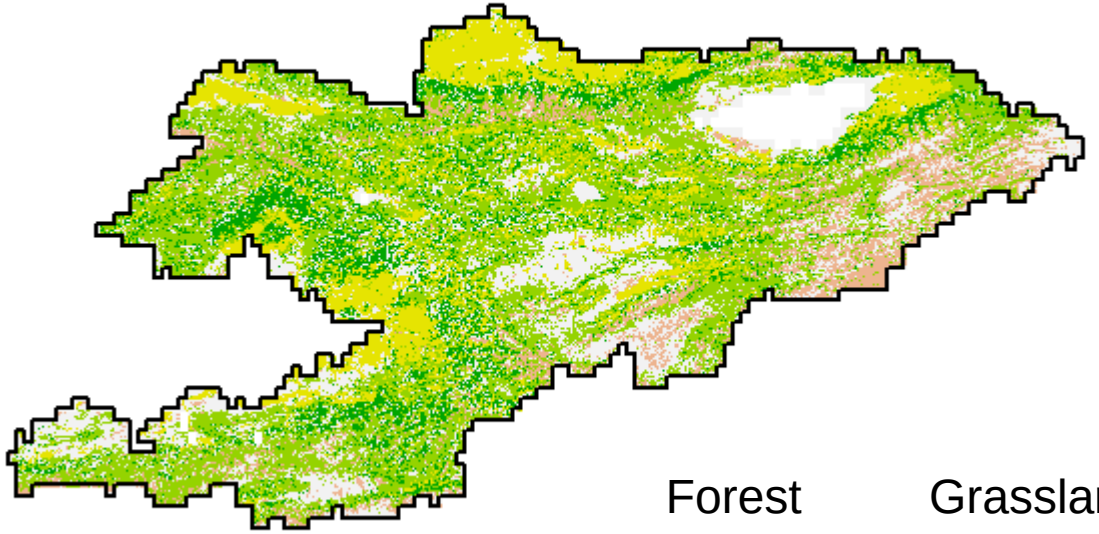


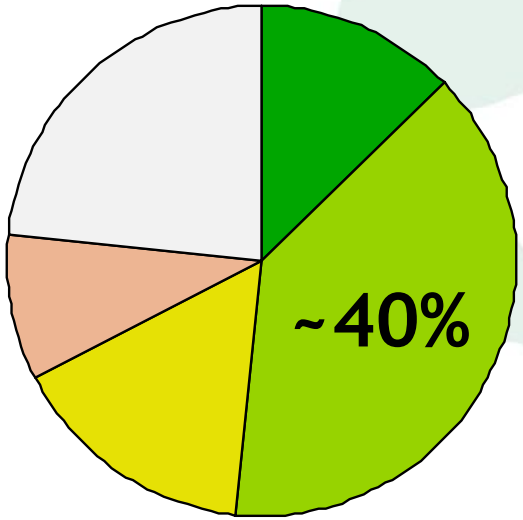
The role of livestock in adapting to climate change, reducing GHG emissions and supporting food security in Kyrgyzstan

Félix Teillard, Anne Mottet, Alessandra Falcucci
Animal Production and Health division, FAO

Pastures: a key natural resource

- Over 60% of the population lives in rural areas and depends on natural resources for their survival
- Pastures cover 40% of the country and 85% of agricultural lands



