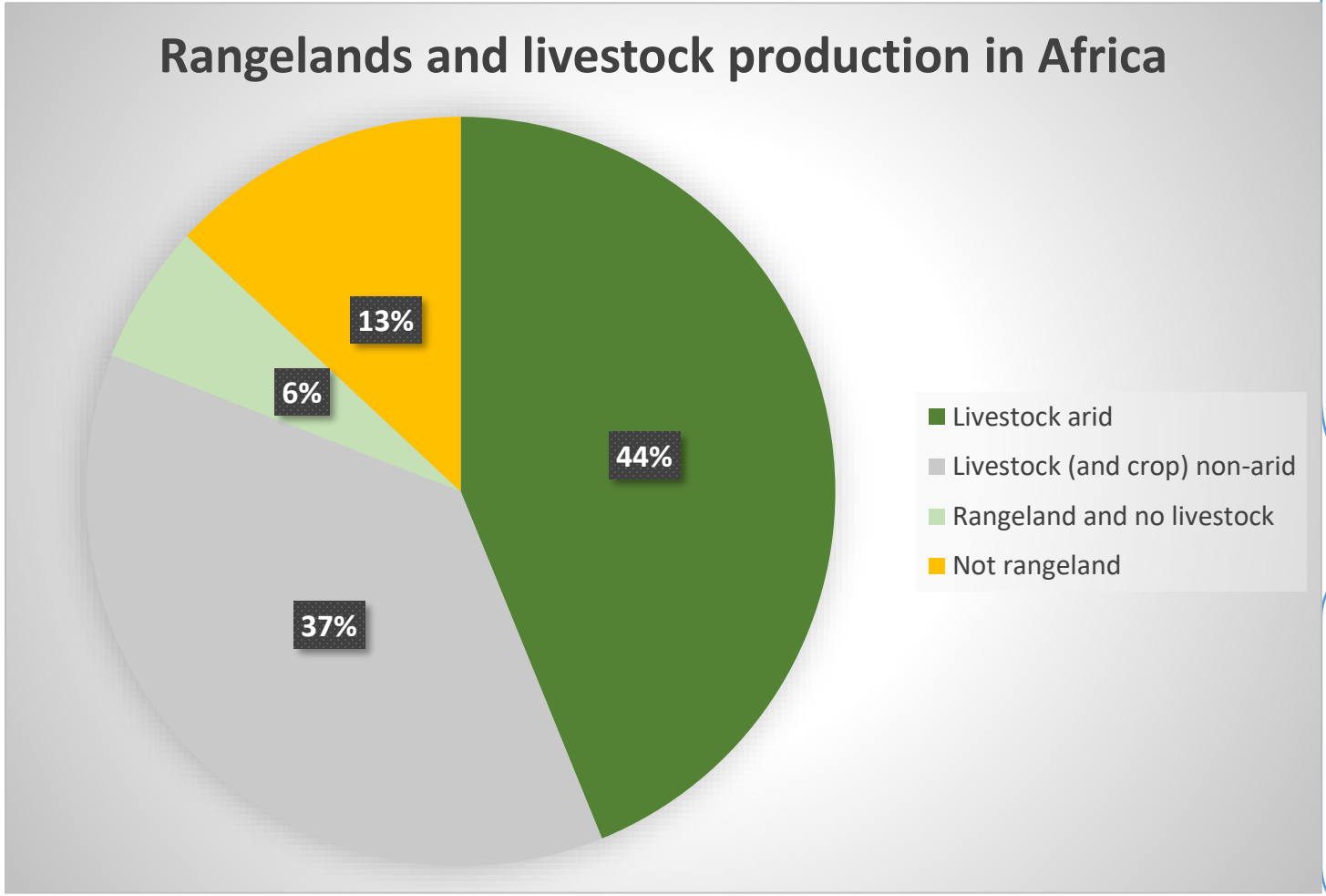
Key Challenges: Climate Perspectives

Anthony Whitbread
Sustainable Livestock Systems (SLS) program, ILRI

Inclusive Investment Opportunities for Unleashing the Power of the Pastoral Sector
31 Jan 2023

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
CGIAR

Rangelands & livestock Africa



Rangelands

Cover 30 million sq km

81% of which is used for livestock production

13 million sq km (44%) of land is classified as arid and too dry for crops

Grasslands make up 37% of Africa's rangelands

Rangelands and their people offer two major opportunities yielding *many* co-benefits

Food production
Environmental stewardship

Source: Rangelands Atlas*, ILRI et al, 2021*

Restore and sustain the rangelands and its communities

- Pastoral systems are in transition: pressures of degradation, climate, population, conflict.
- Droughts have increasing severity and frequency: '…three consecutive droughts capped by the worst March-April-May (MAM) rains in 73 years, famine looms in southern Somalia…'
- Poverty rates, food insecurity, and malnutrition remain high.
- Data scare: Rangeland condition/water sources/markets/HH dynamics, GHG's and mitigation pathways

- Interventions require a deep understanding the pastoral system (society, livestock, land, markets etc.), its dynamics and responses (including adaptation), multifunctionalilty and resilience.
- Local institutions are at the core of sustainable rangelands — local institutions must drive management, restoration, animal health and other priorities of communal producers. Our role must be to support these institutions toward self-sufficiency.

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
CGIAR

Opportunities – Sustainable Livestock Systems

Restore and sustain rangelands and communities

1. **Participatory rangeland management (PRM)** to improve land and resource tenure security and governance, land use planning.
2. **Early warning/anticipatory action** by understanding how drought impacts pastoral systems and livelihoods. **KAZNET** & **crowdsourcing** as a way to overcome the complexity of collecting data in fragile and remote pastoral settings. **Jamel Observatory**

Building climate smart livestock-based systems – mitigation and adaptation

1. **GHG:** Most African countries have NDC commitments, but capacities for MRV (esp. livestock) do not match NDC ambitions: Build livestock GHG emissions/mitigation options and inventory requirements
2. **Climate risk management** tools for pastoral systems co-developed with public and private sector extension services.
3. **Science-policy interactions:** Institutional support for knowledge brokers, overcoming the mismatch between national priorities and investments.

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

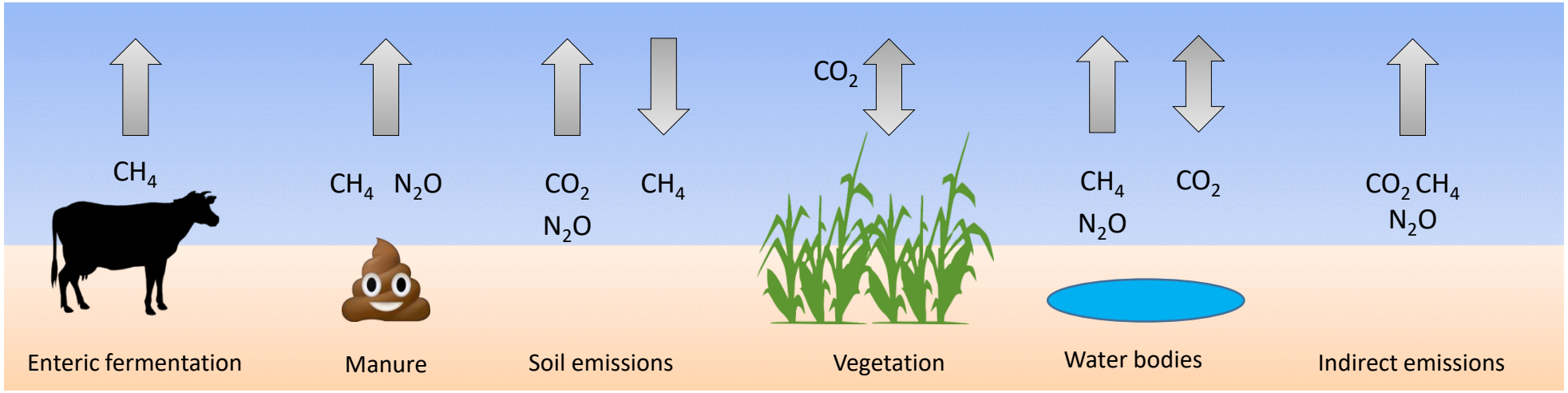
The International Livestock Research Institute (ILRI) is a non-profit institution helping people in low- and middle-income countries to improve their lives, livelihoods and lands through the animals that remain the backbone of small-scale agriculture and enterprise across the developing world. ILRI belongs to CGIAR, a global research-for-development partnership working for a food-secure future. ILRI's funders, through the CGIAR Trust Fund, and its many partners make ILRI's work possible and its mission a reality. Australian animal scientist and Nobel Laureate Peter Doherty serves as ILRI's patron.

You are free to use and share this material under the Creative Commons Attribution 4.0 International Licence CC BY.

better lives through livestock

ilri.org

Greenhouse gas emissions from rangelands



- 14.5% of total global GHG emissions originate from livestock
- Low livestock productivity in SSA in extensive livestock systems
- → high GHG emissions intensities (GHG emissions per kg of milk or meat) in Africa

➢ Need for low-emissions development to ensure climate change mitigation & adaptation

Enteric CH_4 emissions from livestock (indirect estimation)

