

Hidden gold in the dirt? – Soil carbon, climate change, & socio-economic development in East Africa

By

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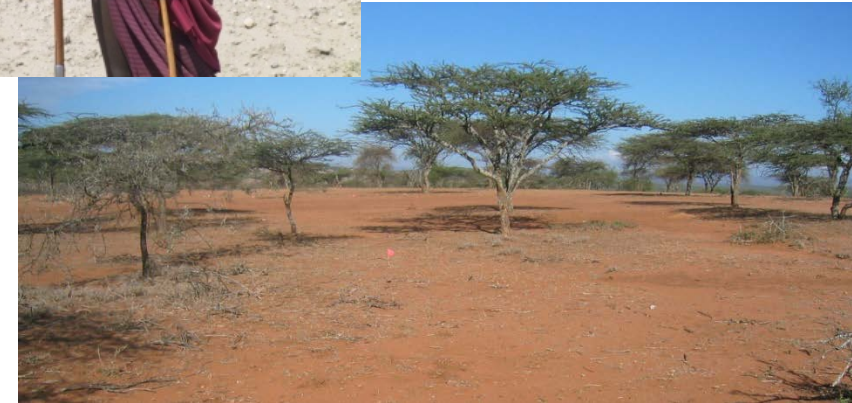
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Rural African Livelihoods and the Loss of Productive Capacity

Pastoralists and nomadism

- Sedentary livestock husbandry: animals consume > 95% of forage production
- Loss of soil organic matter and water-holding capacity
- Increased vulnerability to drought, limited livestock value



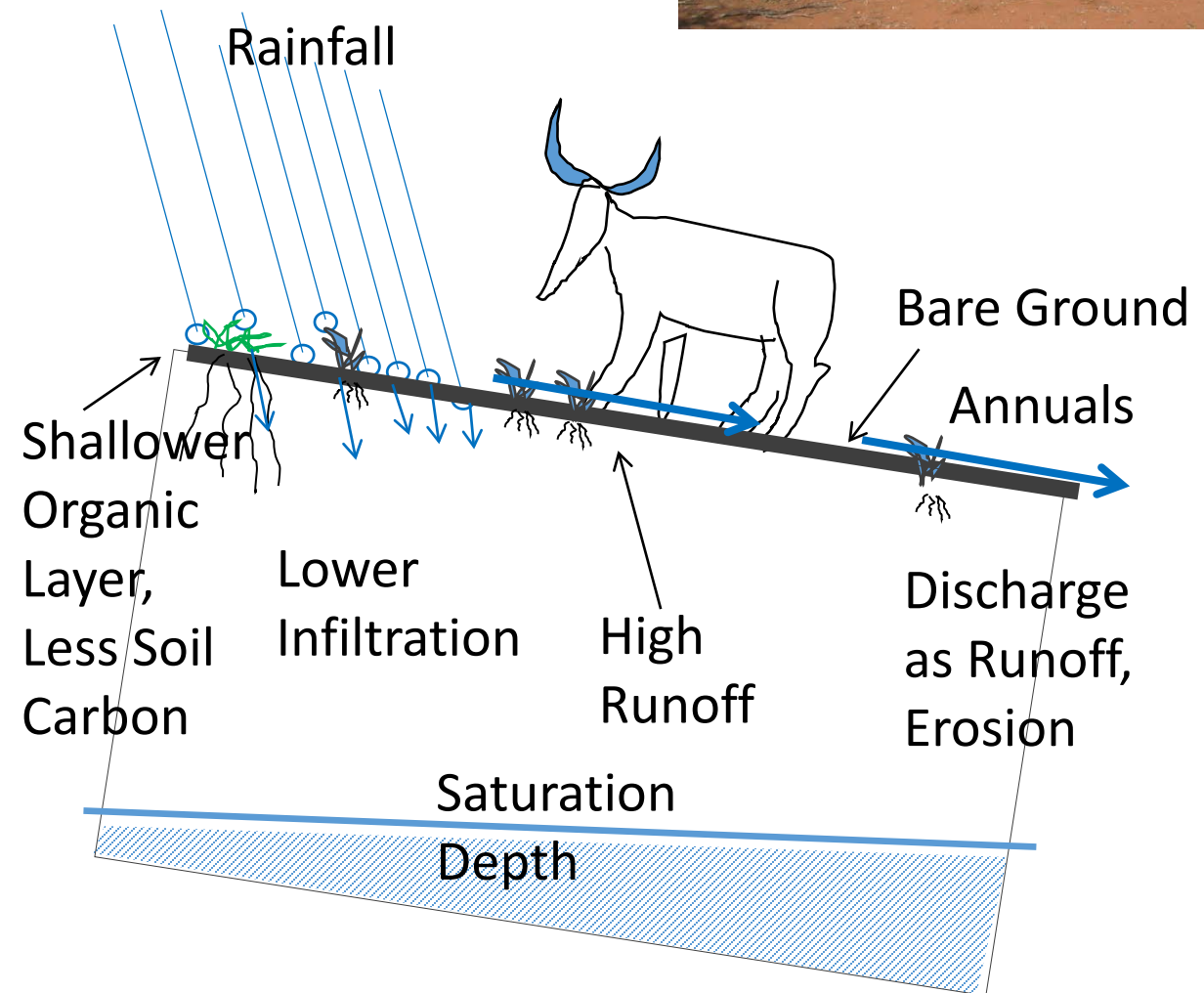
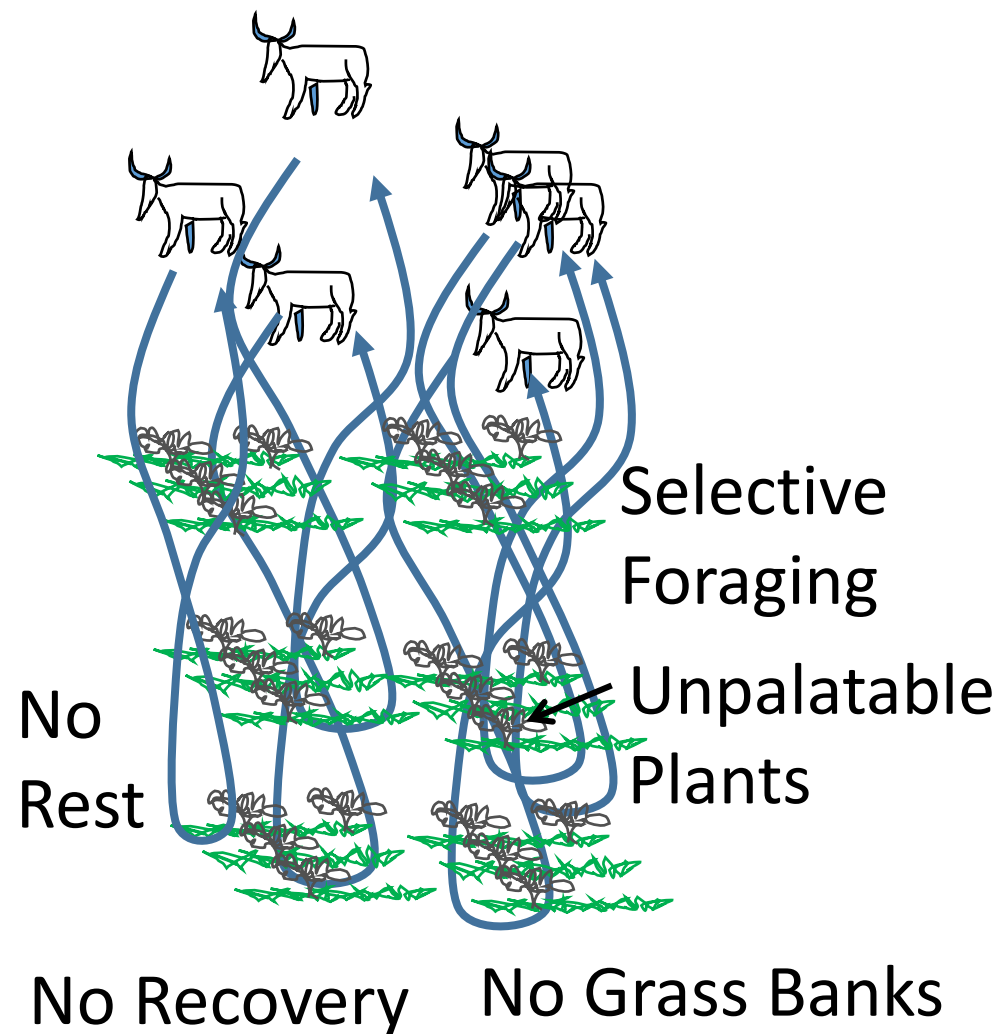
Agro-pastoralists and shifting agriculture

- Fires to clean crop litter, attract game, convert trees into fertilizer
- Fires spread in woodlands and forests causing loss of standing carbon and soil fertility in natural ecosystems
- Loss of biodiversity and ecotourism opportunities