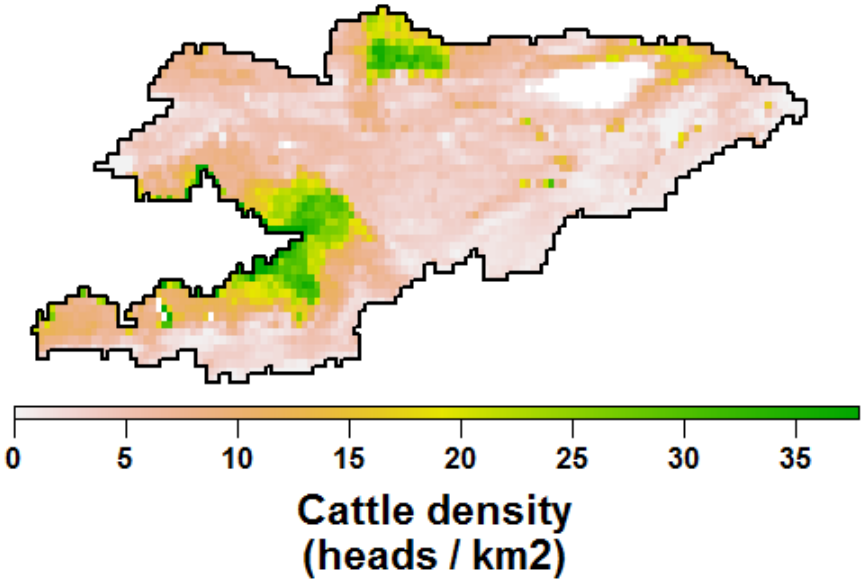


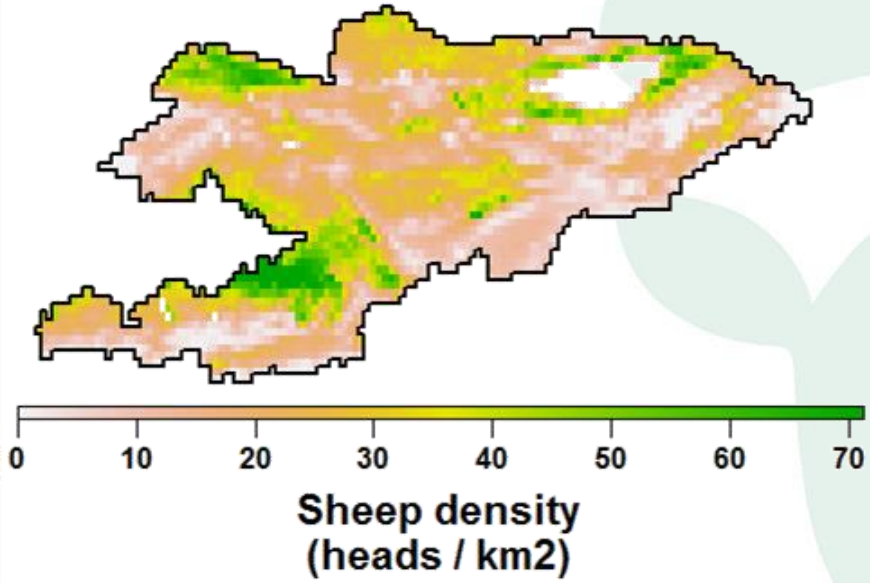
Forest Grassland Cropland Bare soil Other

ESA CCI Land Cover

Pastures: a key natural resource

- Grass is the main feed resource for livestock
- Livestock supplies 22% of kilocalories and 41% of proteins



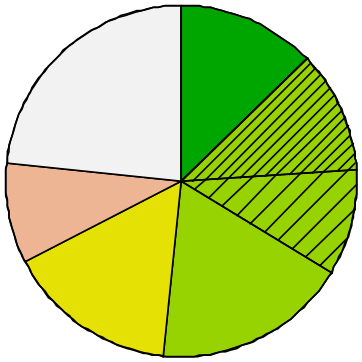


Total herd (million): cattle = 1.3, sheep = 4.1, goats = 0.9

FAO Gridded Livestock of the World

Pastures: a resource under pressure

62% of the soils are prone to light and moderate levels of degradation, **4%** are severely degraded



Pastures

29% degraded

25% deteriorating

Overgrazing can reduce plant cover by **40%** and rangeland productivity by **30%**

Degraded pastures can contain **60%** less humus and **40%** less soil organic carbon