Input data

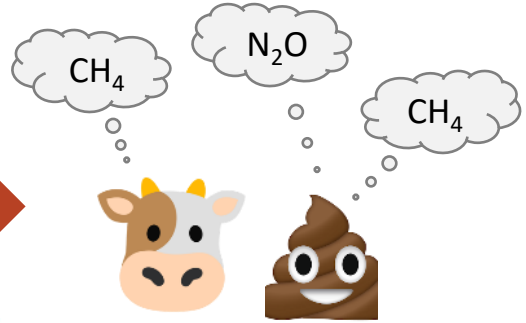
Animals

Feed

Milk **Manure**

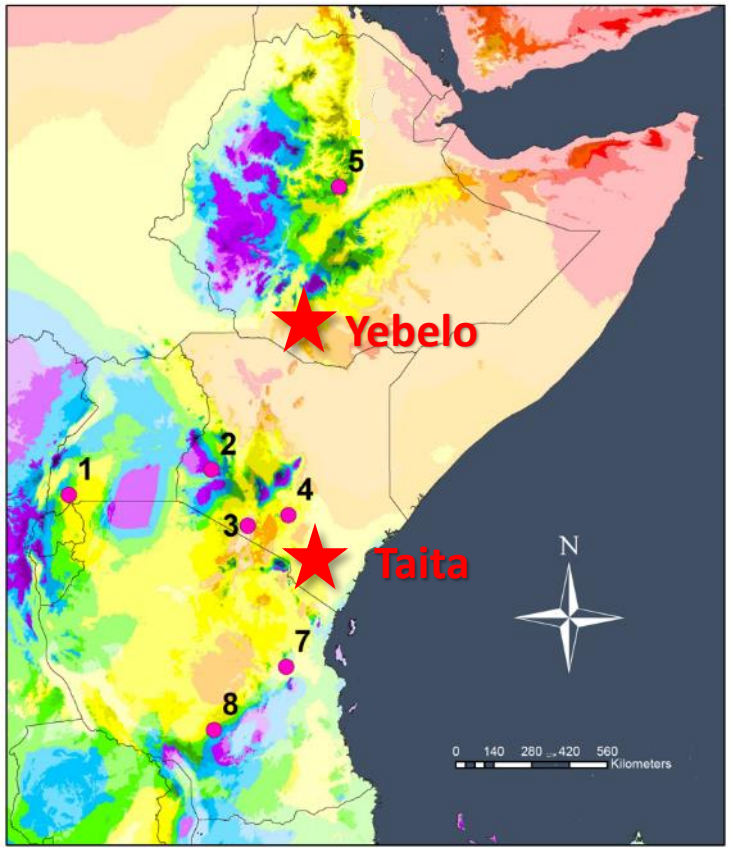
GHG emission factors

Equations

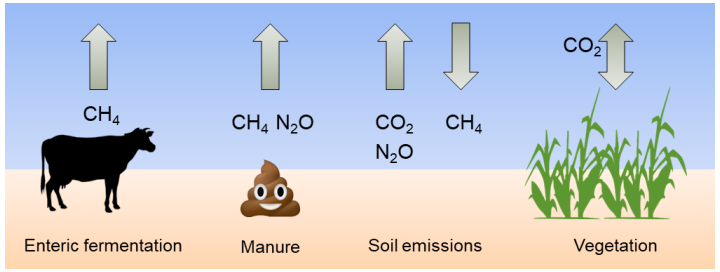


IPCC CSIRO

Upscaling & LCA, national GHG reporting



Ecosystem carbon and water exchange using Eddy Covariance (EC) towers



Eddy tower at Kapiti Research Station

Merbold et al, manuscript in preparation
Vincent Odongo, ongoing research

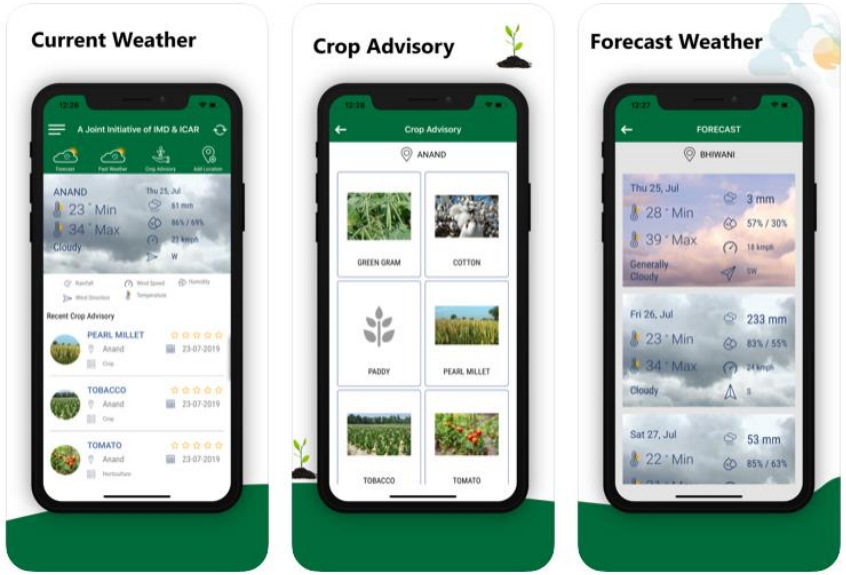
- **Ecosystem CO_2, CH_4 and H_2O exchange** in savanna
- "Sees" incoming and outgoing C and H_2O fluxes
  → **temporal dynamics of C sink or source** strength
  → effects of climate change (long-term)
- Soil moisture profiles & soil lysimeters
  → evapotranspiration, **water balance**
- **Vegetation activity** (sun-induced fluorescence, FLOX)
  → photosynthetic activity, net ecosystem CO_2 exchange

Agroscope
UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA
UNIVERSITÀ DEGLI STUDI DI MILANO
ILRI
CGIAR

Mission of ILRI's Mazingira Center

- **Baseline data** on enteric methane emissions from tropical ruminants fed on tropical diets kept under tropical conditions (e.g. dry seasons and restricted intakes)
- **Measurement on interventions** that **increase animal productivity** and thereby **decrease emission intensities** (g methane per kg animal-source product).

Adaptations – Risk reducing measures



Climate risk management

- Weather, climate and decision support
- Decision support linked to dissemination (ICT, IVR, Apps)
- Institutional arrangements to integrate public sector resources

(e.g. Met agencies, Dept of Ag, Livestock, Extension services) & private sector

Financial products such as livestock insurance (IBLI)

Early Warning

Welfare benefits of financial products and behavioural change

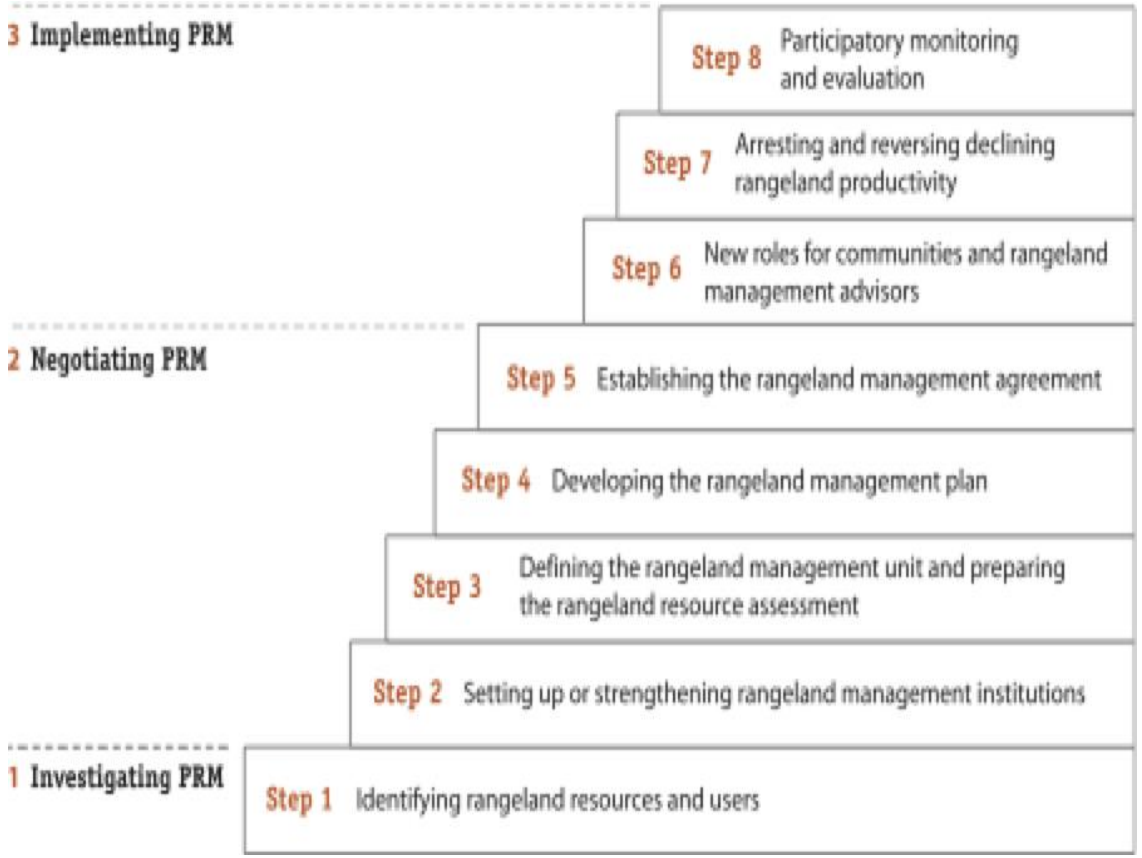
- Financial products such as livestock insurance have resulted in:
  - Almost 50,000 micro-level policies being sold in Kenya and Ethiopia – currently scaling underway in Somalia and Sudan
  - More than 100,000 people covered under livelihood protection livestock insurance programs - ***women account for 43% of policy holders***
    - 36% reduction in likelihood of distress livestock sales
    - 25% reduction in likelihood of reducing meals, especially (43%) among those with small herds
    - Seemingly responsible for reducing reliance on the most adverse behaviors
    - Major payouts in 2011/12, 2014/15, 2016/17 and 2018/19 – ***close to USD 10 million***
  - Payouts are used for accessing food, fodder, veterinary services, education among others
- Opportunity of value addition by complimenting market driven services and natural resource management efforts

Need for understanding the complex environment of the drylands

- Requires reliable and regular data and information – ***often a scarcity in the drylands***
  - Possible to obtain using the principles of crowdsourcing, engagement of community members through digital technology
  - Data being collected from 14 livestock and commodity markets in Kenya and Ethiopia (via KAZNET)
  - Rangeland data being collected to complement Earth Observation and high frequency data for monitoring
    - Tracking consumption commodities helps in the influence of the diets, and nutrition status, especially during stressful periods
    - Change in diets being observed to cope with the impacts of drought and other climate shocks – shift to legumes in the event of unavailability of milk
  - Need for investments in cost-effective information gathering processes to understand the mechanisms through which shocks impact livelihoods

Strengthening rangelands tenure security, governance and management

Participatory rangeland management (PRM)



ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

• "Key Challenges: Climate Perspectives"

- Prevention is less costly than the cure (rangelands are not at “rock bottom”, not yet!).
- Climate change will vary among regions and agro-ecological zones. Try to swim 'downstream', not ‘upstream’ (we can’t store C in soil that is losing C due to climate change-induced loss of rainfall).
- We still lack feasible and effective restoration options, especially for communal grazing lands (and need to differ from commercial ranching).
- In dry rangelands, the old focus on stocking at carrying capacity and intensive rotational grazing has shifted toward more practical approaches.
- The new focus is on local knowledge, from Mongolia to USA to Somalia.
- Local knowledge is strong on maintaining consistent livestock production, but is not strong on ecosystem restoration. Fusion of science and local knowledge can reverse degradation and restore productive ecosystems and livelihoods.
- Local institutions are at the core of sustainable rangelands — local institutions must drive management, restoration, and links to disease control and other priorities of communal producers. Our challenge is how to effectively support these institutions toward self-sufficiency.

• "Key Challenges: Climate Perspectives"

- Improved land tenure and governance can strengthen the capacities of pastoralists to adapt to climate change.
- Pastoralists are seasoned adaptors to climate change and some suggest that they have reached a ceiling in terms of adapting in their current context – unless their context changes they cannot adapt more. Changing their context includes such as provision of markets, change in policy and legislation, and new opportunities for education or entrepreneurial activities.
- Accessing climate finance is an opportunity for pastoral areas but a significant challenge – pastoral areas are considered high-risk areas. Overcoming or mitigating these risks will be necessary if commercial investment is to become a reality.
- Social networks are critical for pastoralists coping strategies and building the strength of the collective – poorly planned and ill-informed interventions can damage this collective particularly those that promote more individualistic ideals.

Index Based Livestock Insurance (IBLI) and KAZNET: Why and for Whom?

- About 50% of livestock losses in Kenya is attributed to drought impacts.
- Droughts are not only becoming more frequent, but also more intense and prolonged.
- The index-based livestock insurance (IBLI) is a product of research by ILRI and its partners and has been shown to effectively address drought impacts by:
    - Increasing incomes and milk production.
    - Reducing the likelihood of skipping meals by 27–36% and reducing the likelihood of practicing distress selling by 22–36%.
    - Doubling of veterinary expenditures & 46% increase in livestock sales in non-drought years.
    - reducing the risk inherent in keeping livestock in a vulnerable system and enhancing financial deepening in pastoral areas.
- Notable examples include (1) the Kenya Livestock Insurance Program (KLIP), which was designed with technical guidance by ILRI, and which expanded to cover 8 counties and 19,000 households by 2016; and (2) the World Bank funded De-risking Inclusion and Value Enhancement of Pastoral Economies in the Horn of Africa (DRIVE) project, which ILRI led it feasibility analysis and social assessments.
- Designing effective interventions to address drought impacts requires enhanced ability to monitor the mechanisms through which drought affects livelihoods.
    - Using KAZNET, a mobile phone app designed by ILRI and used by pastoralists themselves, ILRI in collaboration with the Kenya Livestock Marketing Council, is able to support data collection in remote and often conflict prone pastoralists contexts to monitor the performance of markets, rangelands, and households' nutrition status. This information is helping to inform anticipatory and early action to address drought impacts and build resilience of pastoralists households in Kenya.