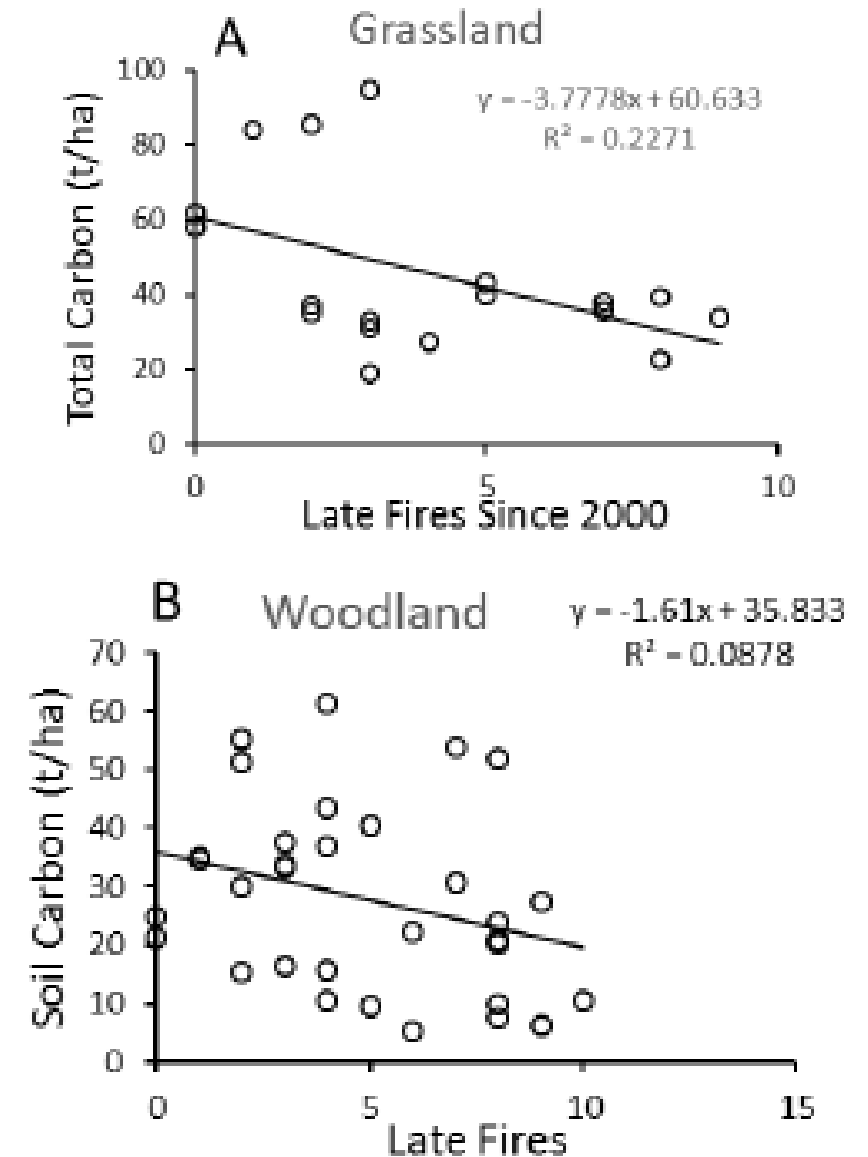
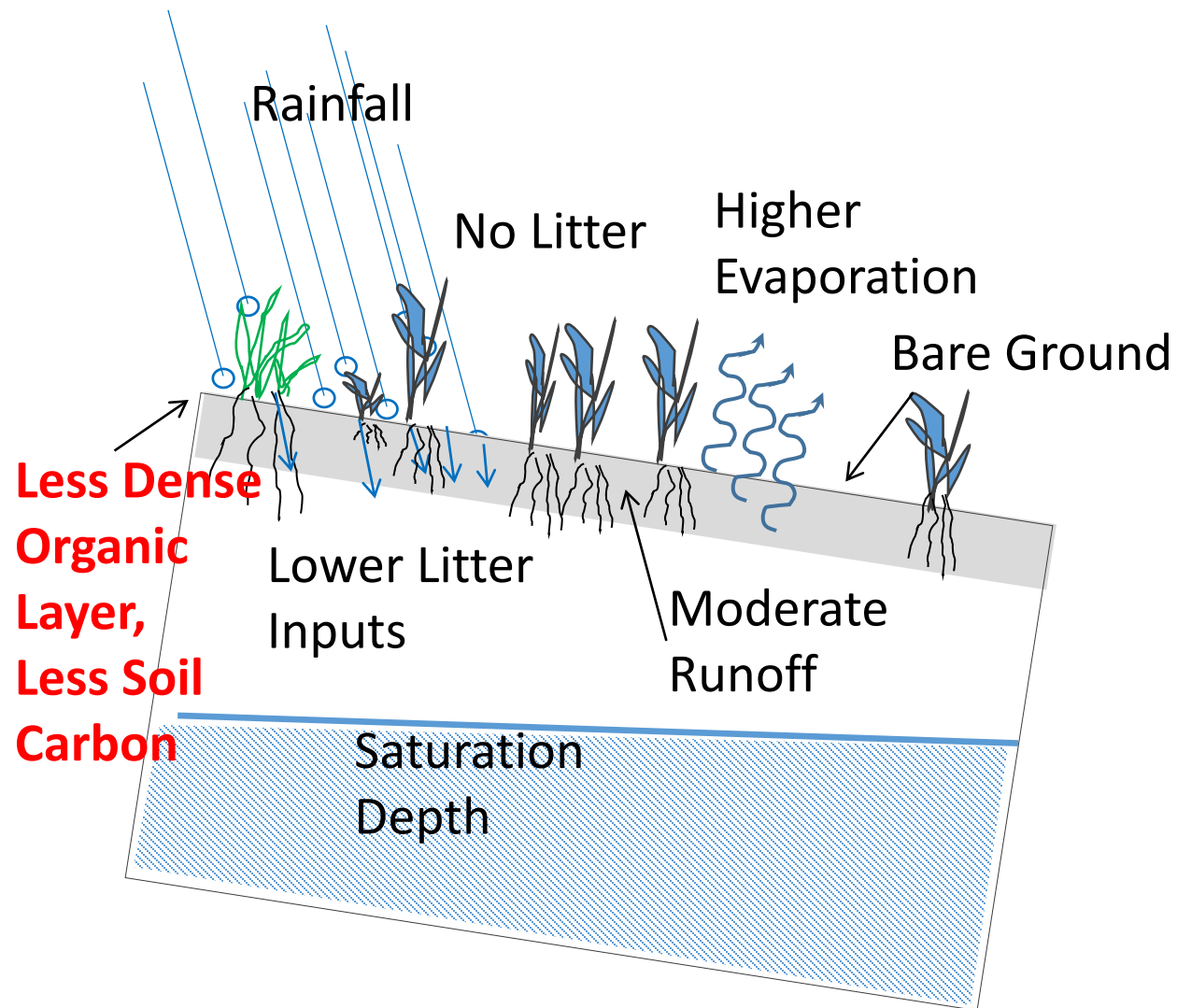
Continuous Grazing and Soil Degradation

Continuous Unrestricted Grazing,
Tragedy of the Commons

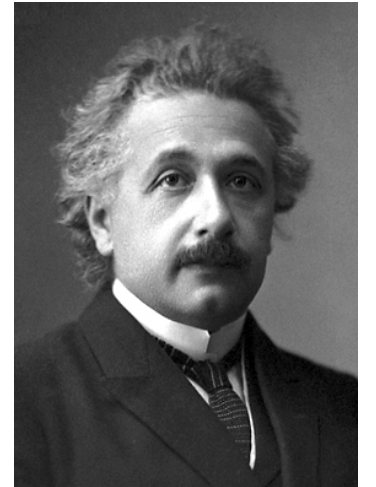


Excessive Burning and Soil Degradation

Unrestricted Burning,
Residual Crop Burning
Poaching



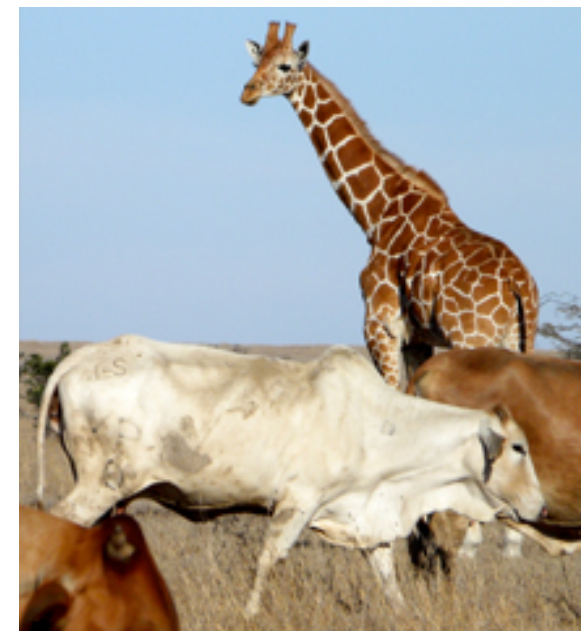
“In the Middle of Difficulty Lies Opportunity”



Albert Einstein

What if the process of degradation could be reversed?
What if new carbon could be stored in the soil?

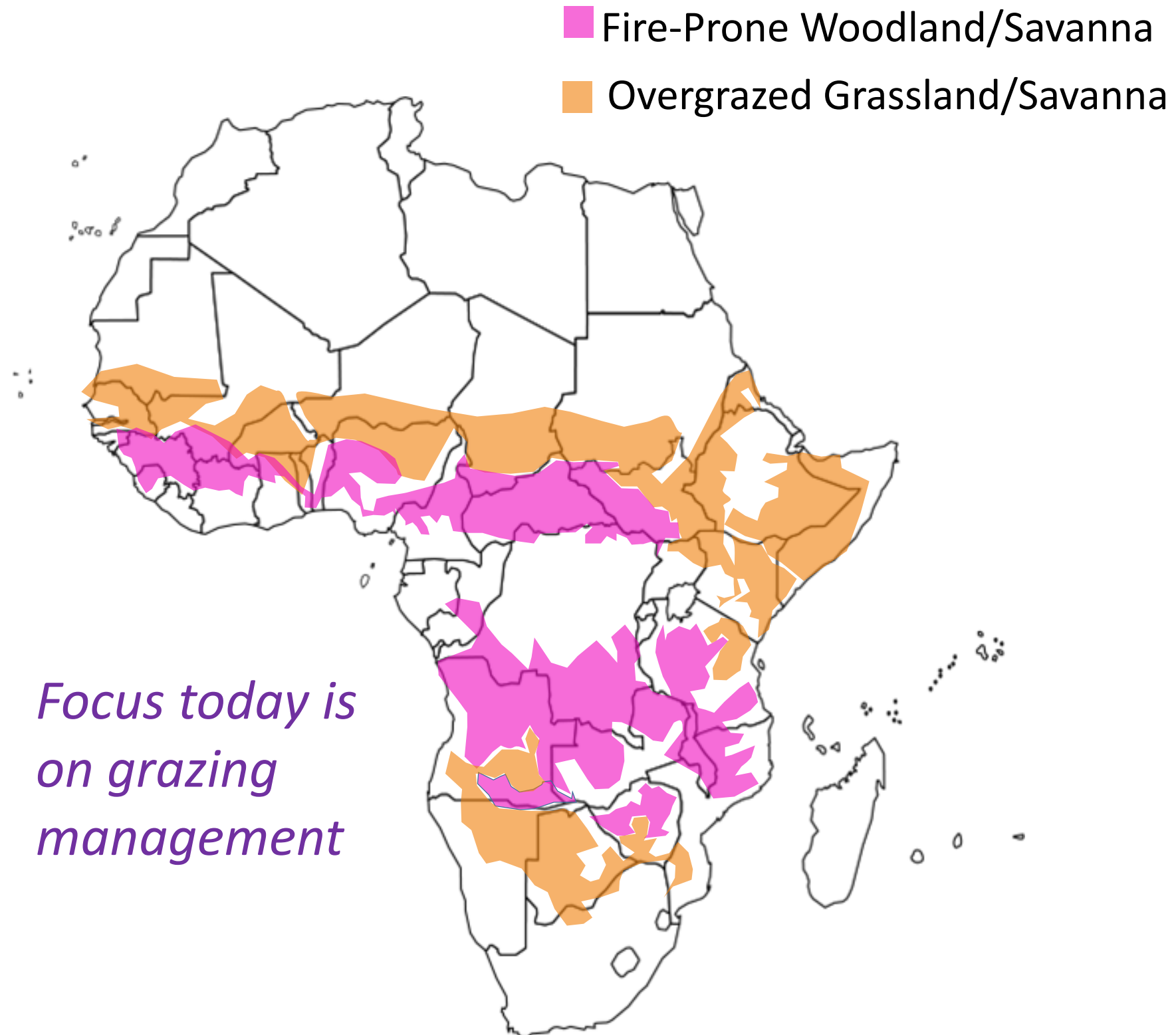
- Remove CO₂ from the atmosphere **WIN!**
- Restore soil and water and **productive capacity** **WIN!**
- Conserve biodiversity **WIN!**
- Social well-being, financial capital **WIN!**



Climate Smart Agriculture: A ~~Triple~~ Win
Quadruple

Potential for Soil Carbon Sequestration in Africa

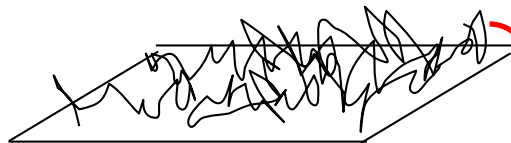
- Overgrazed and over-burned grasslands, savannas and woodlands
- Recover 0.5 – 1.5 tons CO₂e / ha
- ~600 million ha overgrazed by livestock
- ~600 million ha suffer too-frequent hot fires.
- ~ 1 billion tons CO₂e sequestered each year