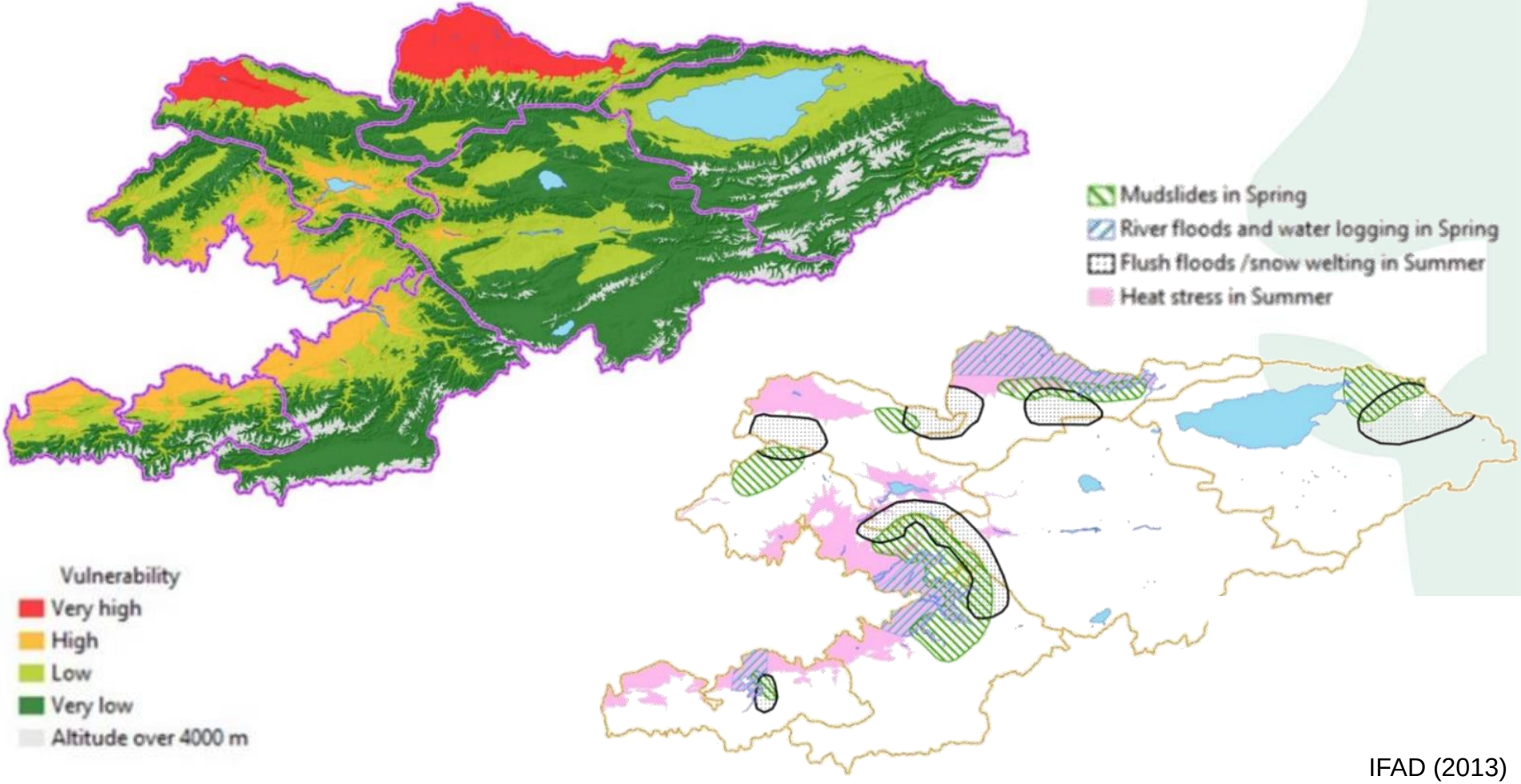
Pastures: a resource under pressure

Underlying causes of pasture degradation

- Overgrazing – livestock concentration and permanent grazing around villages and wells often exceeds the carrying capacity of pastures
- Under utilization – grazing abandonment in remote areas results in a build-up of a soil crust, reduced water absorption and loss of valuable vegetation species
- Increased risk from climate change

Pastures: a resource under pressure

Climate change vulnerability and impacts



IFAD (2013)

Objective

Identify improved livestock management practices and quantify their potential contribution to increase productivity, mitigate greenhouse gas emissions and adapt to climate change