Modeling Pastoral Resilience

The **Challenge**: Resilient Pastoral/Livestock Systems into the Future…

Resilience: What is resilience? Resilience… *of what? for who? for when? Under what conditions?*

Brief Simulation **Example**…Pastoralist agroecosystems in southern Ethiopia…

The Way Forward …

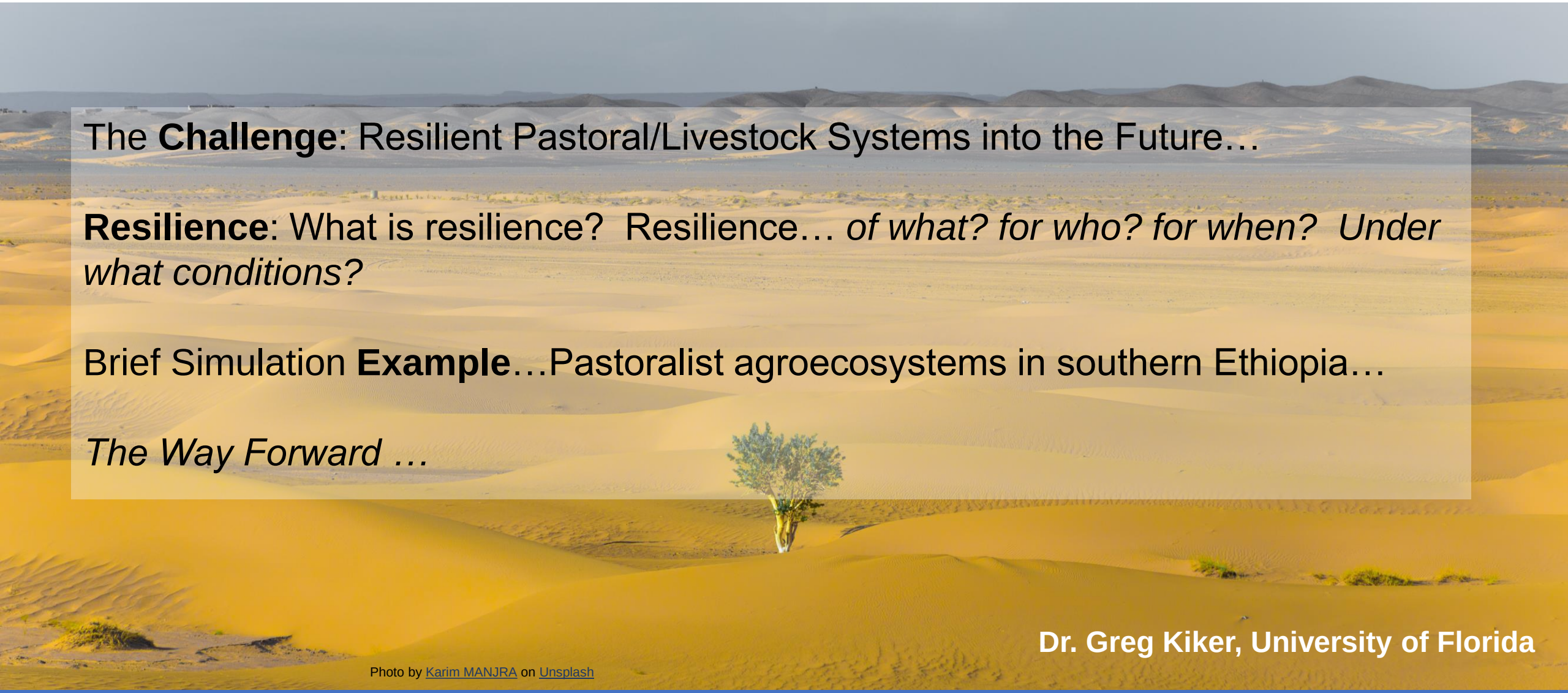
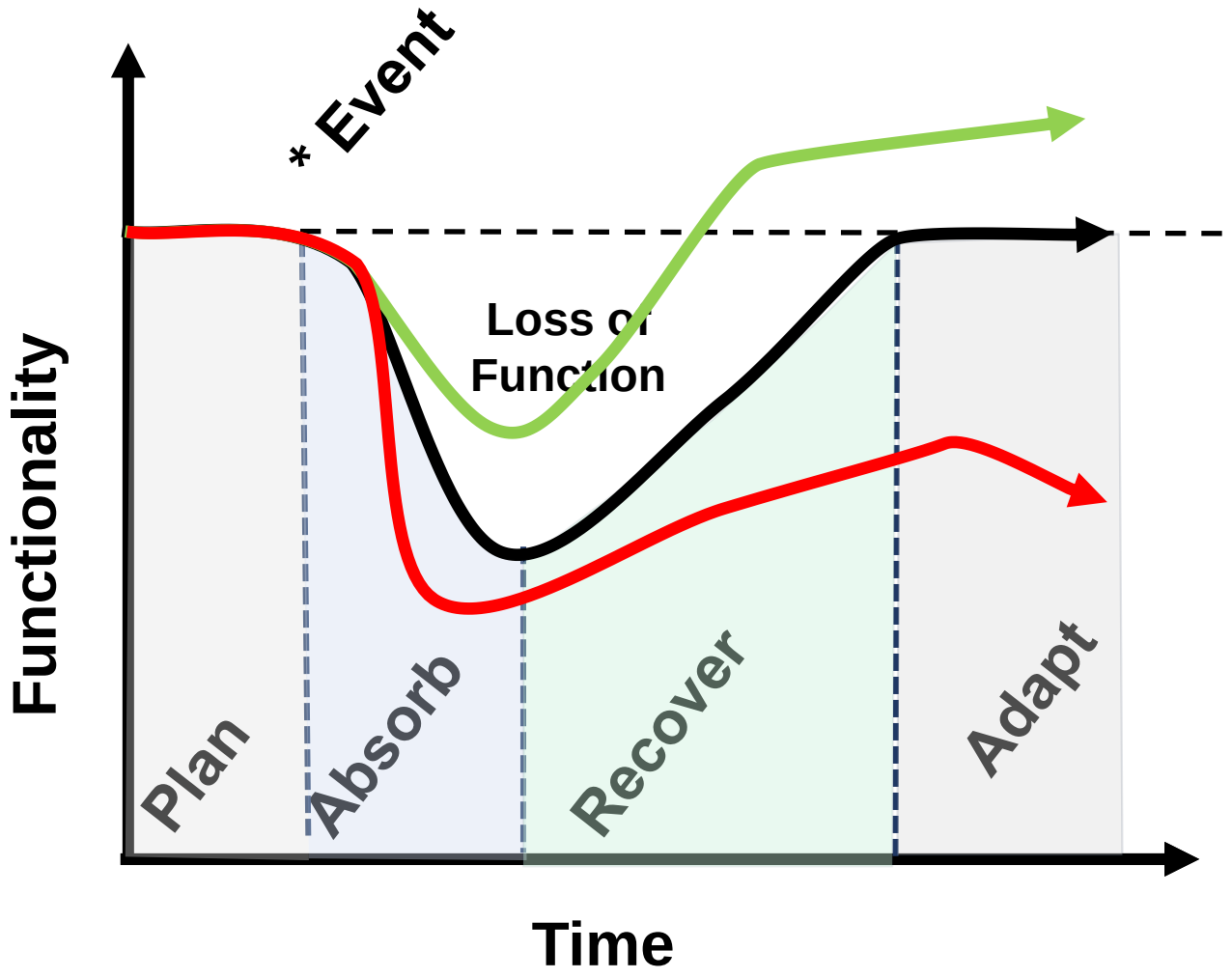


Photo by Karim MANJRA on Unsplash

Dr. Greg Kiker, University of Florida

What is resilience?



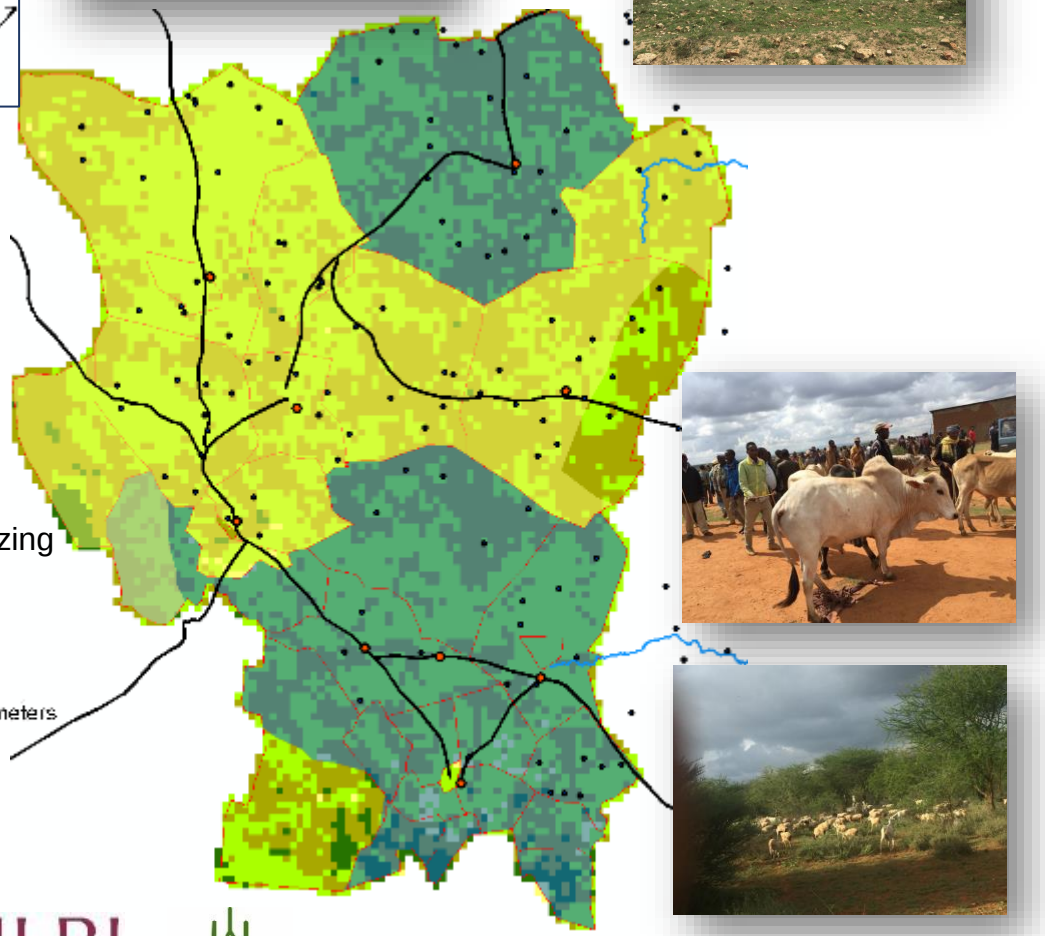
Resilience Challenges

- Volatility
- Uncertainty
- Complexity
- Ambiguity

National Research Council 2012. *Disaster Resilience: A National Imperative*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13457

Linkov, I., Trump, B. and Kiker, G., 2022. Diversity and inclusiveness are necessary components of resilient international teams. Humanities and Social Sciences Communications, 9(1), pp.1-5.