Migratory Grazing in East Africa and Soil Carbon Storage



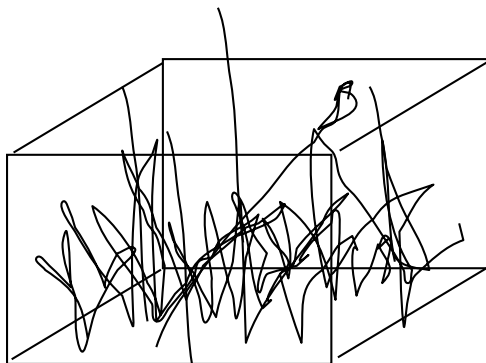
Grazed



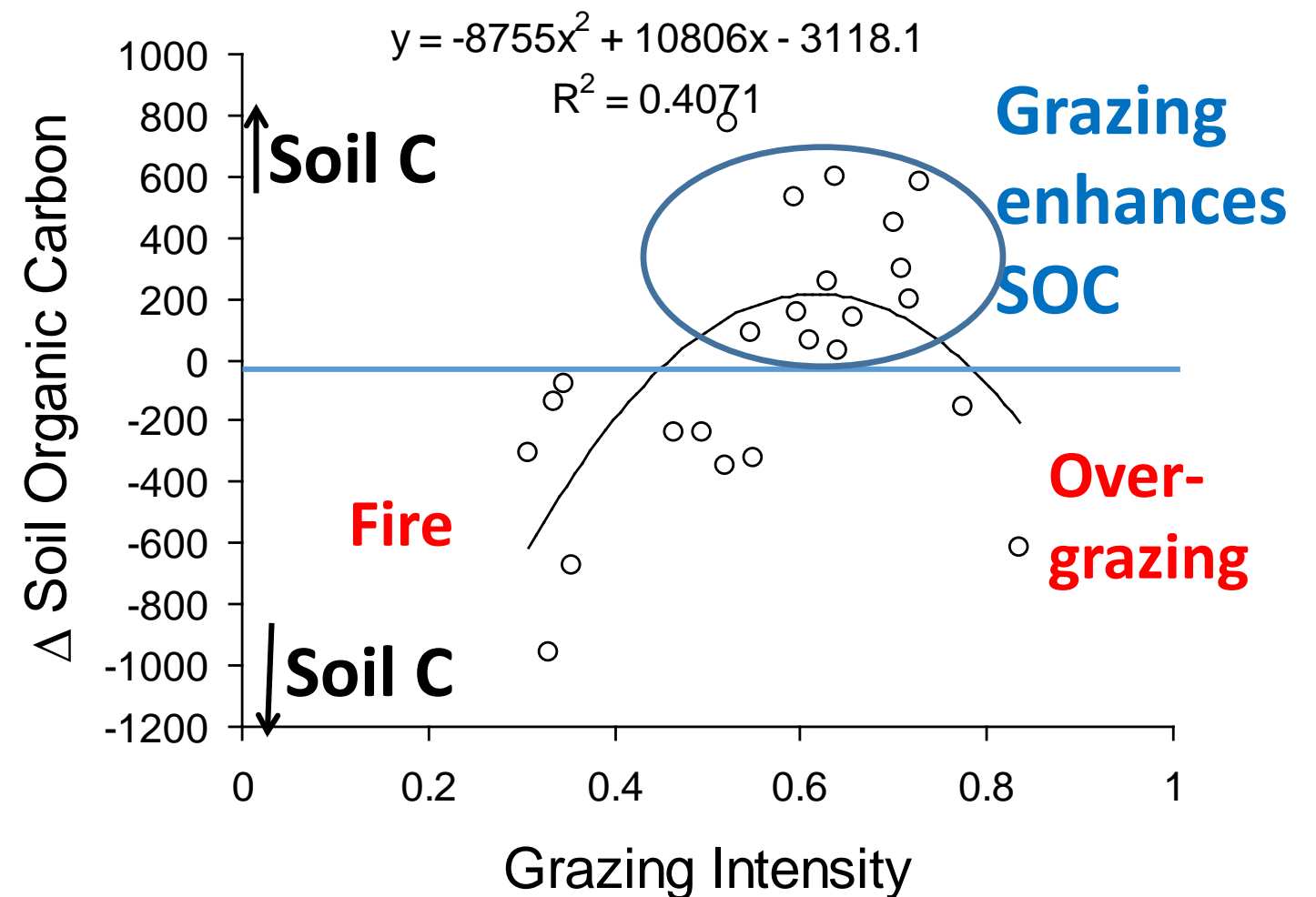
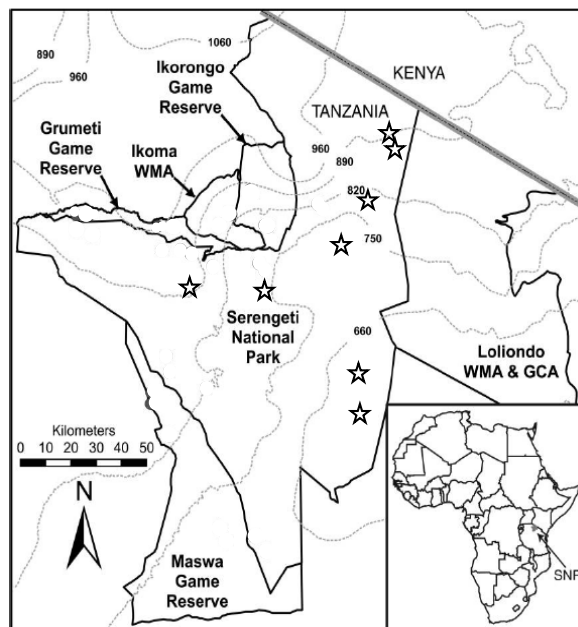
Grazed C

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Ungrazed C

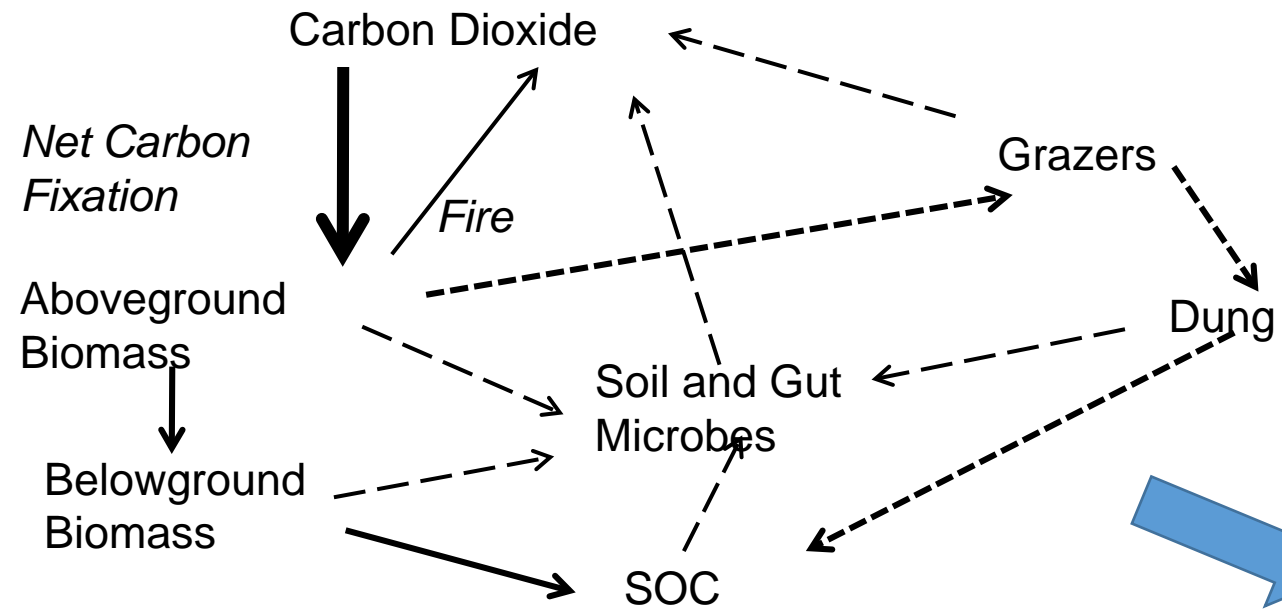


Ungrazed



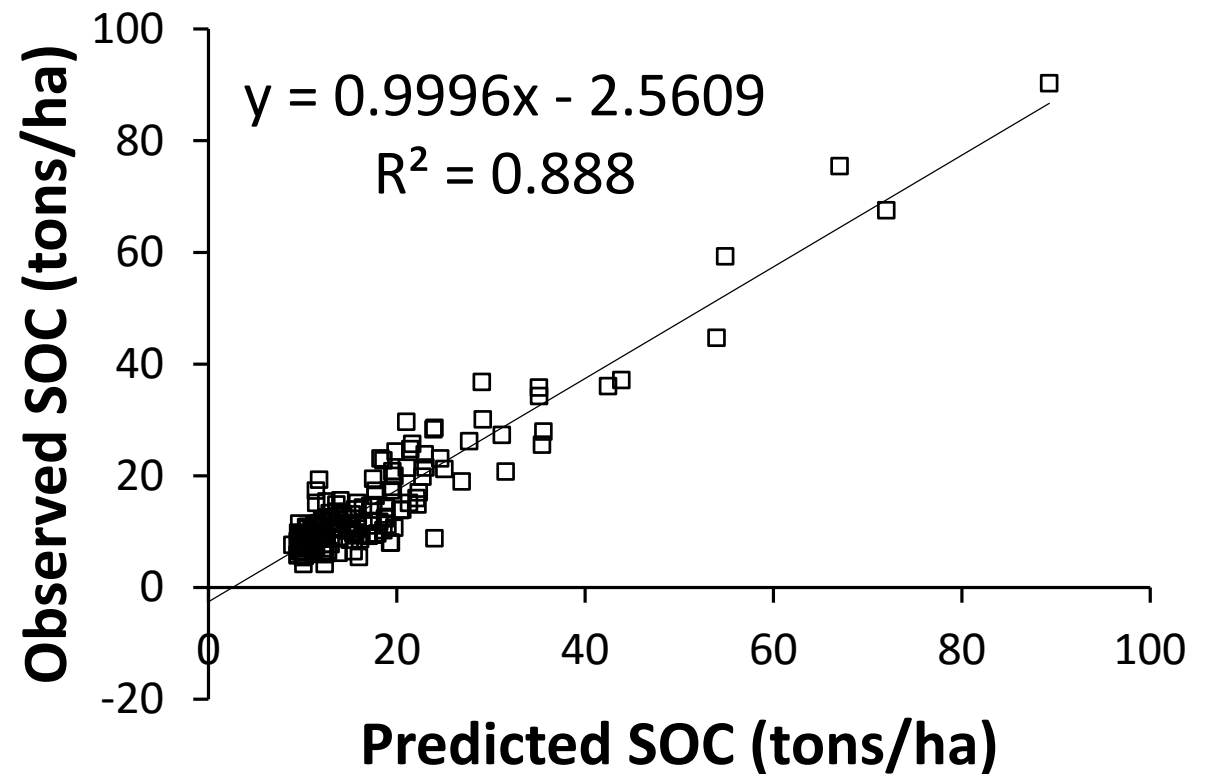
8 Sites across Serengeti National Park (Anderson et al. 2007 *Ecology*, Ritchie 2014 *PeerJ*)