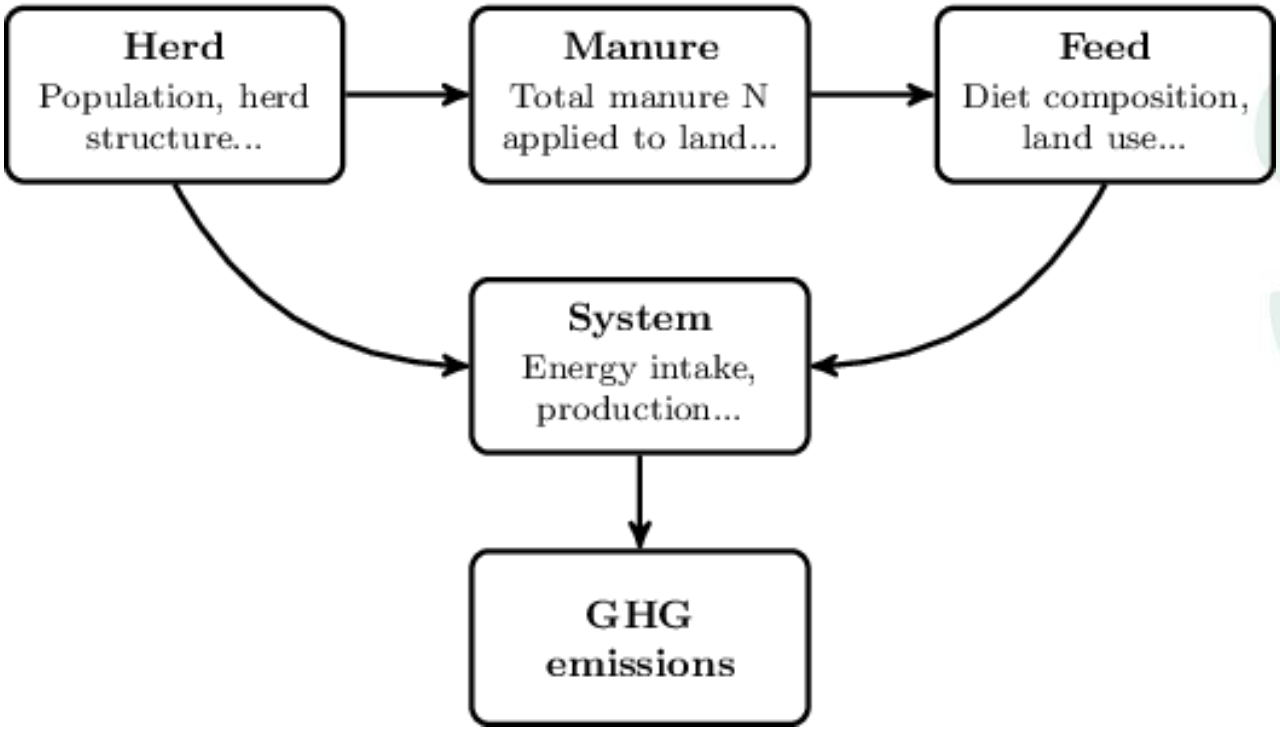
Methods

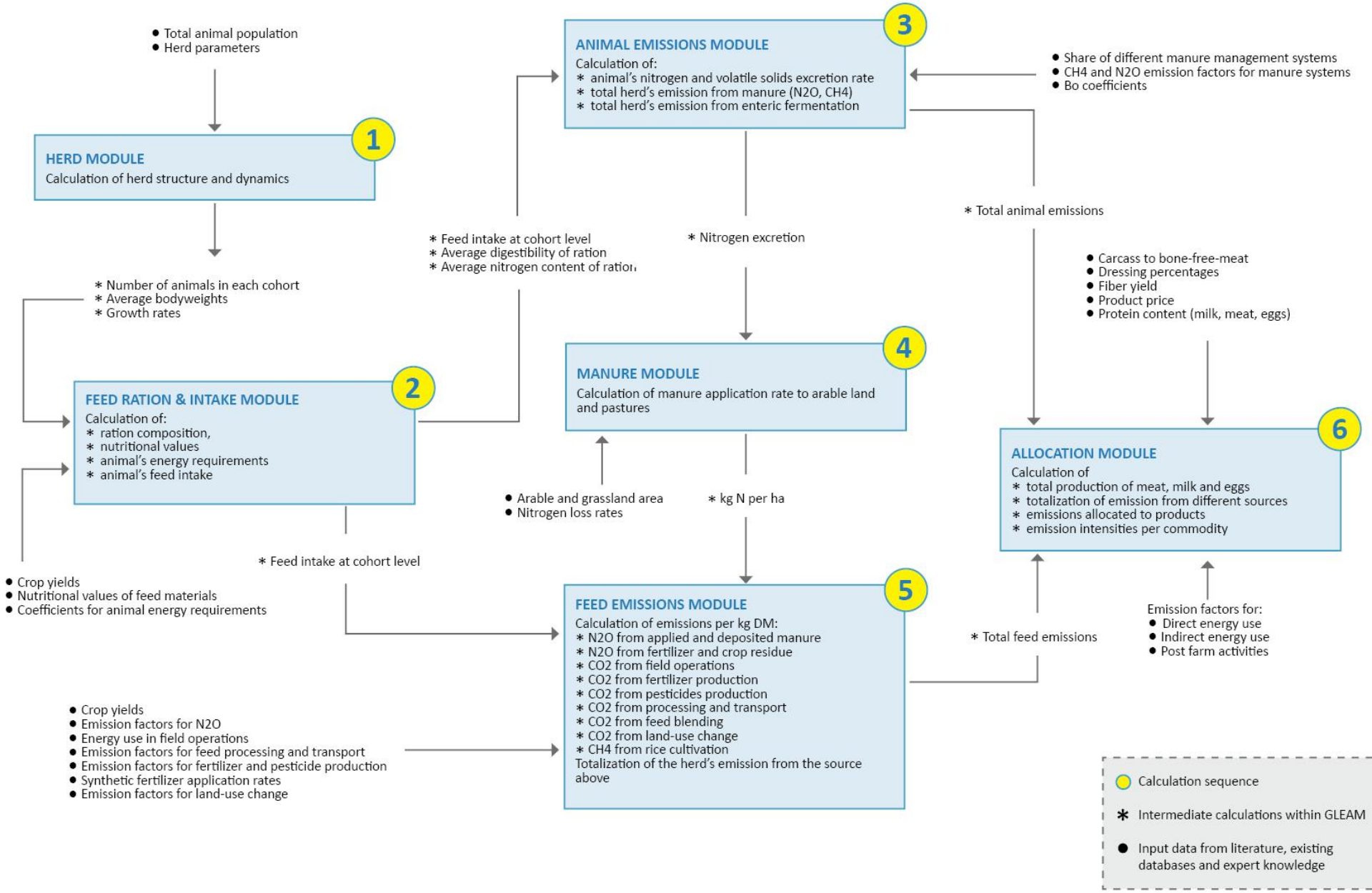
The Global Livestock Environmental Assessment Model (GLEAM)

- Computes GHG emissions (CO_2, CH_4 et N_2O) using a Tier 2 methodology
- 6 main livestock species, main commodities
- Life Cycle Assessment modelling (cradle to retail), GIS based
- Global coverage, can generate averages at different scales
- Scenario analysis and quantification of intervention on GHG emission mitigation and productivity
- Developed at FAO, in collaboration with other partners
- Expanded to other environmental aspects (land use, nutrients, water, biodiversity)

Methods

Model overview




• Total animal population
• Herd parameters
1
HERD MODULE
Calculation of herd structure and dynamics
* Number of animals in each cohort
* Average bodyweights
* Growth rates
2
FEED RATION & INTAKE MODULE
Calculation of:
* ration composition,
* nutritional values
* animal's energy requirements
* animal's feed intake
• Crop yields
• Nutritional values of feed materials
• Coefficients for animal energy requirements
* Feed intake at cohort level
3
ANIMAL EMISSIONS MODULE
Calculation of:
* animal's nitrogen and volatile solids excretion rate
* total herd's emission from manure (N2O, CH4)
* total herd's emission from enteric fermentation
* Feed intake at cohort level
* Average digestibility of ration
* Average nitrogen content of ration
• Share of different manure management systems
• CH4 and N2O emission factors for manure systems
• Bo coefficients
* Nitrogen excretion
* Total animal emissions
4
MANURE MODULE
Calculation of manure application rate to arable land and pastures
• Arable and grassland area
• Nitrogen loss rates
* kg N per ha
5
FEED EMISSIONS MODULE
Calculation of emissions per kg DM:
* N2O from applied and deposited manure
* N2O from fertilizer and crop residue
* CO2 from field operations
* CO2 from fertilizer production
* CO2 from pesticides production
* CO2 from processing and transport
* CO2 from feed blending
* CO2 from land-use change
* CH4 from rice cultivation
Totalization of the herd's emission from the source above
• Crop yields
• Emission factors for N2O
• Energy use in field operations
• Emission factors for feed processing and transport
• Emission factors for fertilizer and pesticide production
• Synthetic fertilizer application rates
• Emission factors for land-use change
* Total feed emissions
• Carcass to bone-free-meat
• Dressing percentages
• Fiber yield
• Product price
• Protein content (milk, meat, eggs)
6
ALLOCATION MODULE
Calculation of
* total production of meat, milk and eggs
* totalization of emission from different sources
* emissions allocated to products
* emission intensities per commodity
Emission factors for:
• Direct energy use
• Indirect energy use
• Post farm activities
Calculation sequence
* Intermediate calculations within GLEAM
• Input data from literature, existing databases and expert knowledge