SAVANNA/DECUMA Model for Landscape-Scale Processes for Pastoralists



- Federal Democratic Republic of Ethiopia in Yabelo, the Borena zone of Oromia
- Dirre Dheeda (03° 55’ 37” N, 04° 46’ 24” N, and 037° 58’ 10” E, 039° 05’ 05” E) a grazing unit of the Borana Zone in southern Ethiopia.
- 15 876 km^2, Avg. Temp. 19-24 ° C, Bimodal Rainfall (300-900mm)
- Mixed Savanna (grasses, forbs, shrubs and trees)
- Both agro-pastoralists and full-time pastoralists
- Livestock dominated by cattle, small stock, with some camel
- Teff (a local cereal) is the main staple with primary protein sources from meat and milk
- Undergoing tenure policy reforms related to seasonal grazing
- **Management Question:** Open Access or a return to Seasonal Access (Wet/Dry Areas)?

UNIVERSITY OF NAIROBI

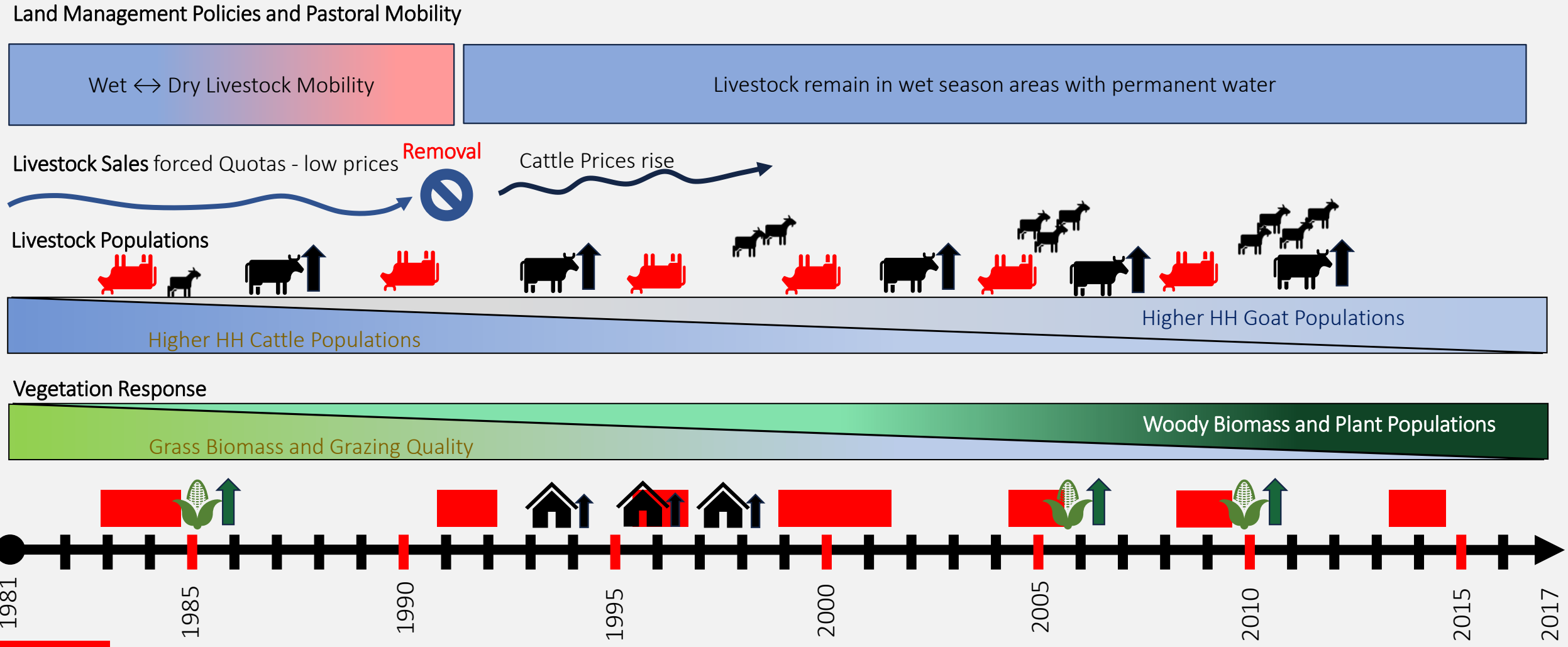
ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

DAAD
Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Pastoral Agroecosystems are complex and ever changing

Historical Dynamics in the Dirre/Borana Region

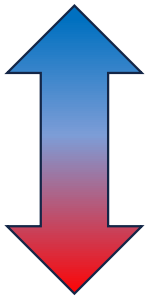


Senda, T.S., Robinson, L.W., Gachene, C.K. and Kironchi, G., 2022. Formalization of communal land tenure and expectations for pastoralist livelihoods. Land Use Policy, 114, p.105961.

Senda, T.S., Robinson, L.W., Gachene, C.K., Kironchi, G. and Doyo, J., 2020. An assessment of the implications of alternative scales of communal land tenure formalization in pastoral systems. *Land Use Policy*, *94*, p.104535.

SAVANNA/DECUMA MODEL FOR LANDSCAPE-SCALE PROCESSES FOR PASTORALISTS

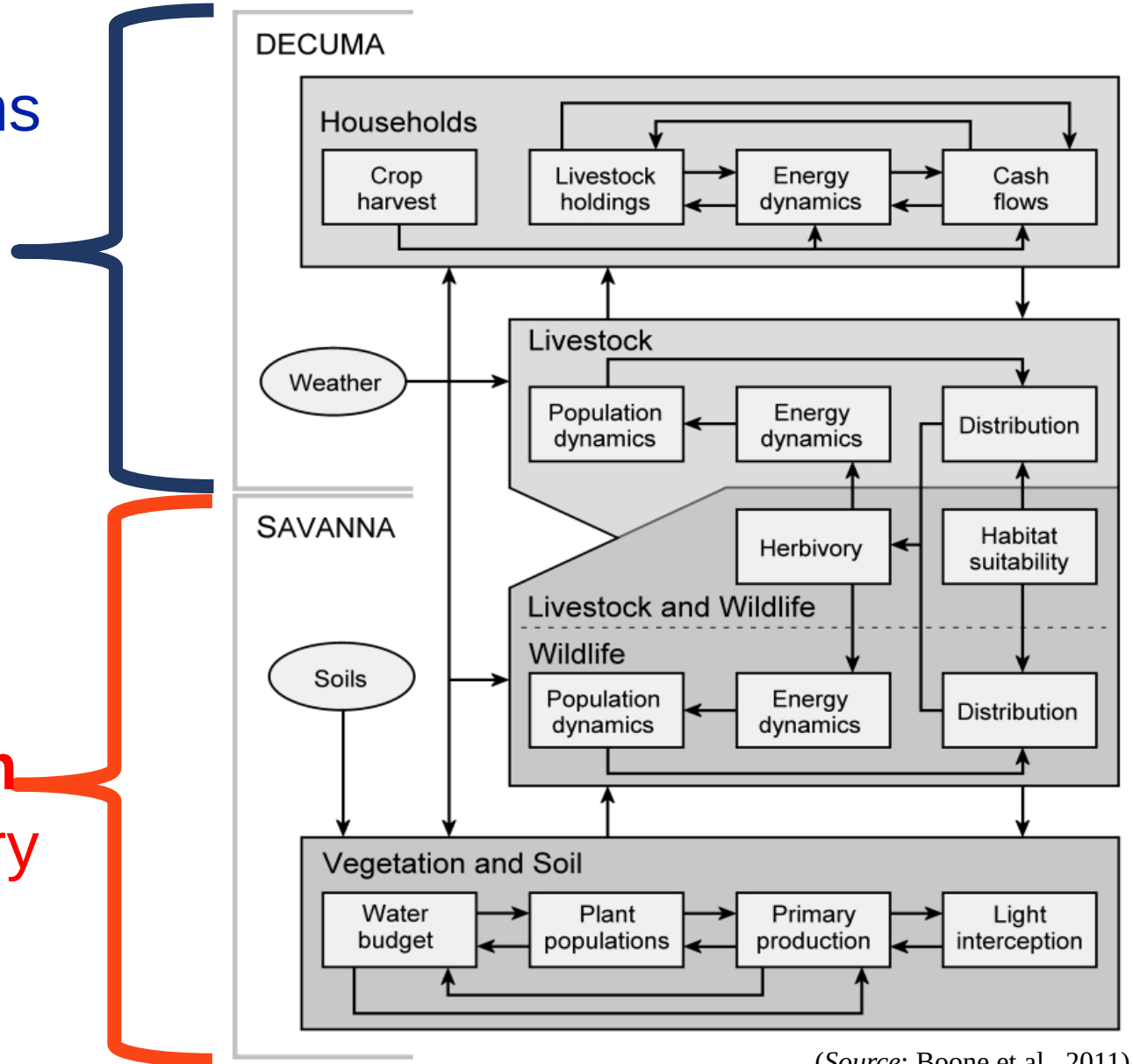
DECUMA: Simulates **human** actions on the landscape (crops, cattle, movement)



Each simulated week… maps are exchanged…
Humans moving household livestock
And…
the savanna ecosystem response…

SAVANNA: Simulates **ecosystem** responses to climate and herbivory

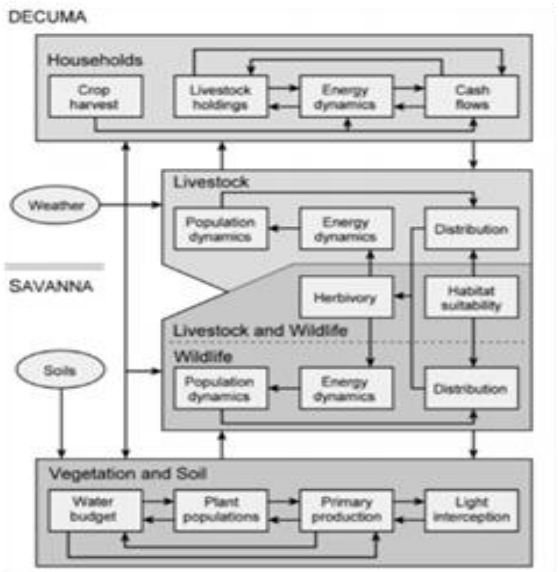
Test Conditions: Pastoral Grazing Access (Open vs Managed)
Climate Change (↗ Temp and CO_2 Conc)