Migratory Grazing in East Africa and Soil Carbon Storage



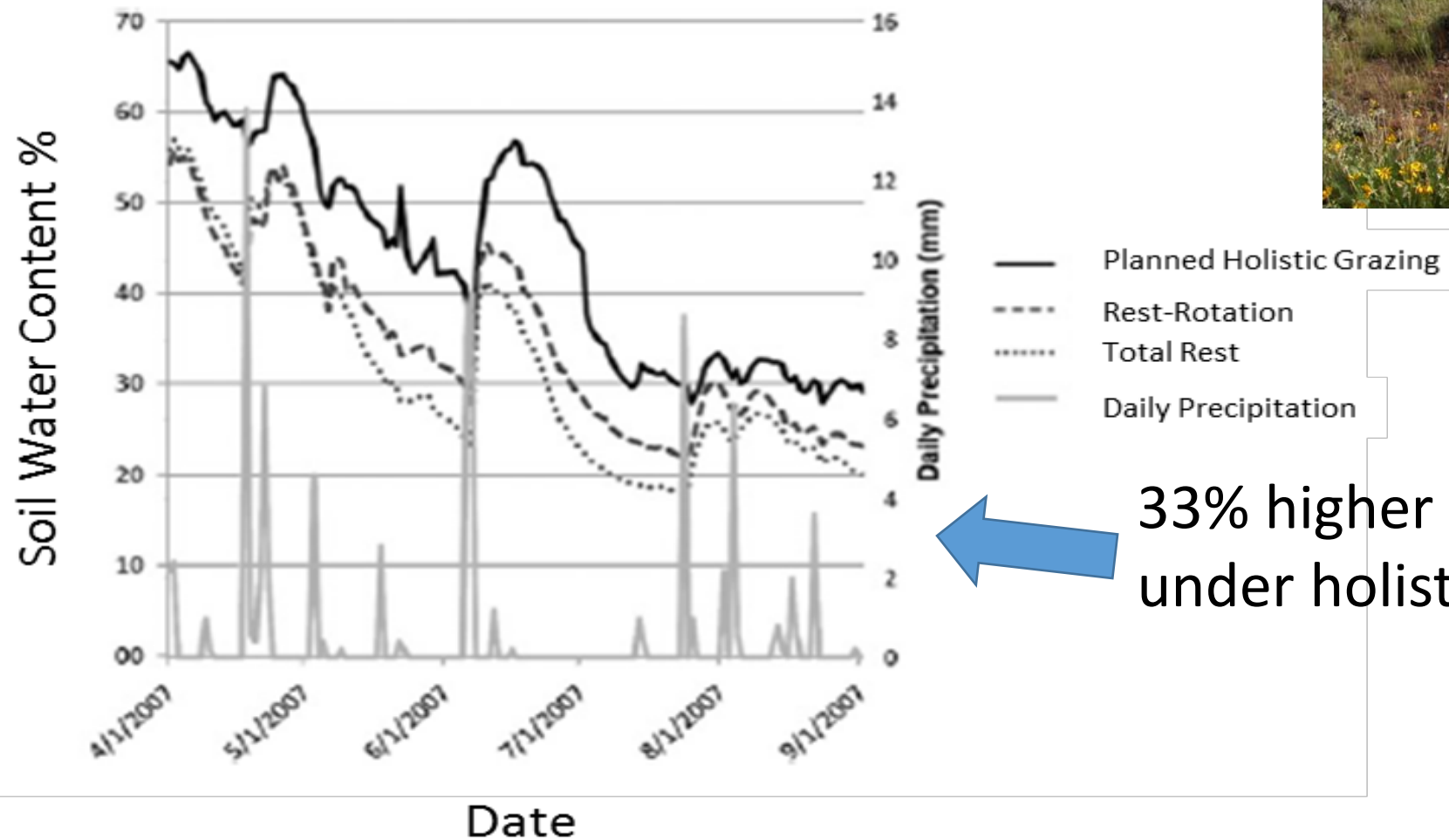
Serengeti migratory grazing system (SNAP model)

A test of the SNAP model in a northern Kenya pastoralist system

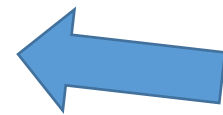


Sustainable Grazing and Water

Grazing and Dry Season Soil Water Content, Idaho USA (Weber & Gokhale 2011)



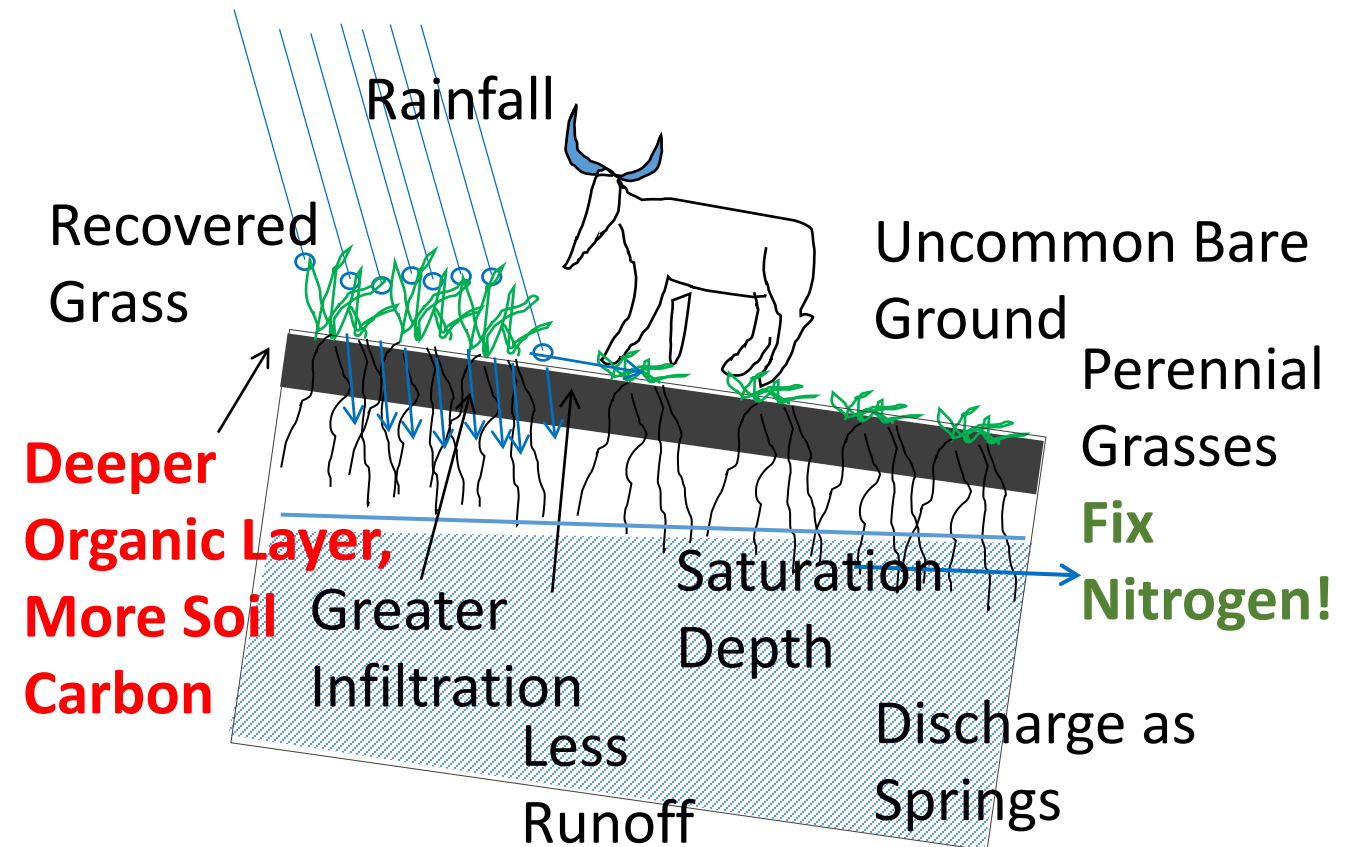
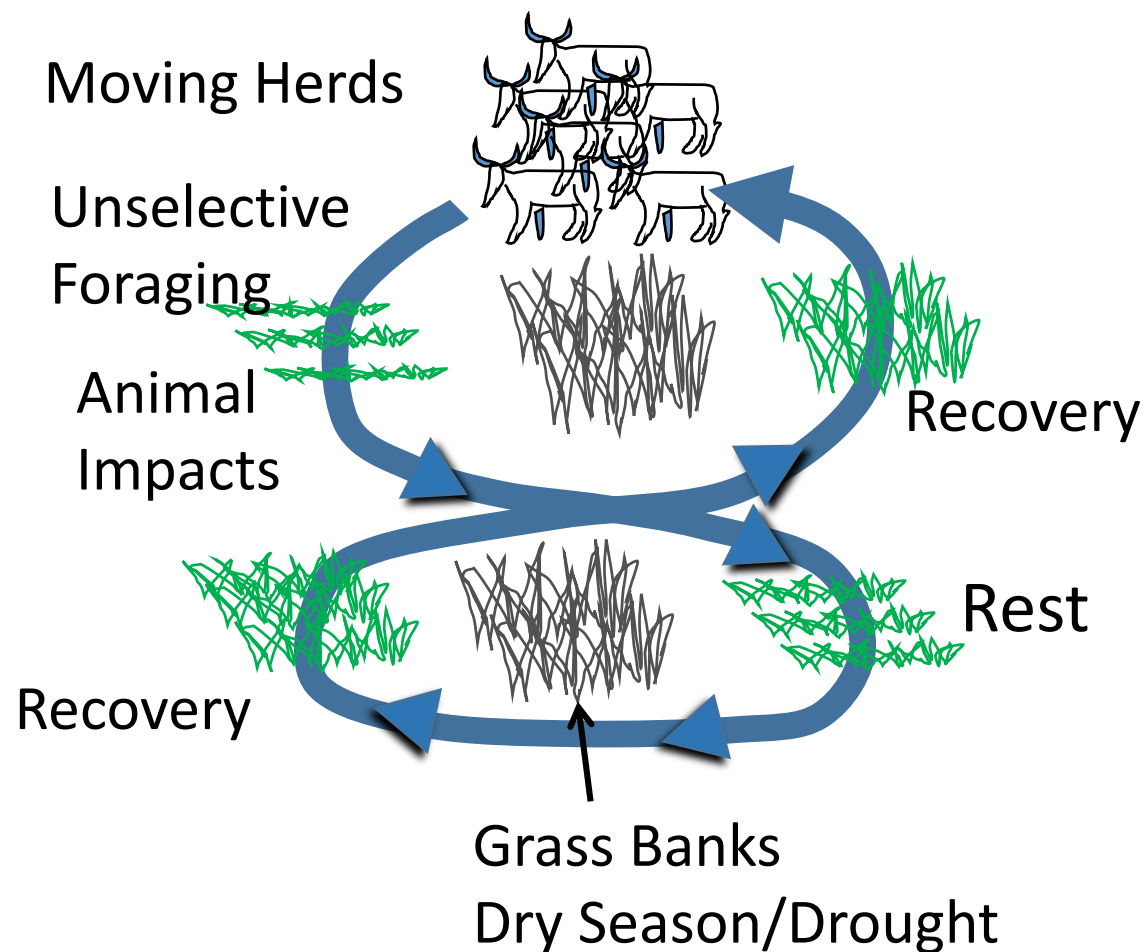
33% higher soil water content under holistic grazing



Sustainable Grazing Practices



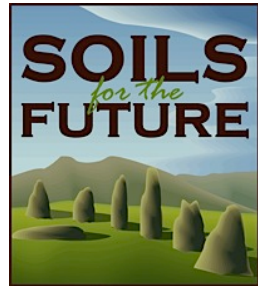
Migratory Grazing Concepts Applied to Livestock