Methods

Herd parameters

Parameters	Cattle	Sheep	Goats
Fertility (%)	75	74.5	83.9
Mortality of young animals (%)	15	30	19.7
Mortality of adult animals (%)	7	14.1	9.3
Weight at birth (kg)	33	5.3	3
Slaughter live weight (kg)	530	27	35
Milk yield (kg/animal/year)	1992	90	33

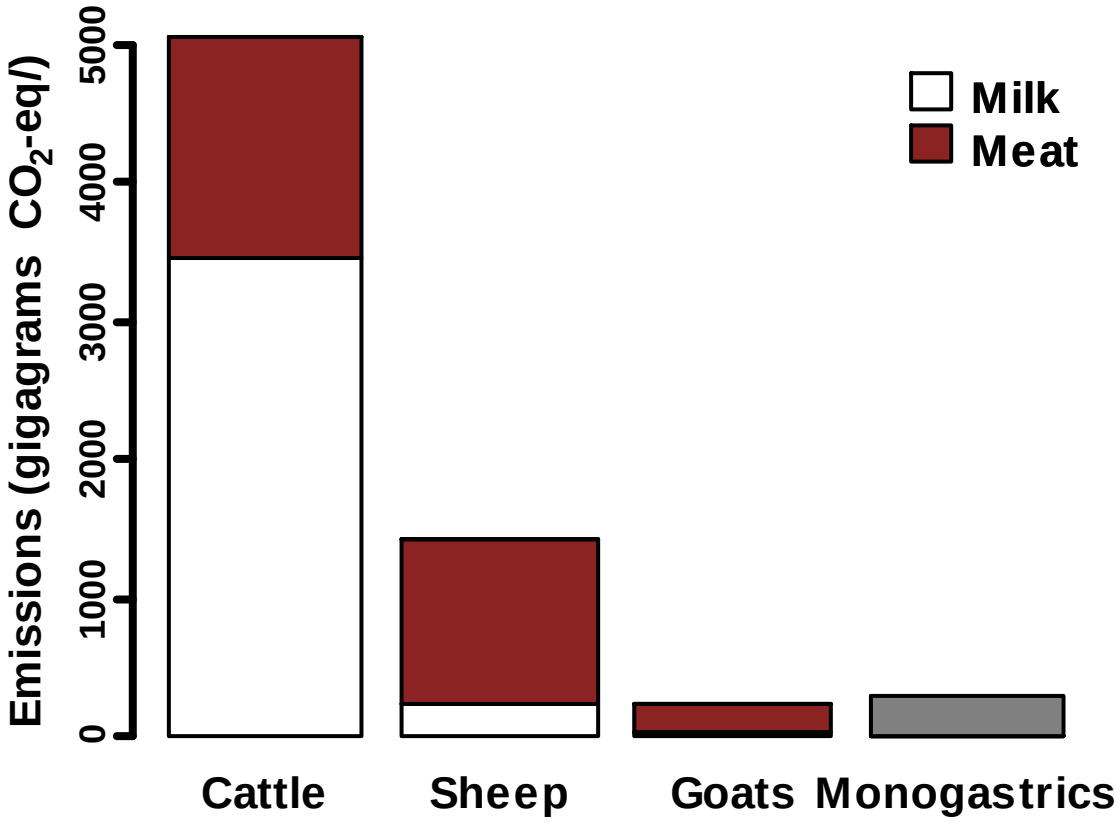
Methods

Feed parameters (dairy animals)

Feed ration (%)	Cattle	Sheep	Goats
Gras & silage	40	46.5	46.5
Crop residues	34	39.3	39.3
Fodder beet	8	9.2	9.2
Grains	3.5	0	0
By-products	14.5	5	5

Total emissions from livestock

7016 gigagrams of CO_2-eq



Total emissions from livestock

Emissions by sources

1 FEED: Fertilizer & crop residues, N_2O
Emissions from fertilizers application and crop residues decomposition.

2 FEED: Applied & deposited manure, N_2O
Emissions from manure's application and animal deposition.

3 FEED, CO_2
Emissions from feed production, processing and transport of feed.

4 FEED: LUC soybean, CO_2
Emissions from the expansion of soybean for feed into natural areas.

5 FEED: LUC palm kernel cake, CO_2
Emissions from the expansion of palm oil plantations into natural areas, as cakes are used for feed.

6 FEED: LUC pasture expansion, CO_2
Emissions from the expansion of pastures for grazing into natural areas.

7 FEED: Rice, CH_4
Emissions from rice cultivation used as feed.

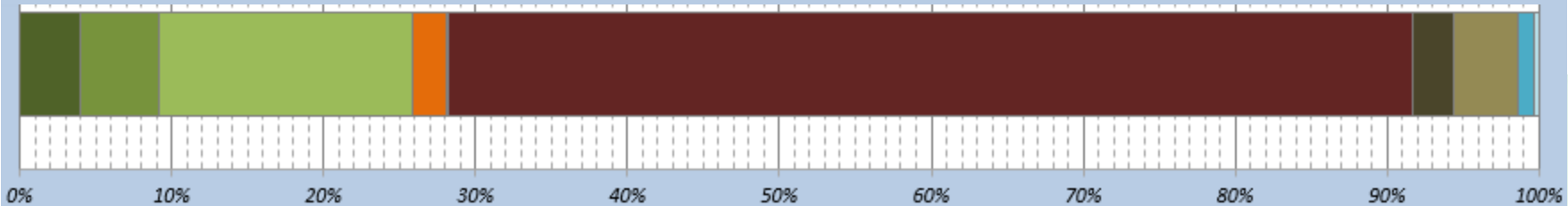
8 ENTERIC FERMENTATION, CH_4
Emissions from enteric fermentation from ruminant species and swine.