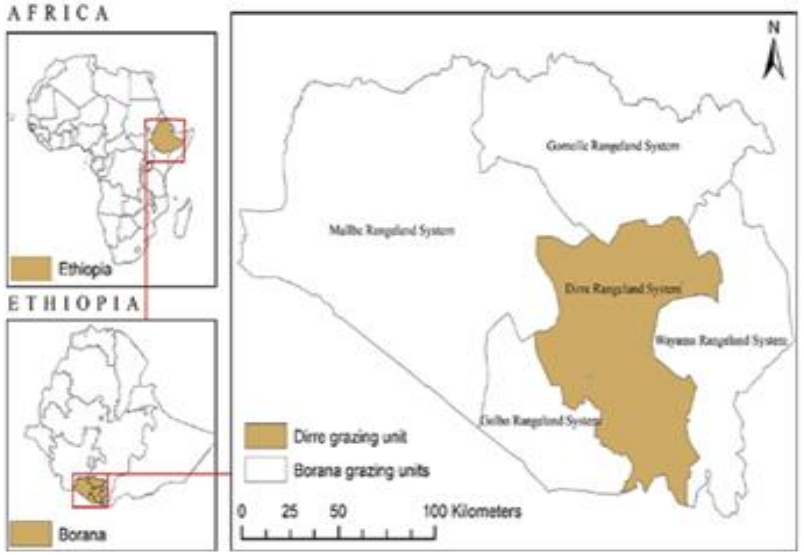


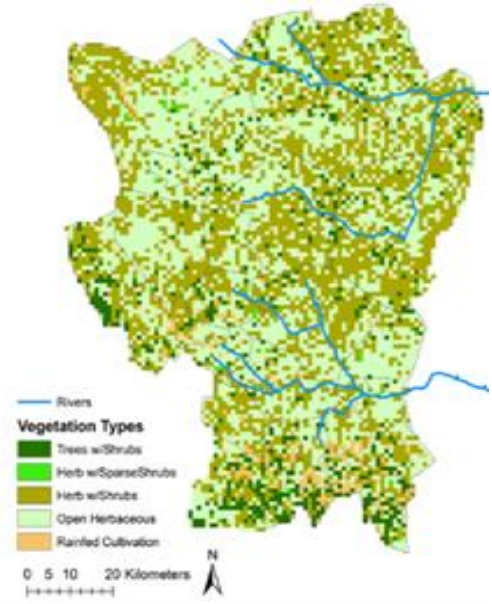
(*Source*: Boone et al., 2011)

Overview: SAVANNA/DECUMA application in the Dirre region of Ethiopia

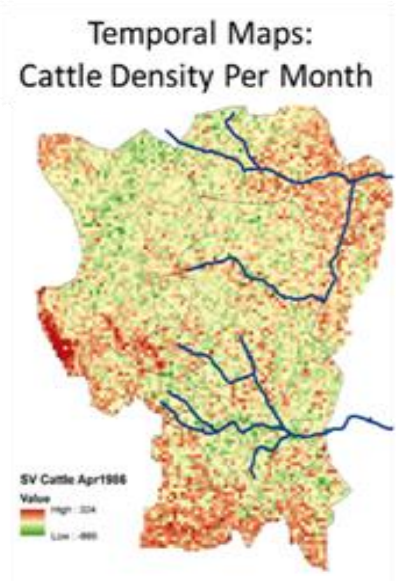
- Inputs
  - Grid = 1 km^2
  - Communal stocking rates
  - 250 HHs with livestock + crops
  - 38 years simulated (1981 – 2017)

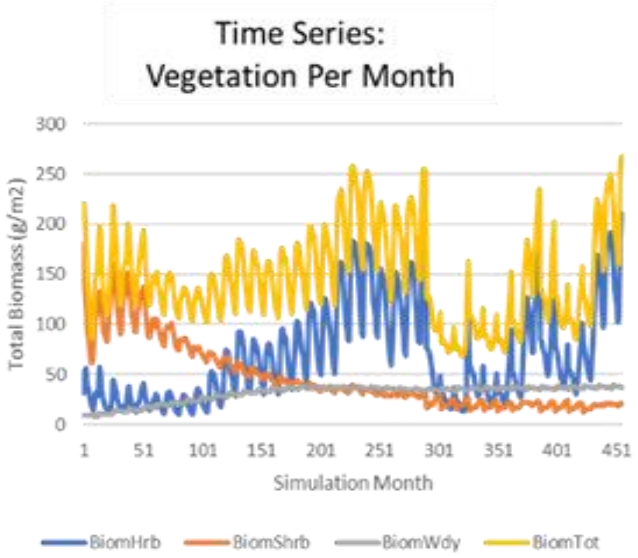


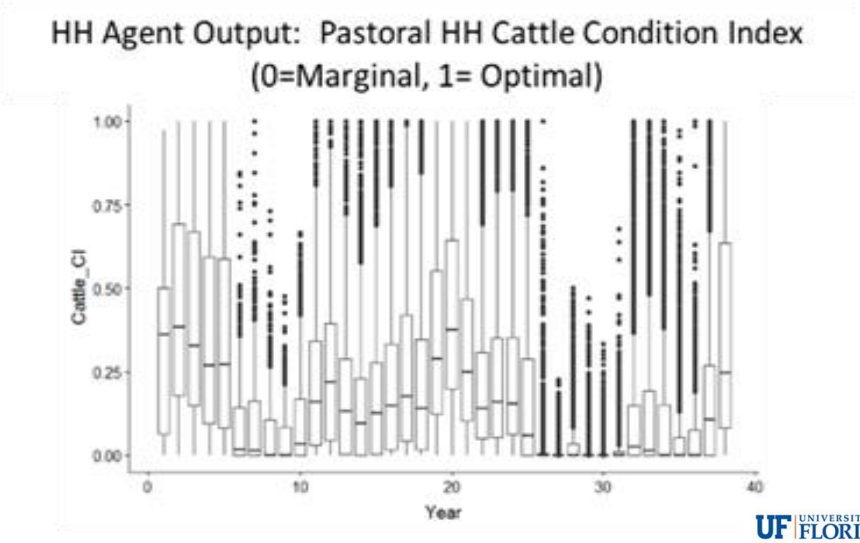




- Outputs
  - Grids
  - Time Series
  - Household data
    - Maps
    - Food/Finance budgets/ Livestock over time







Sources: Boone et al., 2011; Senda et al., 2022 in prep; Ajayi et al., 2022 in prep.

Results in Brief

SAVANNA/DECUMA creates **a lot** of results… (300+ Mg per run…)

Livestock Resilience
(Condition Index & Populations)

Human Resilience
(Livelihoods, food consumption)

Ecosystem Resilience
(Biomass, Plant functional groups)

Pastoralist Livelihoods

Through managed grazing, households can manage to preserve their herds and even acquire some additional animals

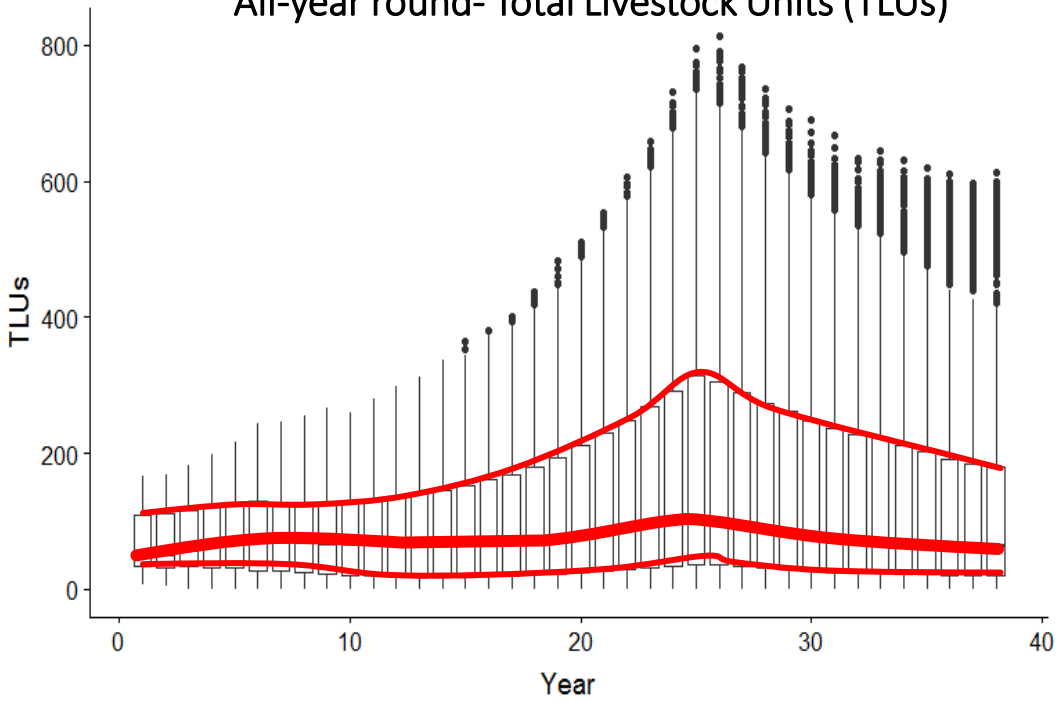
- Most TLU increase is due to shoats (sheep & goats)
- Results vary ***widely across*** HH's in all management scenarios (*there are significant winners and losers in all scenarios*)
- Climate change can add volatility and variations