Voluntary Carbon Finance



Communities

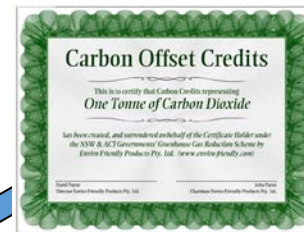


- Technology
- Validation and Verification

Implementation



Marketing



Companies seeking Corporate Social Responsibility, Governments



Certified Carbon Credits

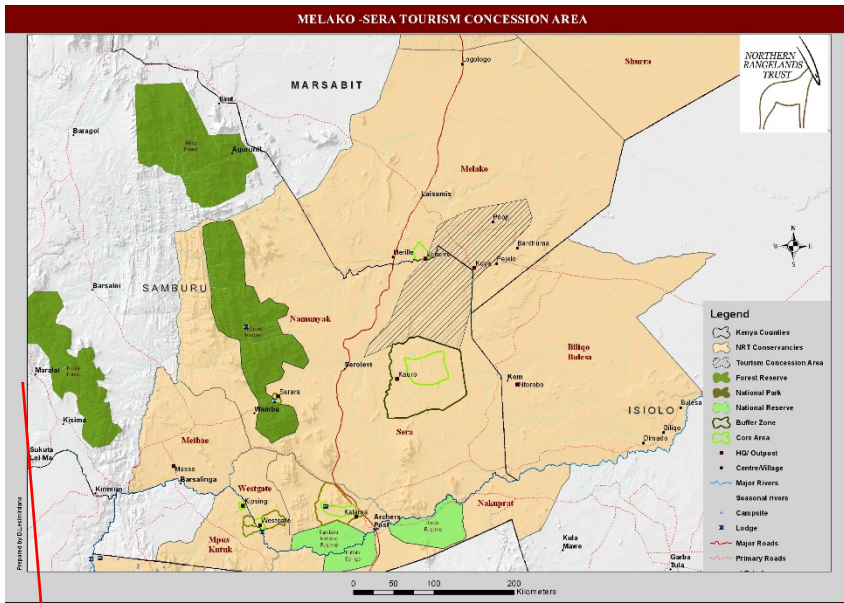


Registry Awards **Verified Carbon Credits** in Return for NEW Land Use for 30 yrs)

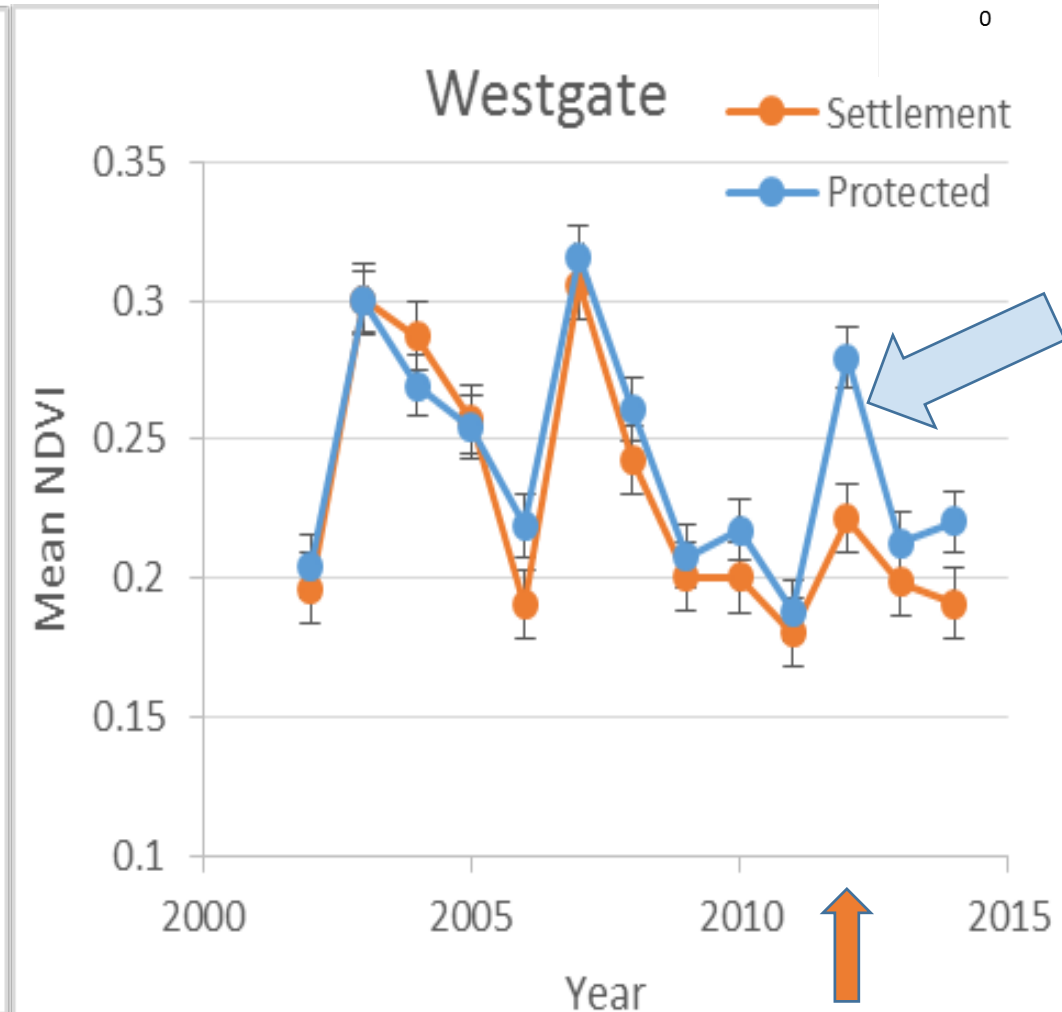
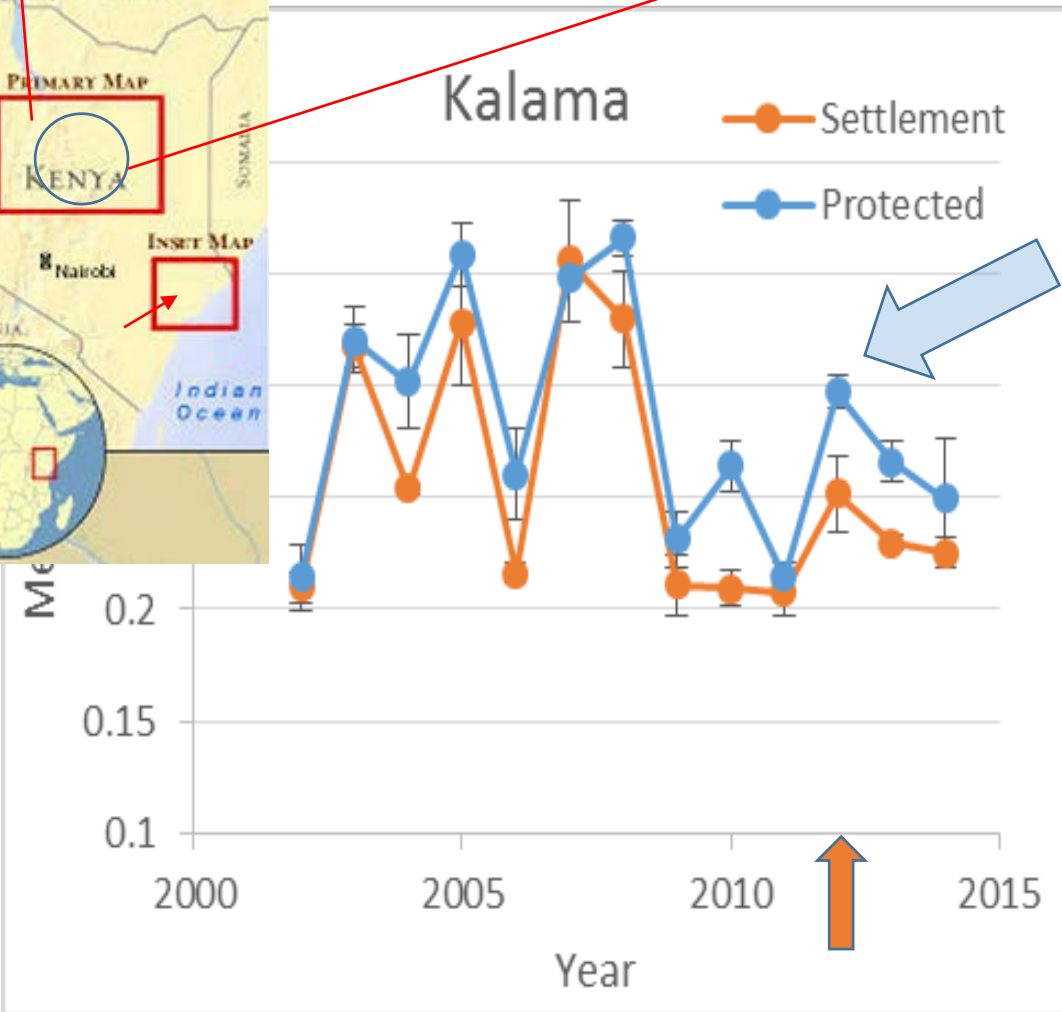
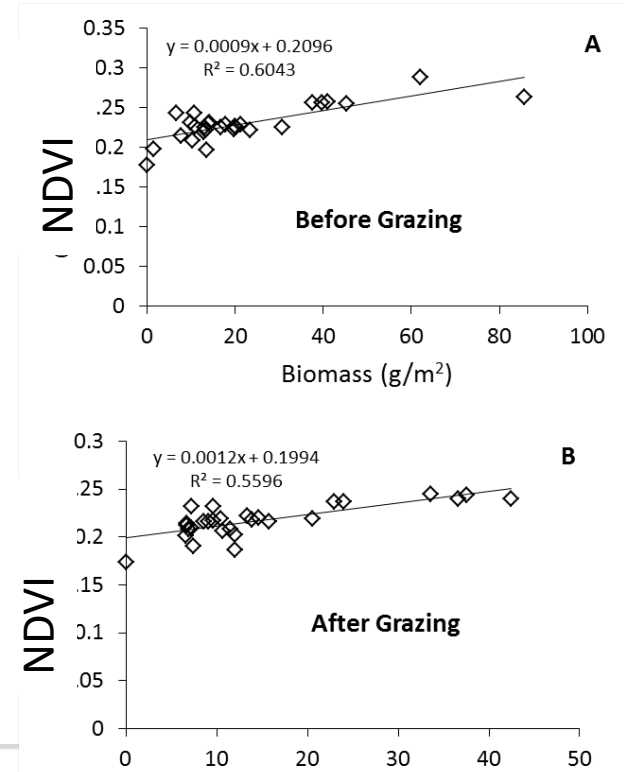
Top 20 companies bought 18.8 million credits for \$ 97.2 million USD in 2014 (average price ~\$5.00 USD per credit)

Rotational Grazing: Does It Work?