9 MANURE MANAGEMENT, CH_4
Emissions from manure management and storage.

10 MANURE MANAGEMENT, N_2O
Emissions from manure management and storage.

11 ENERGY USE: Direct energy, CO_2
Emissions from the use of energy on production site (ventilation, heating…)

12 ENERGY USE: Embedded energy, CO_2
Emissions from the use of energy on the construction of facilities and equipment.



	1 FEED N_2O fert.	2 FEED N_2O man	3 FEED CO_2	4 FEED CO_2 soy	5 FEED CO_2 palm cake	6 FEED CO_2 past.	7 FEED CH_4	8 ENTERIC CH_4	9 MANURE CH_4	10 MANURE N_2O	11 ENERGY CO_2 d.	12 ENERGY CO_2 i.
Baseline	4.0%	5.1%	16.7%	2.2%	0.1%	0.0%	0.0%	63.5%	2.7%	4.2%	1.0%	0.4%
Scenario	4.0%	5.1%	16.7%	2.2%	0.1%	0.0%	0.0%	63.5%	2.7%	4.2%	1.0%	0.4%

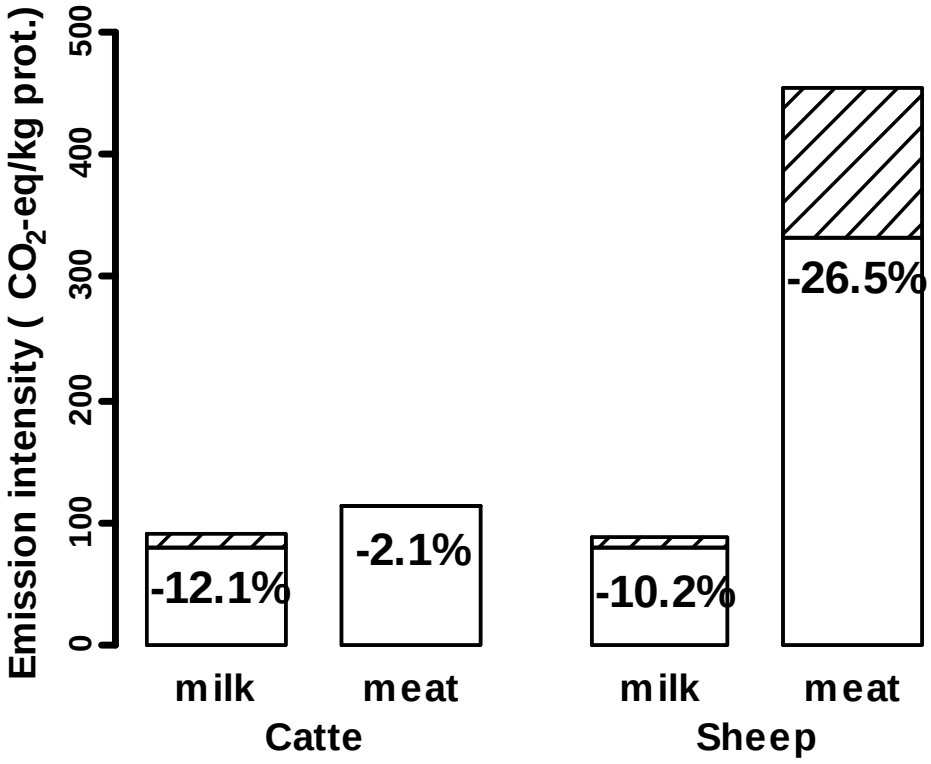
Interventions for mitigation & productivity

Quantitative changes in parameters	Associated changes in practices
5% increase in fertility and decrease in mortality	• Veterinary practices (e.g. vaccination, deworming) • Reproduction management (e.g. age at first mating)
+1-3% digestibility of forages in the feed ration	• Improved forage quality (e.g. legumes in pastures) • Crop residues processing (e.g. urea, chopping)
+1-2% grain supplementation in the feed ration	• Use of grains (or concentrates) in the feed ration
+10-15% milk yield	• Improved feeding practices (see above) • Breeding