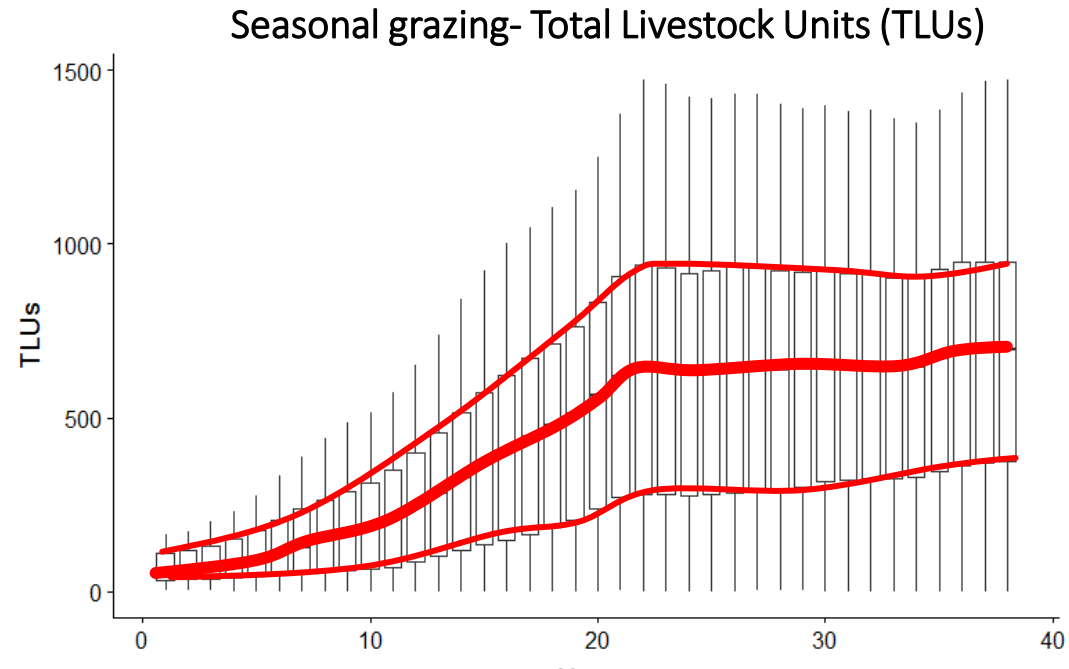
Open Access

Managed Access

Wet

Dry



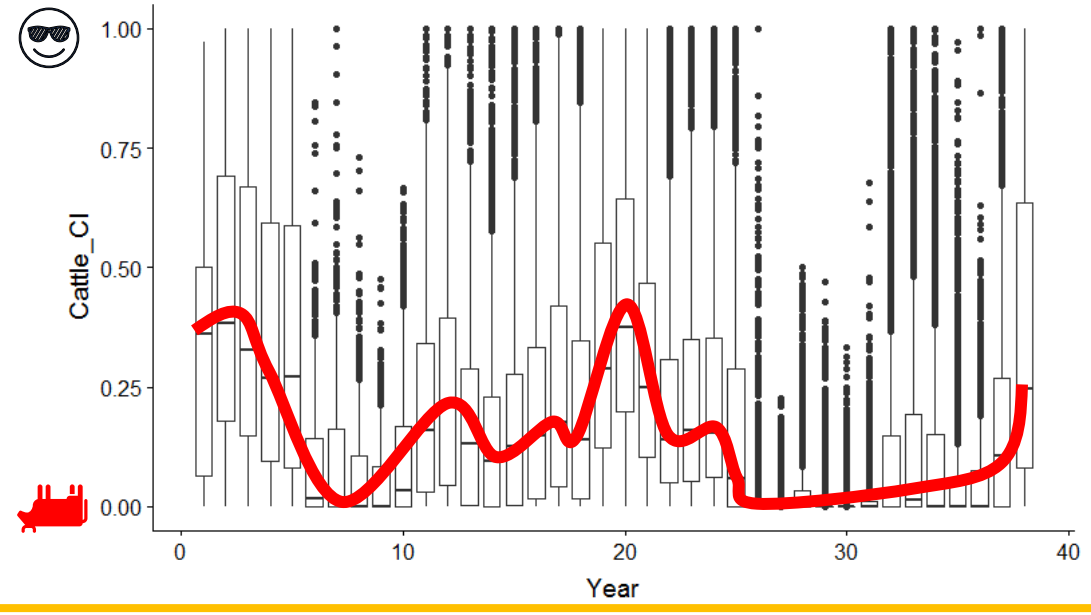


Household Cattle and Goat Condition Index (0=Marginal, 1= Optimal)

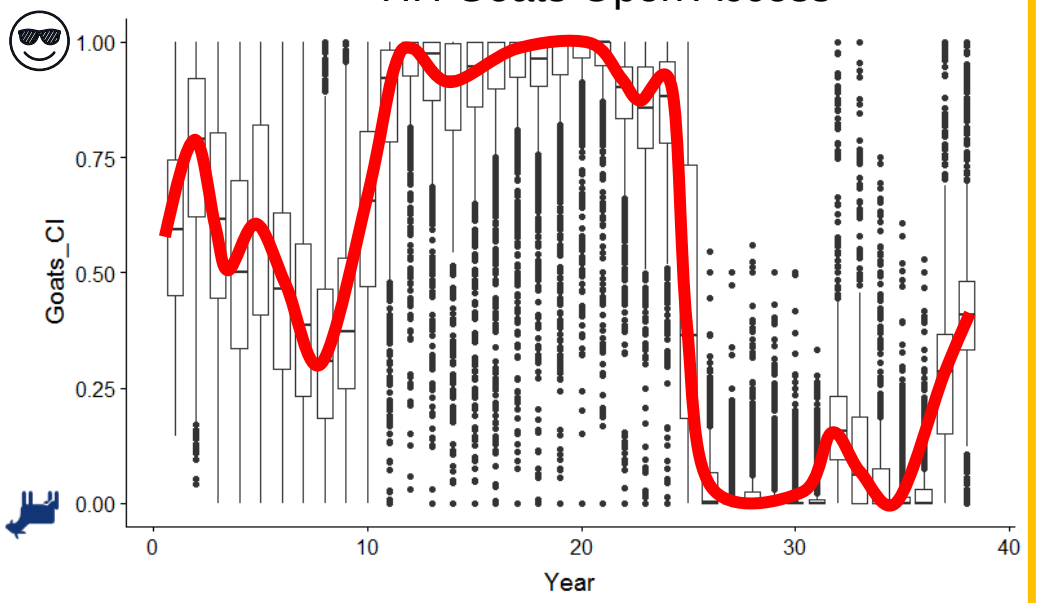
95%
75%
Mean
25%
5%

n = 250 Household Agents

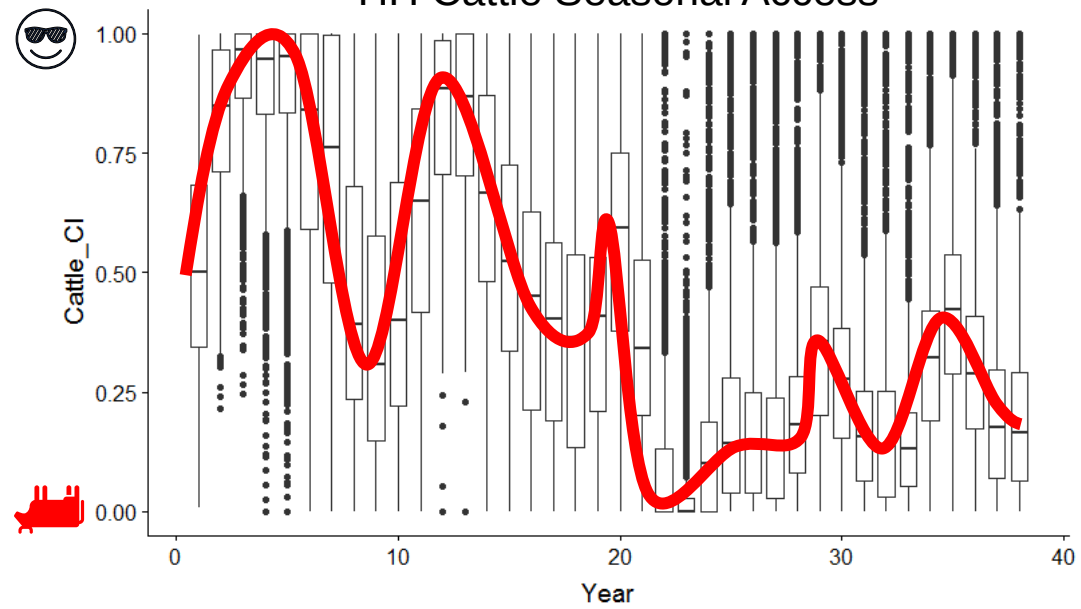
HH Cattle Open Access



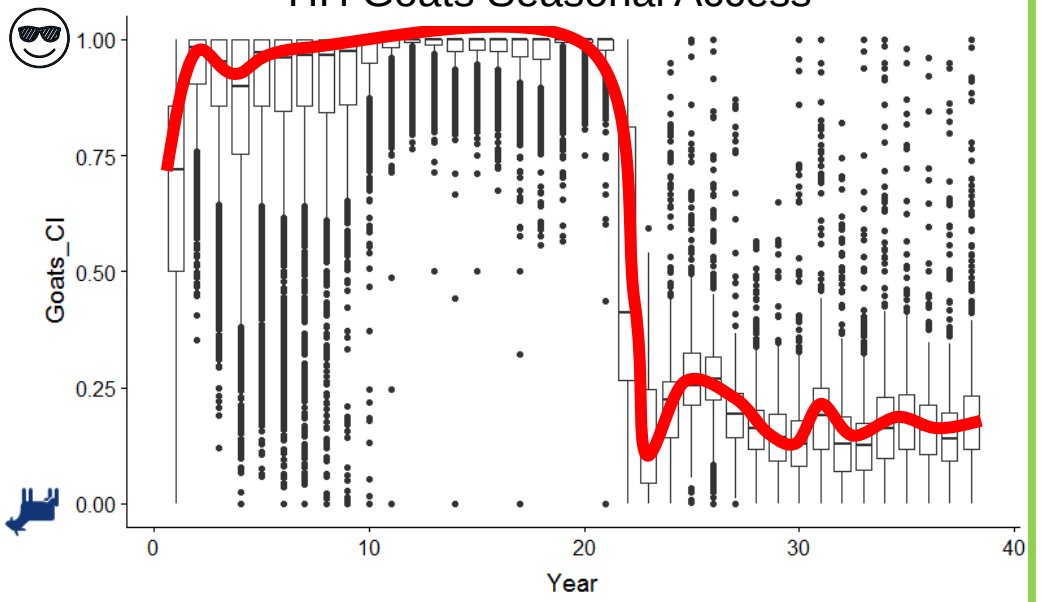
HH Goats Open Access



HH Cattle Seasonal Access



HH Goats Seasonal Access



Results in Brief: Grass Biomass

Managed Access allows some areas to recover

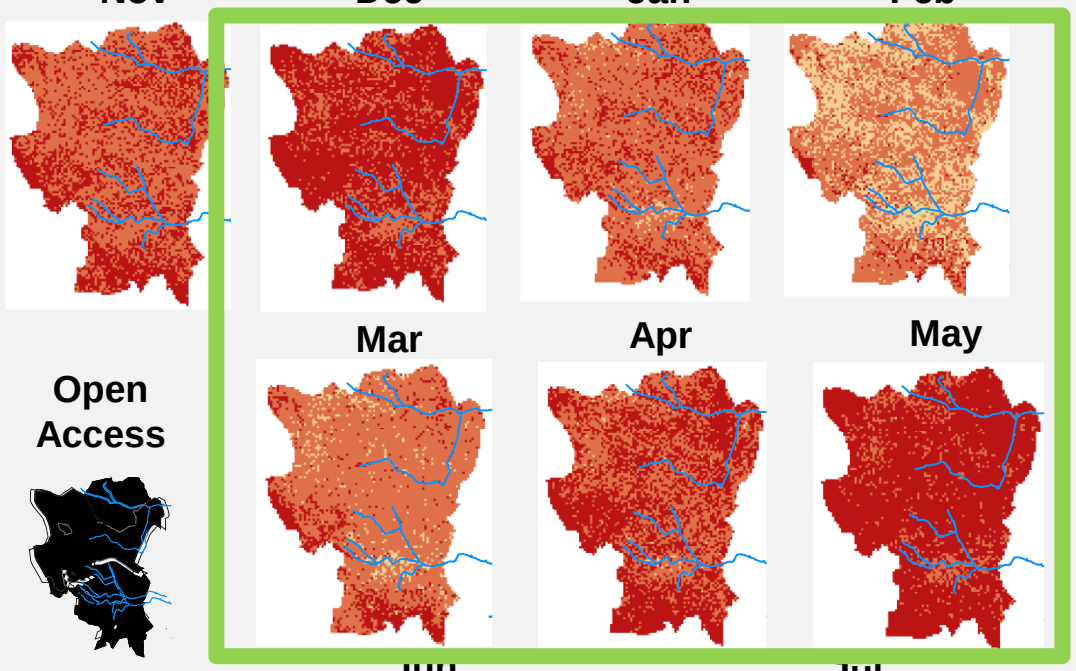
Benefits of Managed Access grazing are greater in higher rainfall years

By moving the grazing pressure around good grazing is maintained further into February and also starts to recover more in October

