Implementing ecological functions in a land use change model to assess impacts of crop expansion and overstocking in a Kenyan savanna

Benjamin Warth, Carsten Marohn, Folkard Asch
Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute), University of Hohenheim, Germany

Introduction
- Veg. cover is seasonally reduced under cropping and tillage disturbs soil
- Loss of rangeland to cropping increases grazing pressure on remaining pastures, causing rangeland degradation
- Does large-scale conversion of African savannas to cropland generate negative ecological impacts?
- Land conversion is happening on Ol Maisor ranch and a lot more is planned

Model scenarios: Crop expansion vs. Status quo
- 10 year model runs, 4 corrals with 600 cattle each, monthly shifting corral locations, crop and hay expansion reduces pasture from 10,500 to 6,100 ha
- Higher grazing frequency of remaining pastures in crop expansion scenario does not cause additional pasture degradation
- SOC is higher under maize, but lower under hay after pasture conversion

Discussion and Conclusion
- Pasture is more productive and grazing resistant on less clayey red soils due to higher plant water availability, despite tree competition
- Plant growth is patchy, because it is highly influenced by lateral water flows
- SOC increases after grassland conversion to maize, because residues are left on fields and are not removed for livestock feeding
- Adjustment of soil physical equations improved simulation of clay soil hydrology and enhanced pasture (re)growth
- Pasture degradation was observed where water limitation and overgrazing coincided

Materials and Methods
Added grazing and growth reserves to LUCIA
Growth reserves module
- Enables regrowth after grazing
- Reserve depletion causes plant death and vegetation degradation

LUCIA model
- Land Use Change Impact Assessment tool (lucia.uni-hohenheim.de)
  - Spatially explicit, process-based
  - Daily timestep, 100m grid resolution

Grazing module
- Monthly shifting grazing locations
- Constant herd size and herbage offtake
- Dung and urine NPK contents depend on plant NPK contents

Contact: benjamin.warth@uni-hohenheim.de; Garbenstr. 13, 70599 Stuttgart