Northern Kenya Conservancies



NDVI = “greenness” index based on reflected light detected by satellite measures available forage

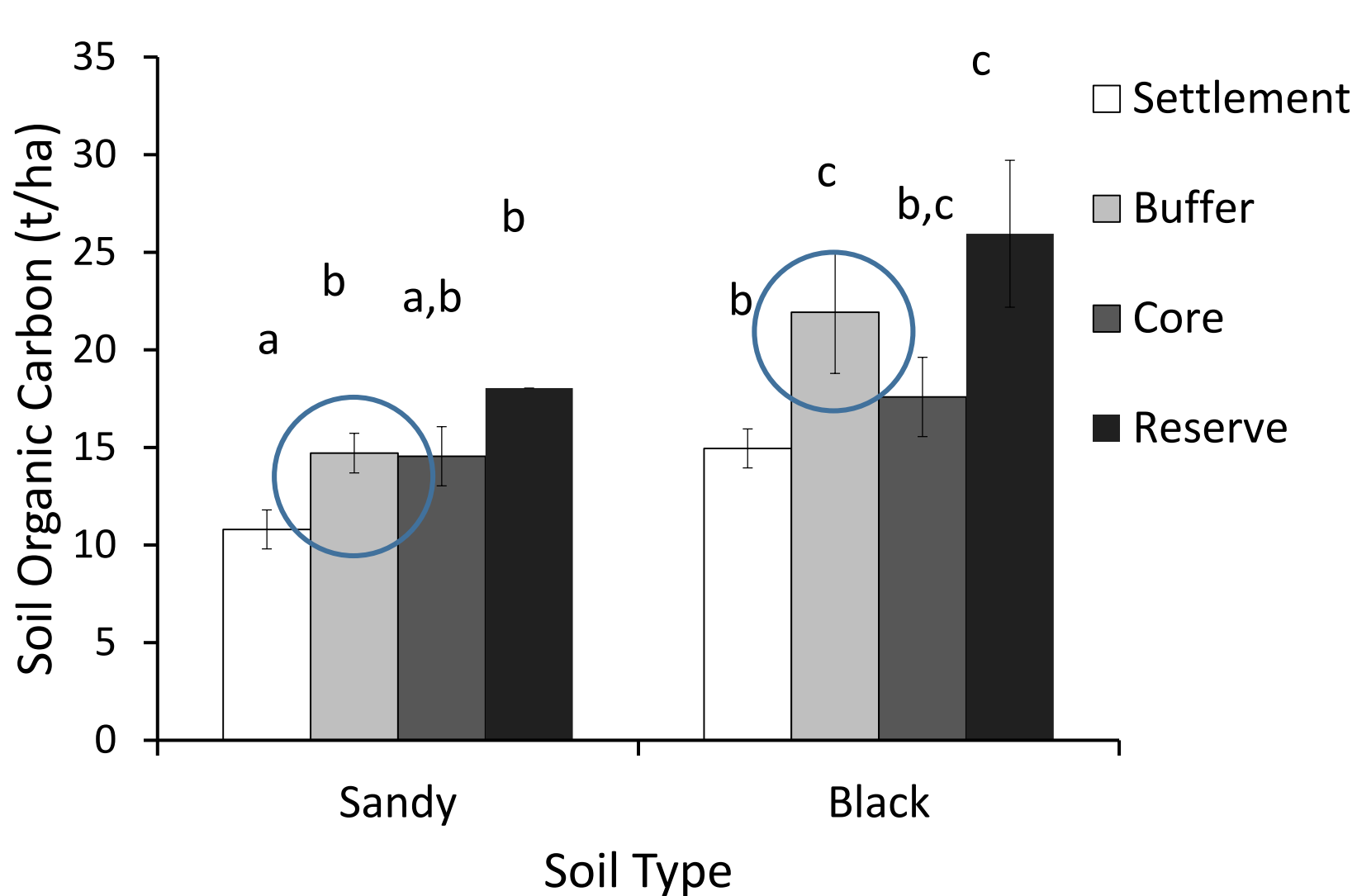


Effect of Rotational vs Continuous Grazing

Start of Rotational Grazing

Grazing Management and Soil Carbon

~10 Years management in Buffer, 3 years rotational grazing,



Core = No Livestock

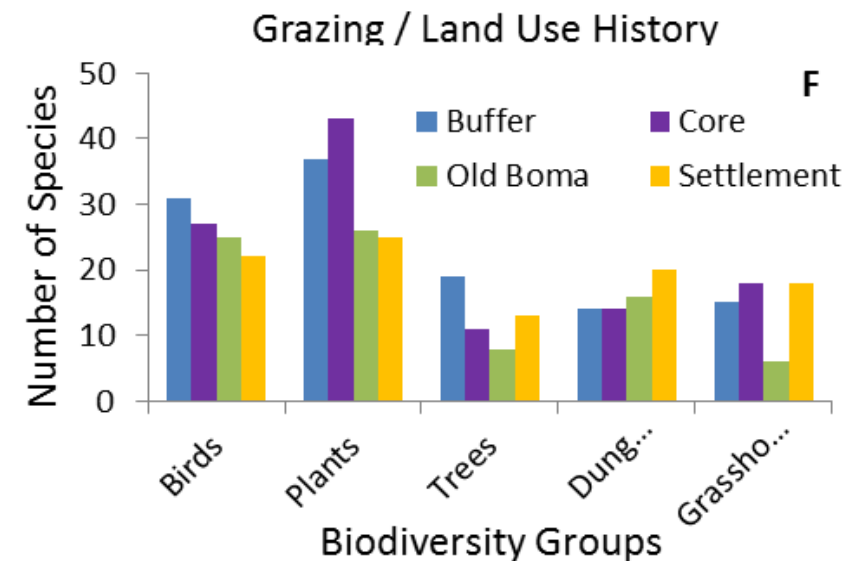
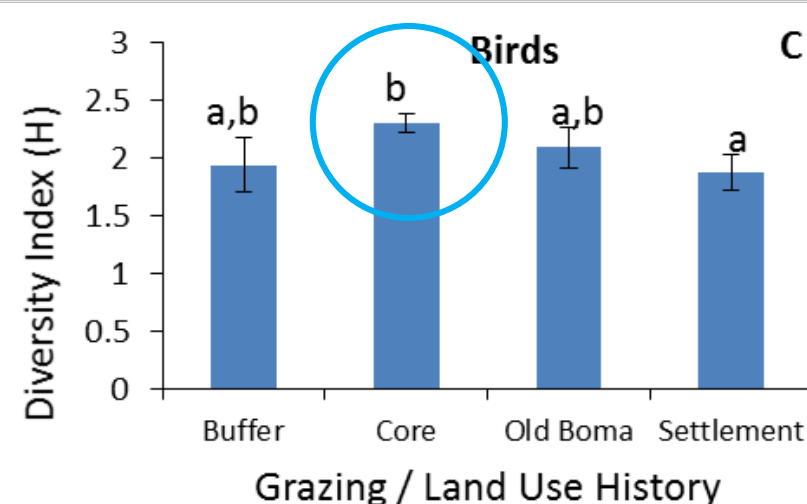
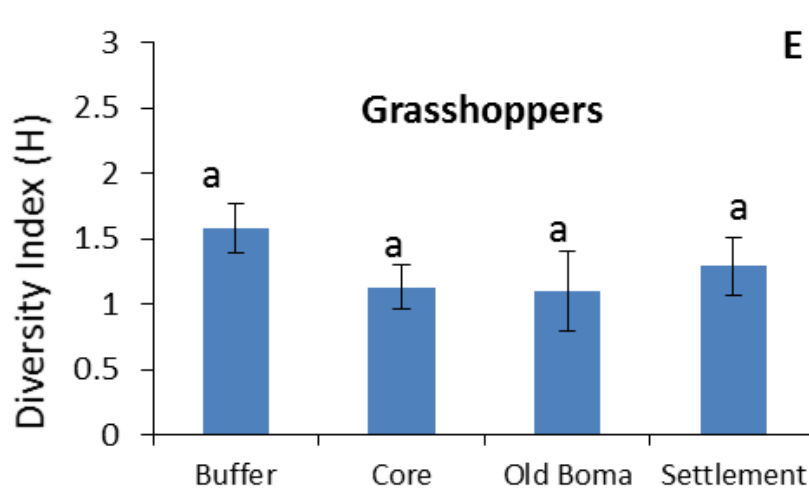
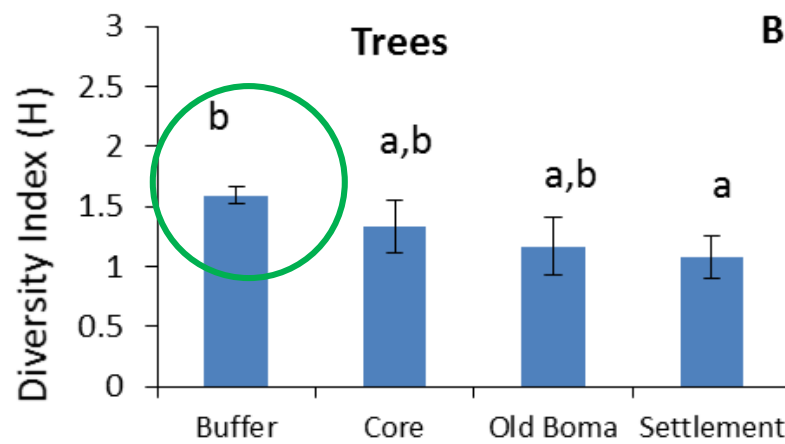
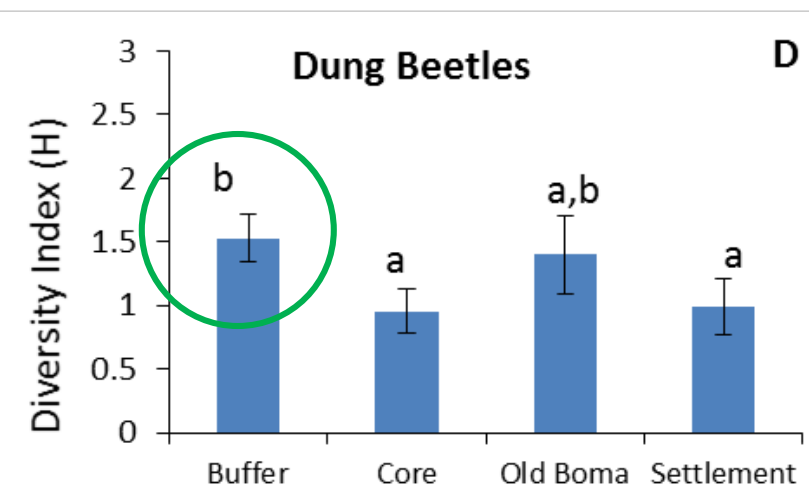
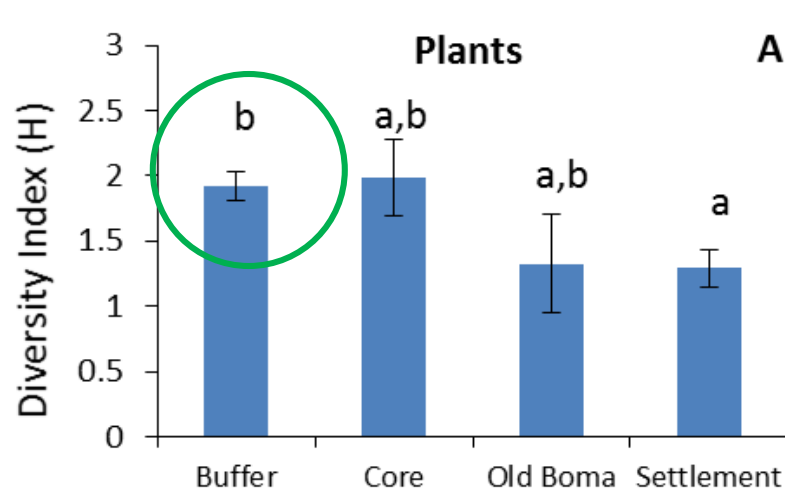
Buffer = Seasonal grazing + recent rotational grazing