Systematic reduction of palatable species occur in all management scenarios

Good Year 1981/82

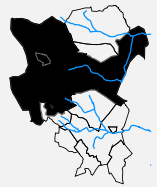
S1:Open Grazing



Open Access

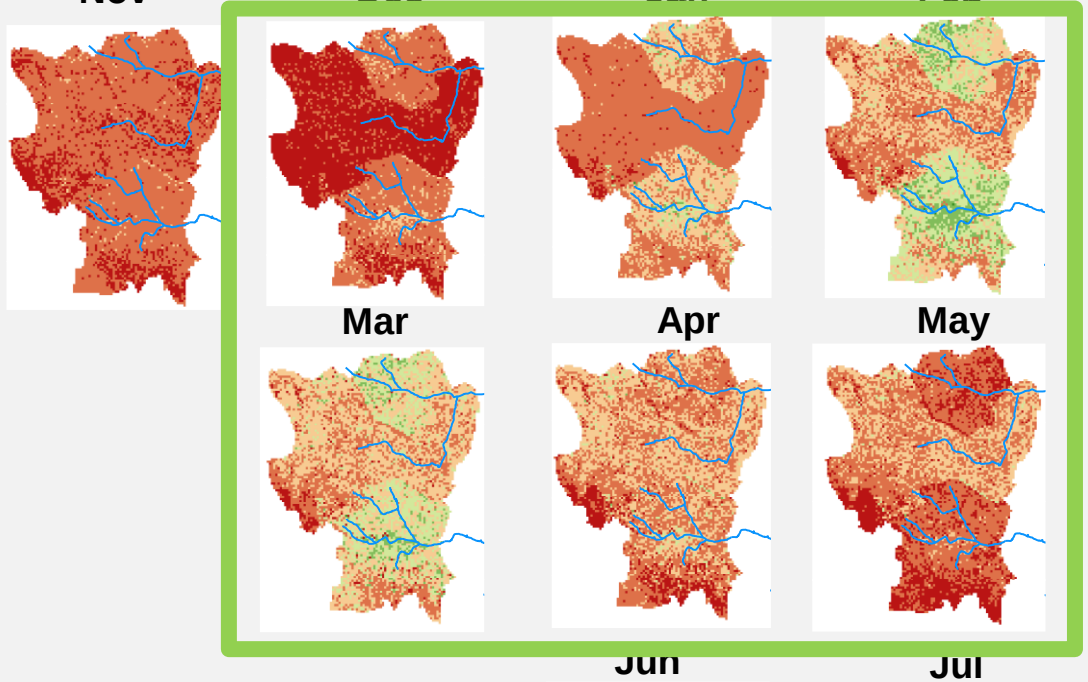
< 25 g/m2
25 - 50 g/m2
50 - 75 g/m2
75 - 100 g/m2
100 - 150 g/m2
150- 200 g/m2

Wet Season Grazing



Dry Season Grazing

S2:Wet/Dry Grazing Areas



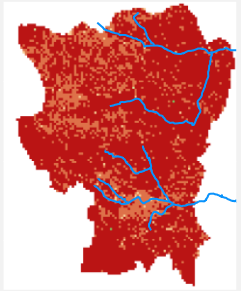
< 25 g/m2
25 - 50 g/m2
50 - 75 g/m2
75 - 100 g/m2
100 - 150 g/m2
150- 200 g/m2

S1:Open Grazing

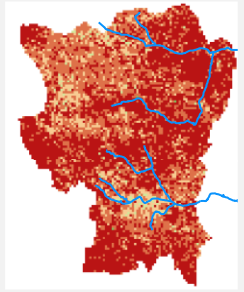
Bad Year 1988/89

S2:Wet/Dry Grazing Areas

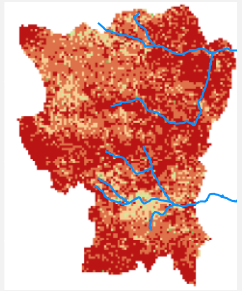
Nov



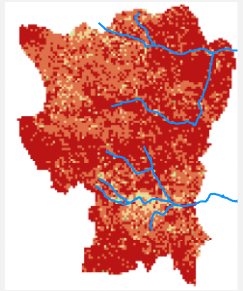
Dec



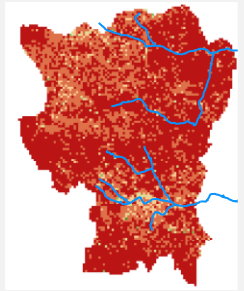
Jan



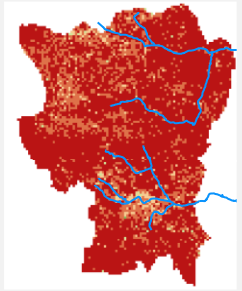
Feb



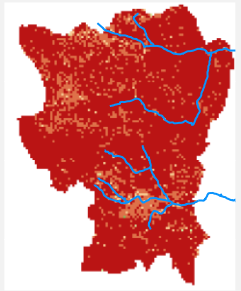
Mar



Apr

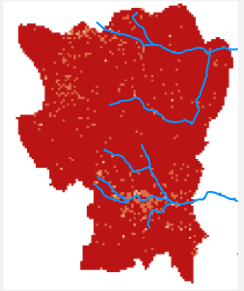


May

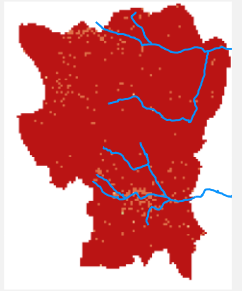


Open Access

Jun



Jul



< 25 g/m2

25 - 50 g/m2

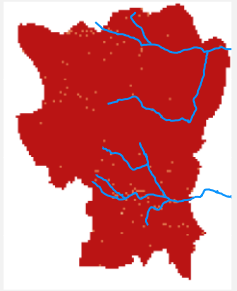
50 - 75 g/m2

75 - 100 g/m2

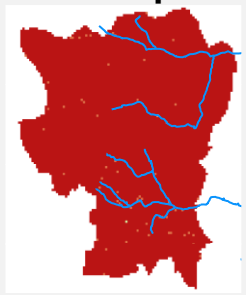
100 - 150 g/m2

150- 200 g/m2

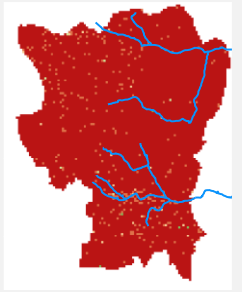
Au



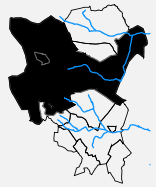
Sep



Oct

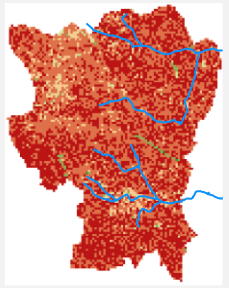


Wet Season Grazing

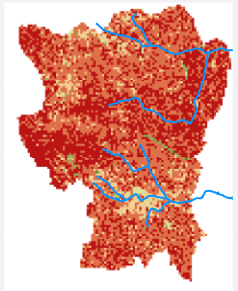


Dry Season Grazing

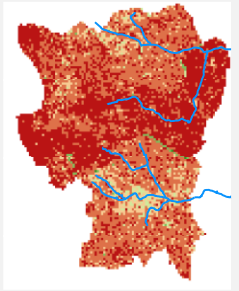
Nov



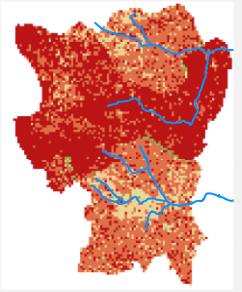
Dec



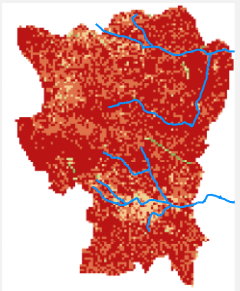
Jan



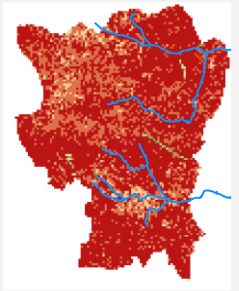
Feb



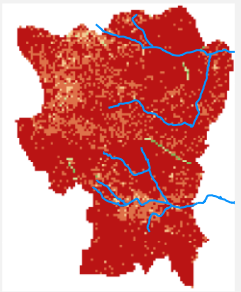
Mar



Apr



May



< 25 g/m2

25 - 50 g/m2

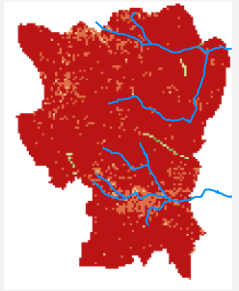
50 - 75 g/m2

75 - 100 g/m2

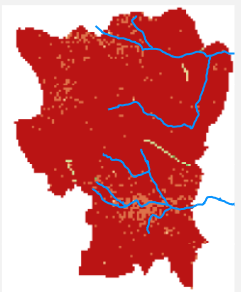
100 - 150 g/m2

150- 200 g/m2

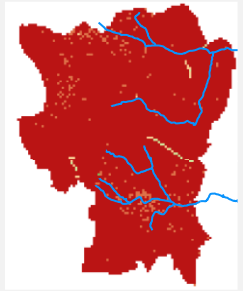
Jun



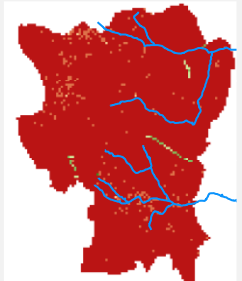
Jul



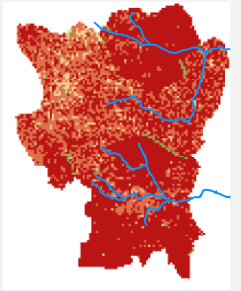
Aug



Sep



Oct



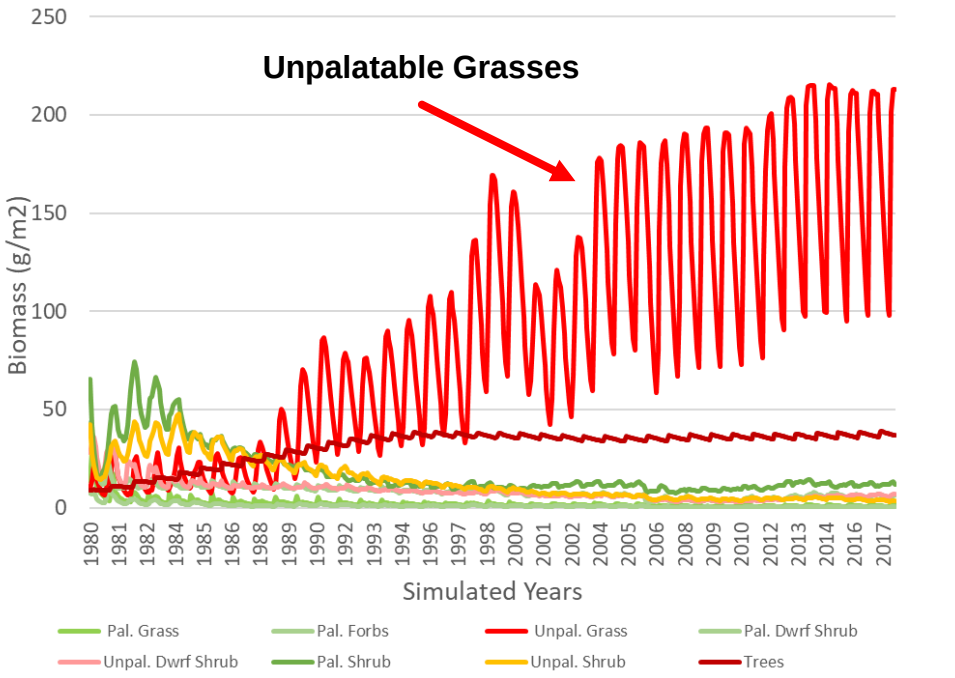
Results in Brief: Ecosystem Resilience

In both grazing scenarios, ***palatable*** grass, forb and shrub species ***decrease*** over time