Interventions for mitigation & productivity

Effect on emission intensity

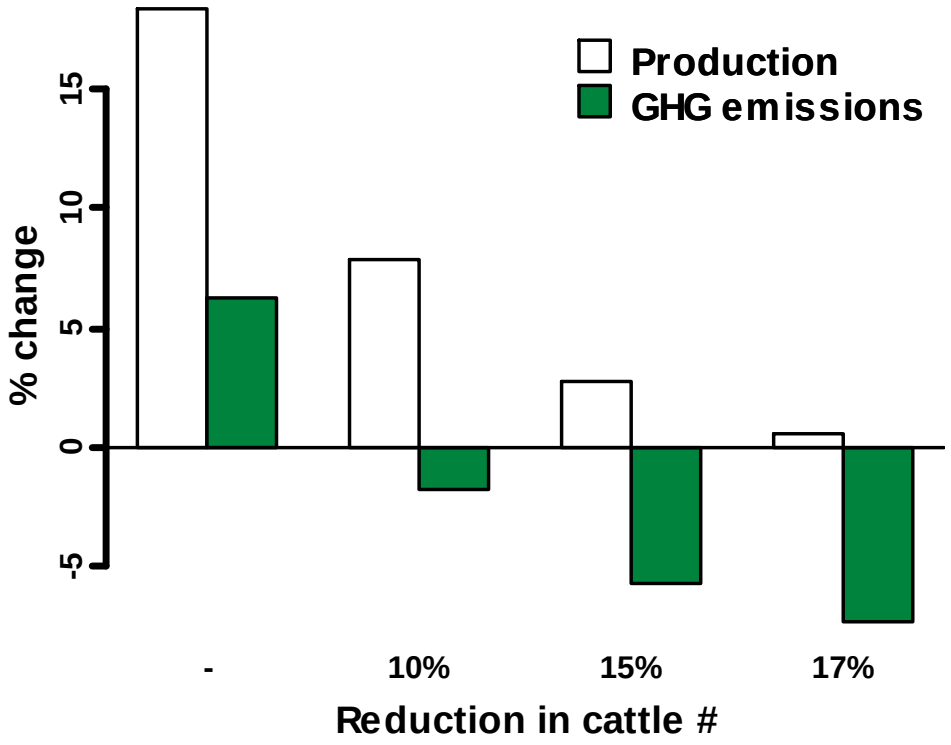
- Higher productivity
- Lower emissions *per* unit of product



Interventions for mitigation & productivity

Effect on total emissions

- +6.2% total emissions with the same herd size
- -7.3% total emissions with the same production

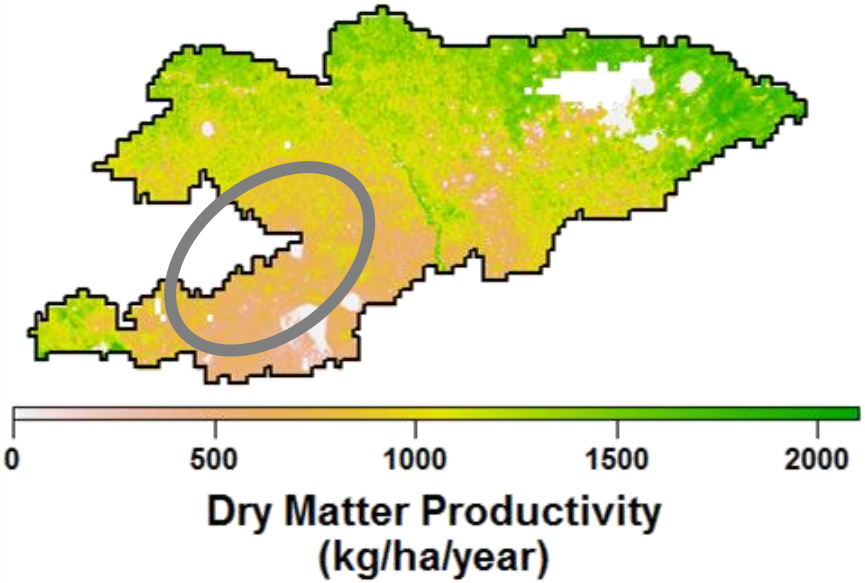


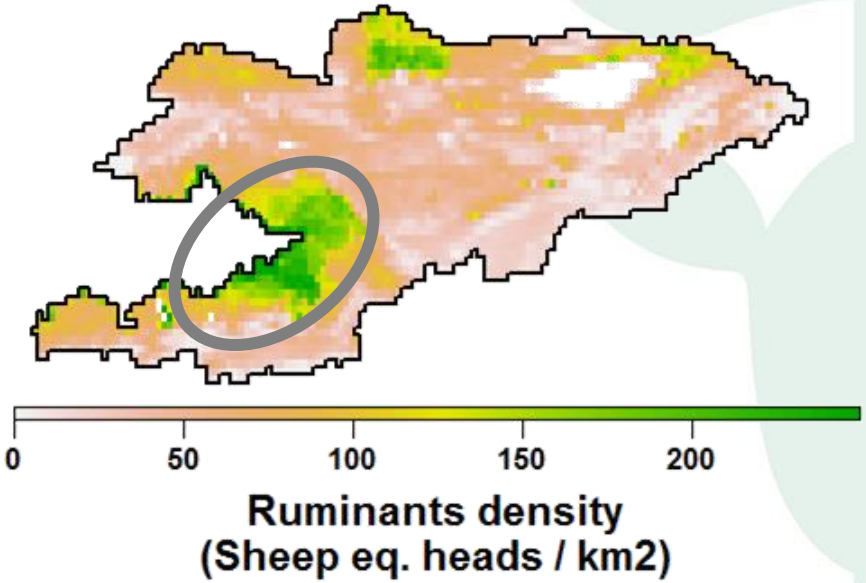
Grazing management & land restoration

Current livestock numbers could exceed the estimated land carrying capacity (up to **1.5 times**?)

Atadjanov et. al (2012)

Vegetation productivity





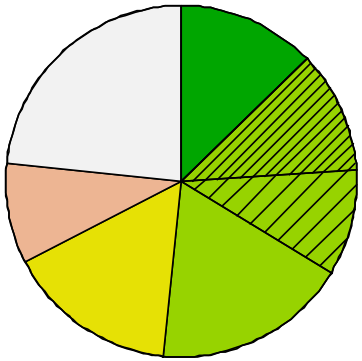
ESA Copernicus Land Service, SPOT-VGT and PROBA-V satellites

Cattle = 5, goats = 0.7 sheep eq.