Old boma – fertilized patches with distinct vegetation

Settlement = Continuous, unrestricted grazing in all seasons

	SOC Accrual (tons/ha)/Year	
	Sandy Loam	Black Cotton
Observed	0.41 (0.09)	0.75 (0.25)
SNAP Prediction	0.38 (0.04)	0.47 (0.06)

Grazing Management and Biodiversity



Core = No Livestock

Buffer = Seasonal grazing + recent rotational grazing

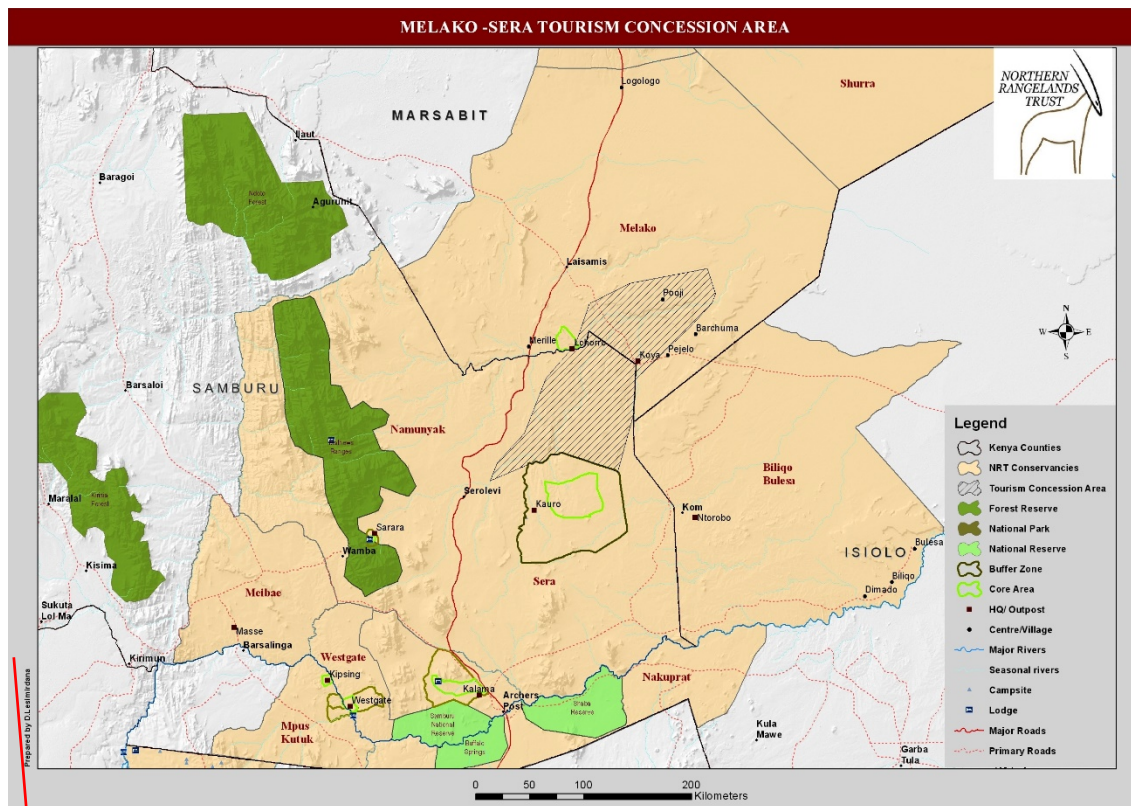
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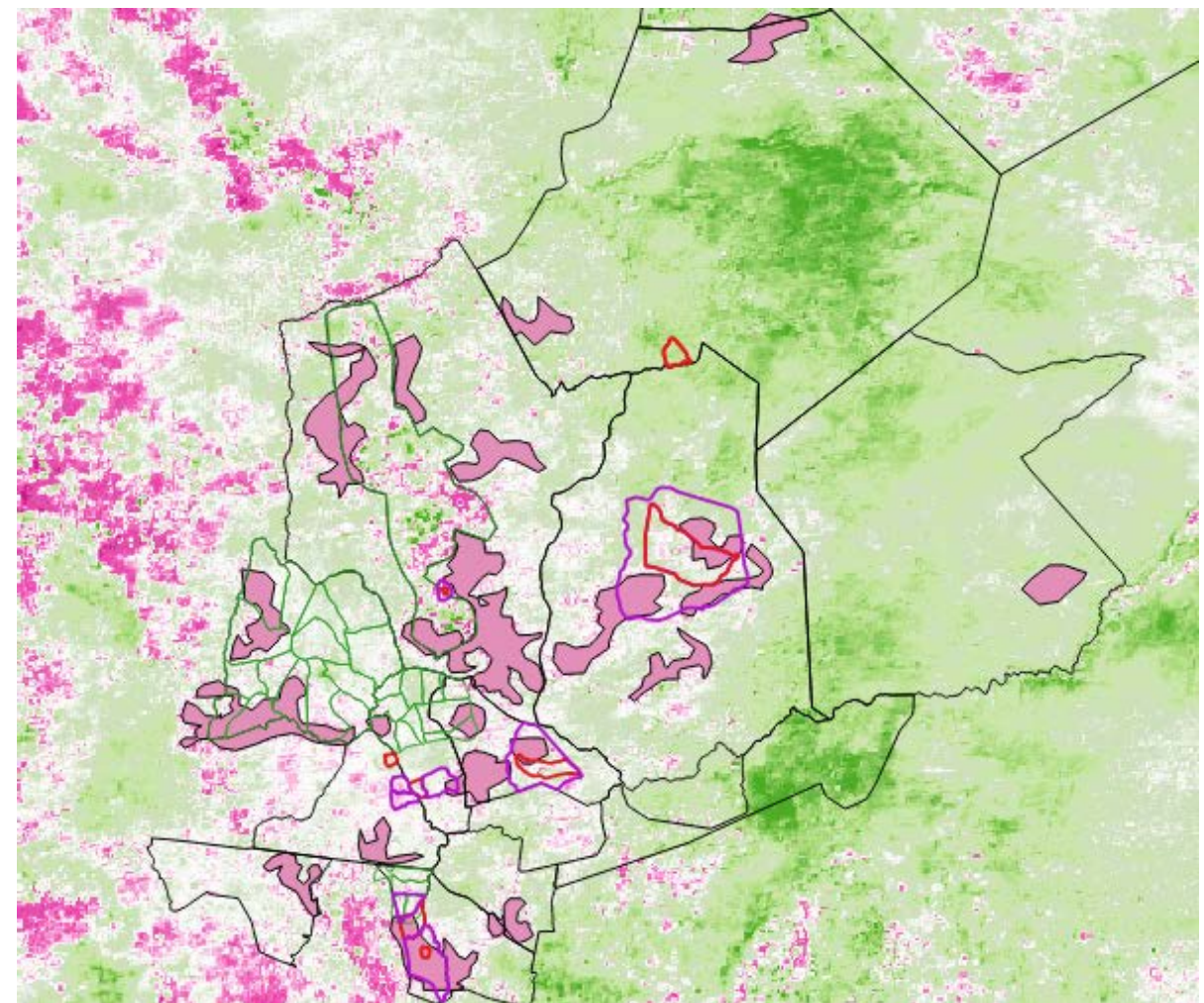
Northern Kenya Carbon Project

Successful implementation of rotational grazing over **86%** of the project area in 2014