Managed access prolongs expanded production at the cost of ecosystem function

Both scenarios end in similarly degraded states…

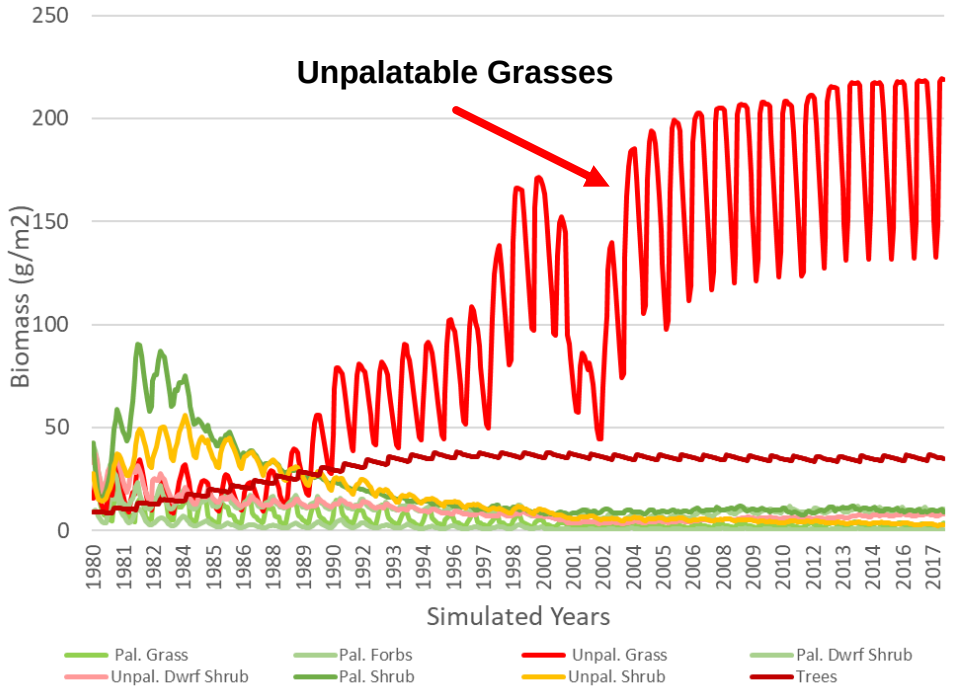
Open Access



Managed Access

Wet

Dry



Key messages

Up to a certain degree, planned grazing allowed the maintenance or even increase of pastoral livelihoods and herds.

Under all simulated grazing access scenarios, unpalatable grass and shrub biomass increases which could imply pervasive ecosystem shifts. Climate change exacerbates this effect…

Planned grazing access prolongs the availability of palatable grasses but the ecosystem continues to degrade over time, to a point that ultimately nullifies the benefits of planned grazing.

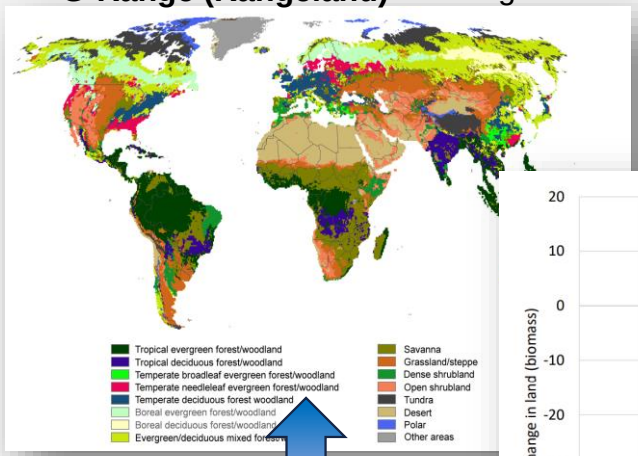
In the long-term both grazing systems may not be the sustainable without reductions in household livestock populations and improved rangeland management.

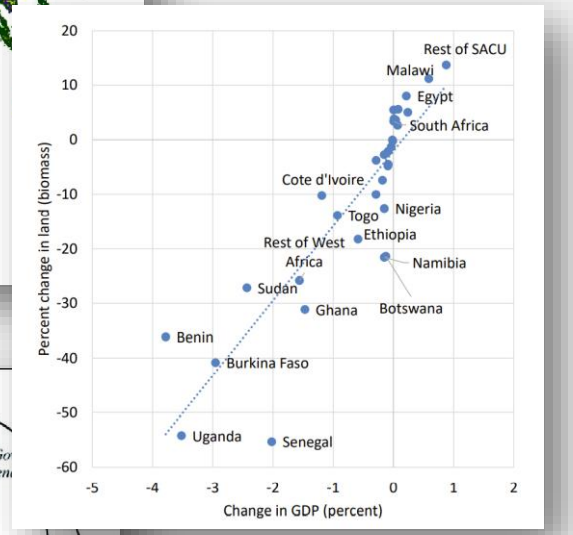
Land rights formalization that allows for planned grazing will also need to be to be coupled with intensive rangeland reclamation, and management efforts, and diversified livelihood activities for it to be sustainable in the long run.

The Way Forward:
Modeling Resilience at Different Scales for Different Stakeholders

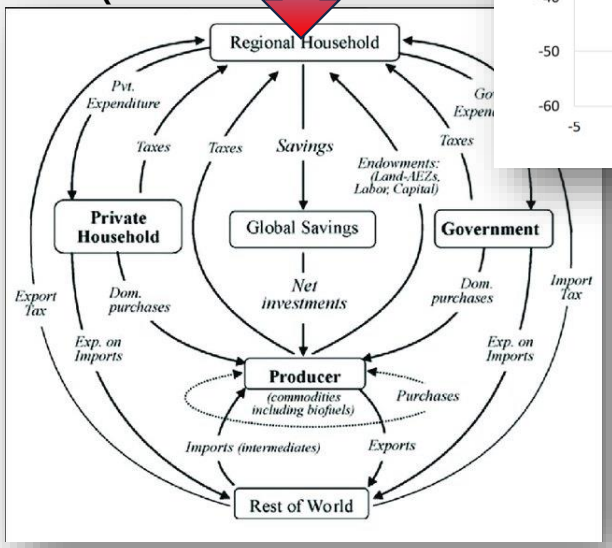
Global and National Scale Models

G-Range (Rangeland) 1 grid = 50km^2





GTAP (Economics)

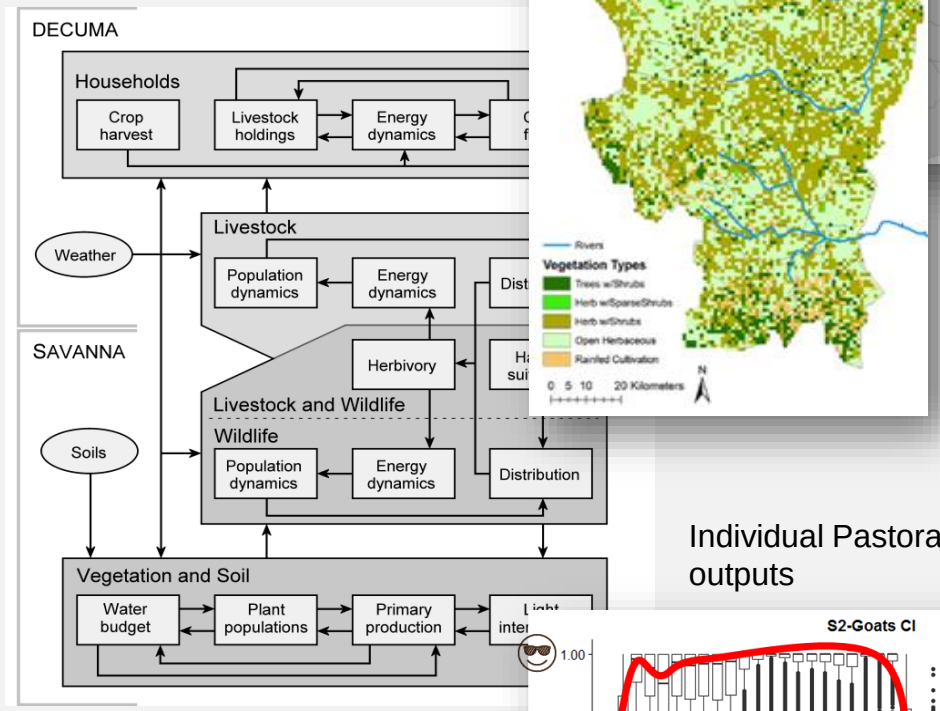


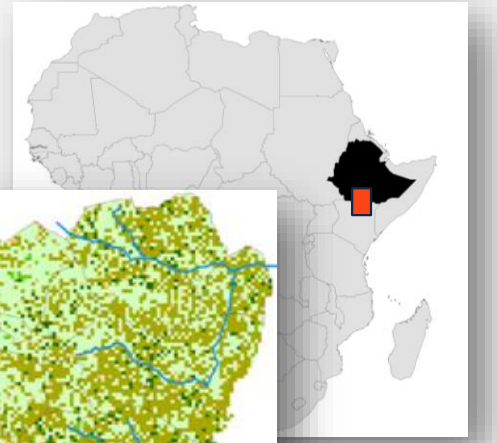
Regional Nations
vs
Specific Nations

Local Scale Models

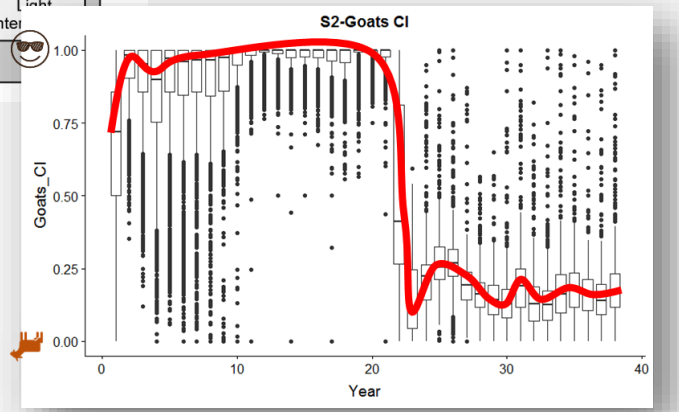
1 grid = 1 km^2

Pastoralist Household outputs





Individual Pastoralist Household outputs



Regional Populations
vs
Specific Households

Conclusions

What current elements of pastoralism contribute to present resilience?

- Pastoralist adapt under uncertain and varying environments (mobility, diversity)

What system elements need to evolve into a more resilient future?

- Agreement/cognizance of underlying, longer-term environmental health …

Metrics

- Resilience Metrics (slow vs fast)
- Circularity metrics? (biomass, carbon, *inter alia*)
- How to compare and scale them ? (adaptive/maladaptive… at what scale?)

We can’t be resilient with 2 out of 3 areas…

- (Social) Humans adapt and social systems can change abruptly…
- (Economic) Ways and means can shift (farming vs pastoralism vs specialized pastoralism)
- (Environment?) ~~is left to heal itself~~

Acknowledgements

Borana Pastoralists

University of Nairobi
(Profs. C.K. Gachene & G. Kironchi and Dr. L.W Robinson)

ILRI

DAAD

UNIVERSITY OF NAIROBI

Colorado State University

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

DAAD
Deutscher Akademischer Austausch Dienst
German Academic Exchange Service