Grazing management & land restoration

+19.0 tonnes C/ha in restored vs. degraded pastures?

Lal (2004)



Sequestration potential in degraded pastures: **153 Mt CO_2-eq.** (22 years of livestock emissions)?

Important uncertainty

- Rate of sequestration
- Time before reaching threshold
- Site-specific potential

Grazing management & land restoration

Improved grazing management for land restoration, pasture productivity and carbon sequestration

- Adapt the timing and intensity of grazing
- Rotational grazing
- Pasture improvement (e.g. fertilization, seeding)
- Feed supplementation in winter
- Veterinary practices
- Breeding management
- Return to transhumance

From quantification to action

- Preliminary results show an important potential to improve the contribution of livestock to productivity, climate change mitigation and adaptation in Kyrgyzstan
- The involvement of local stakeholders and experts is essential to validate the model, refine the quantification and identify the most relevant improvement practices
- Additional information and research is needed to reduce uncertainty in key areas (e.g. land degradation assessment, carbon sequestration potential)

From quantification to action

Improved livestock management require changes at sector and policy levels

- Rotational grazing can only be achieved through collective action
- Extension, veterinary services and breed management are needed to implement the options on animal husbandry, health, and feeding practices
- Specific policies would be required to support transhumance (e.g. targeting infrastructures, land tenure, conflict resolution, planning of water point provision, service delivery to mobile pastoralists)

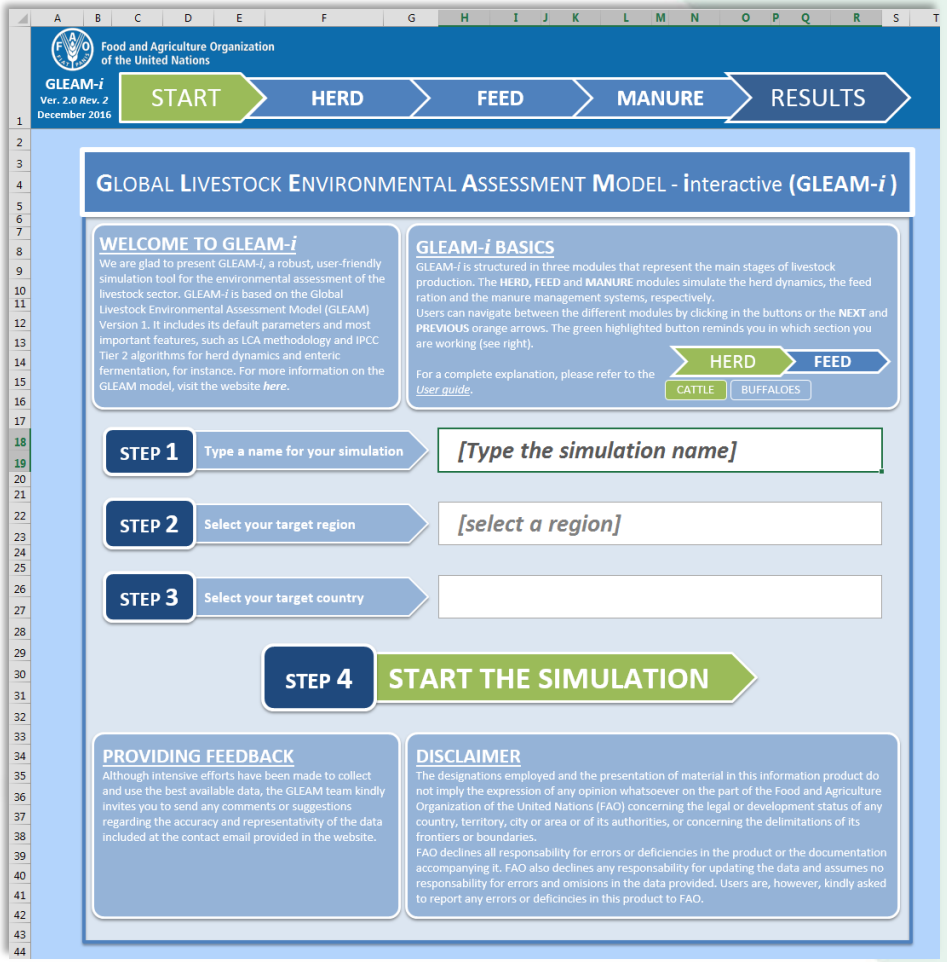
From quantification to action

Opportunities for synergies with existing frameworks and projects

- FAO country programming framework, priority areas on strengthened conditions and resilience to climate change
- GEF project on *participatory assessment of land degradation and sustainable land management in grasslands and pastoral systems*
- FAO project on dairy cows
- GCF proposal on *climate smart transformation of land use practice*

GLEAM-i: interactive version

- Publicly available, user-friendly tool for calculating emissions using Tier 2 methods in a single Excel file at country level
- Designed to support governments, project planners and civil society organizations
- Can be used in the preparation of national inventories and in ex-ante evaluation of projects with interventions in livestock



Thank you

The GLEAM TEAM: Giuseppina Cinardi, Alessandra Falcucci, Juliana Lopes, Ruben Martinez-Rodriguez, Anne Mottet, Carolyn Opio, Monica Rulli, Giuseppe Tempio, Félix Teillard, Aimable Uwizeye