1.5 million carbon credits

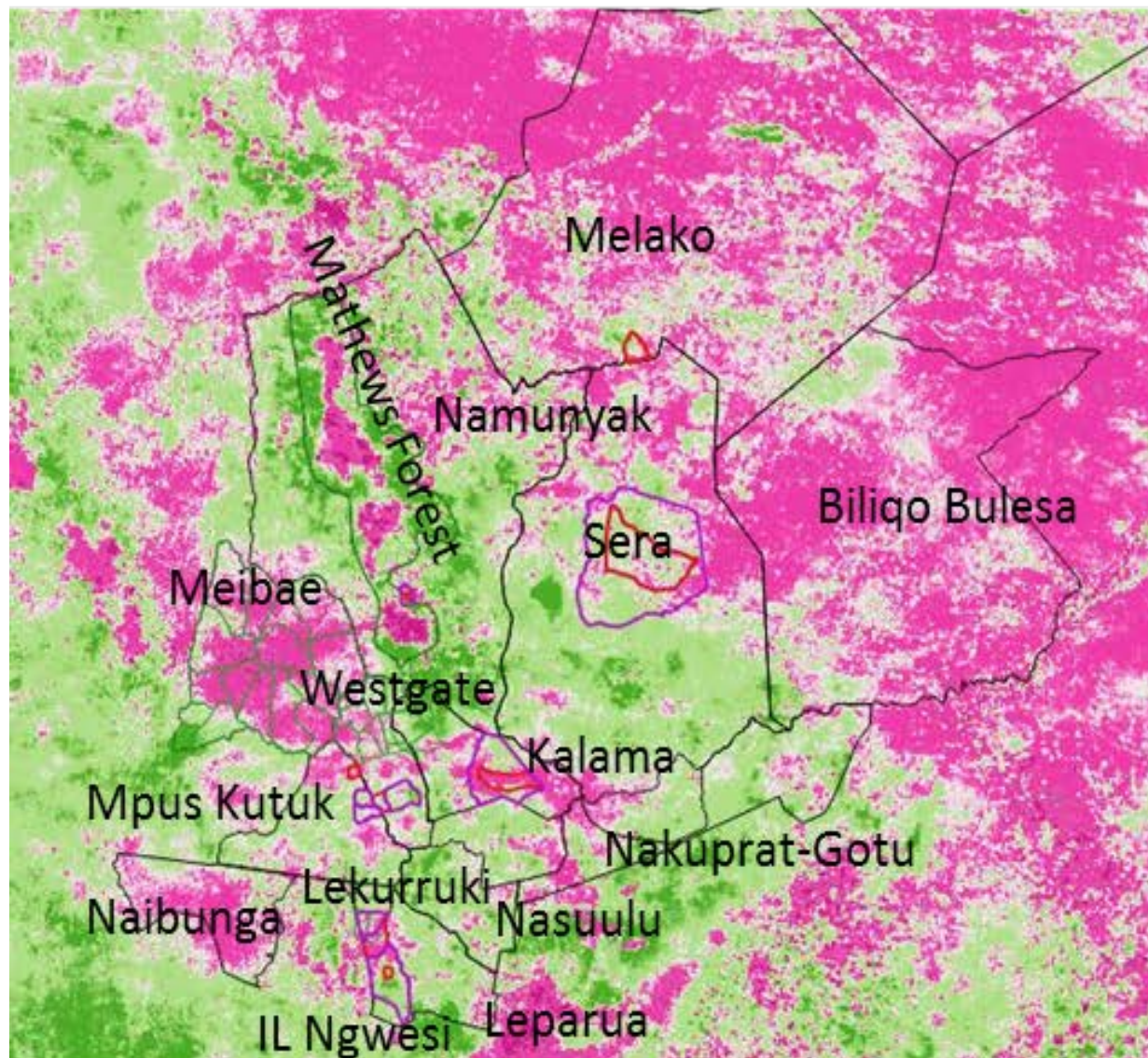


- Net Forage Loss
- No Net Change
- Net Forage Gain

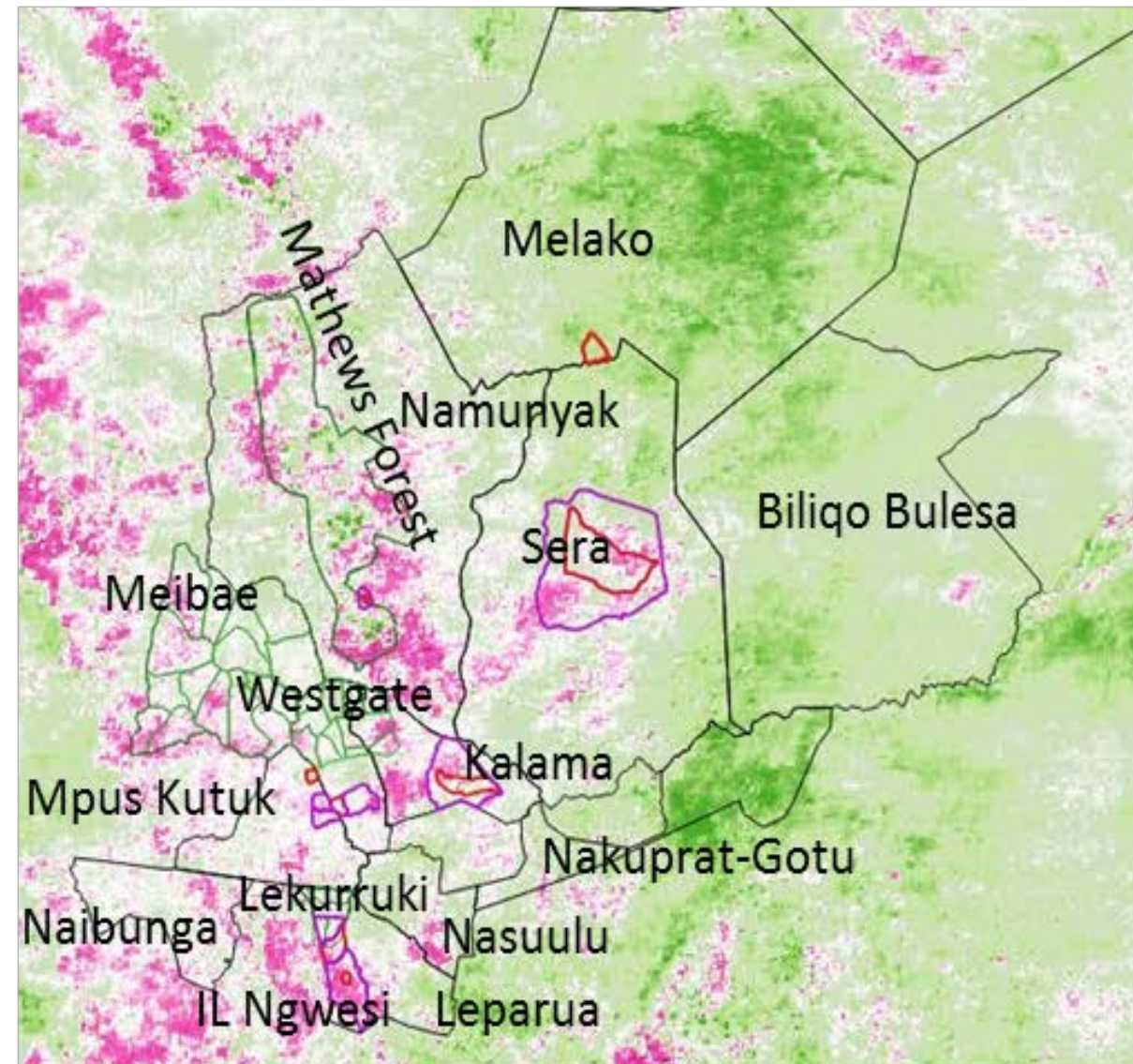





Project Implementation and Satellite Monitoring

2008



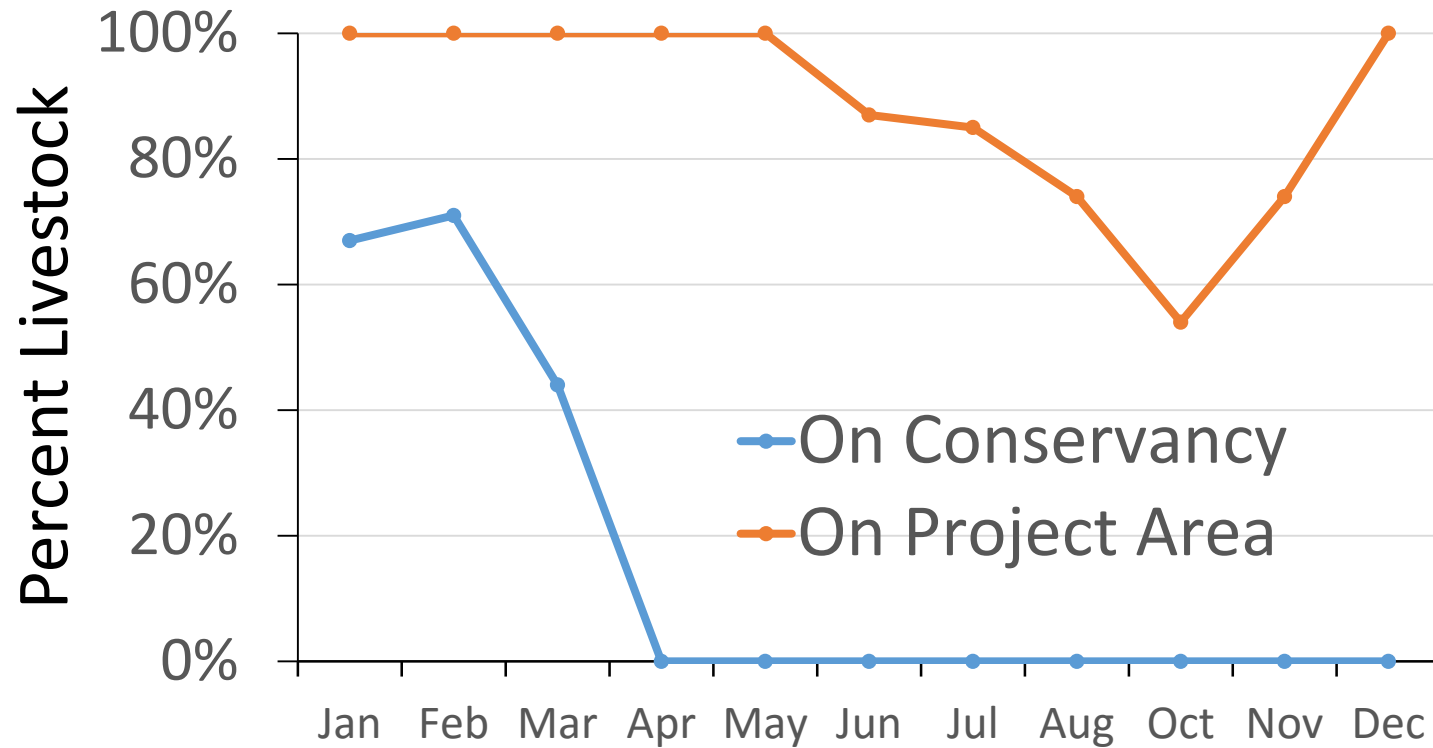
2014



-  Production > Grazing Losses
-  Production = Grazing Losses
-  Production < Grazing Losses

Ecology of Scale: The Curious Case of Westgate Conservancy

\$4.5 million in investment in improved grazing, Grevy's Zebra Trust, USAID, Save the Children, The Nature Conservancy, Northern Rangelands Trust

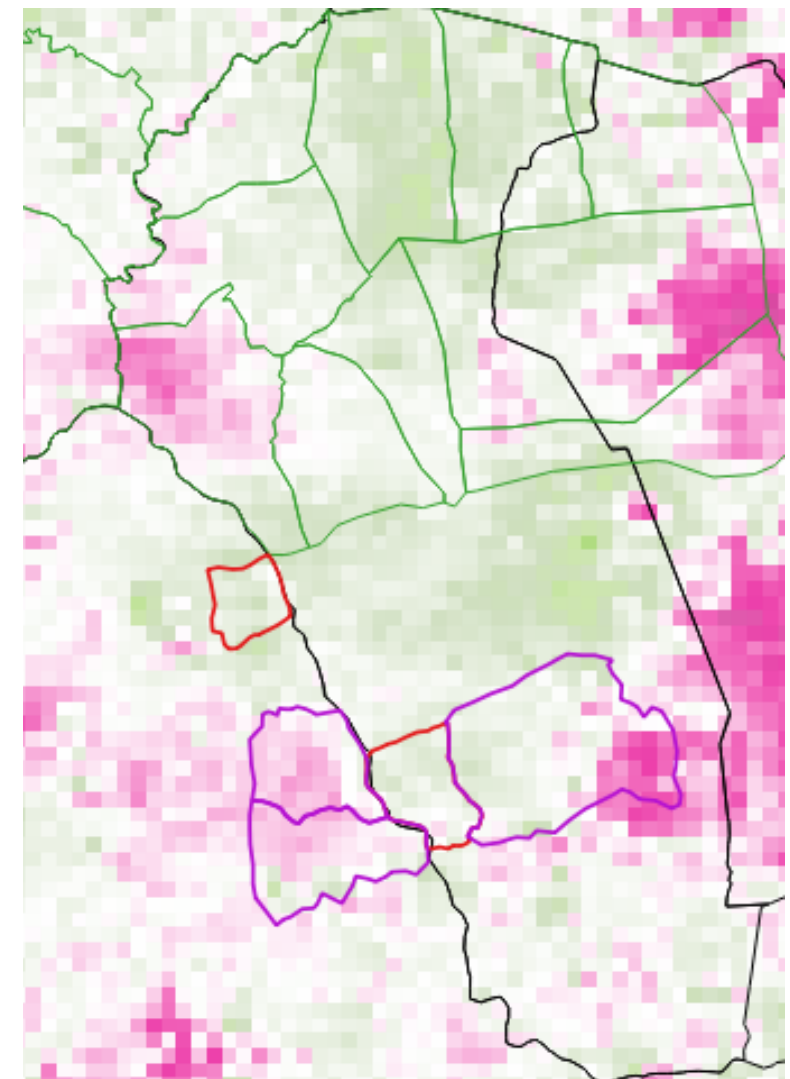


Westgate Conservancy



Grevy's Zebra – Endangered Species

- Net Forage Loss
- No Net Change
- Net Forage Gain



Socio-economic Development From Carbon Finance



Climate Variability and Change

Improved Cattle Breeds
Productive Pasture
Fertile Soils, Widespread Water

Livestock as Assets
Shoats Dominate
Unproductive Pasture
Rare Water and Conflicts

Improving Pasture
Expanding infrastructure
Expanding Products and Markets



Community Investment in livestock value chain

Assisted Market

Internal Market



Donor Subsidies



Cash Market



Current

+ 5-10 Years
Carbon Financed

+ 10-20 Years,
Self-Sustaining

Conclusions

- Rangelands critical to mitigating climate change
- Spiral of degradation, loss of soil carbon... can be reversed!
- Multiple wins: soil, water, productivity, biodiversity, people
- Encompass spatial and temporal variability: Essential that projects be large-scale
- Tools? Ecosystem models and satellite image interpretation
- Incentives? Markets for ecosystem services – carbon
- Carbon market -> Cash for infrastructure -> self-sustaining economy

