Improving estimates of GHG emission factors from livestock production systems on smallholder farms

David Pelster, Klaus Butterbach-Bahl, Mariana Rufino, John Goopy and Todd Rosenstock

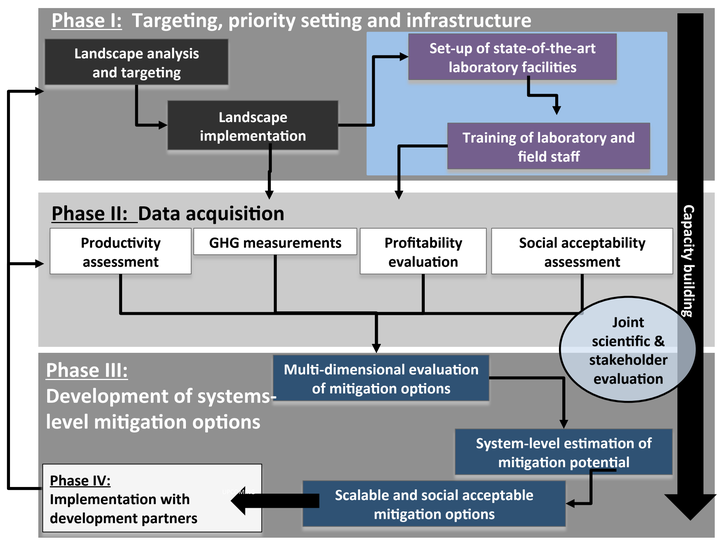
September 2014

Introduction

Lack of data on GHG emissions from African agriculture suggests inaccuracies in national inventories

- In sub-Saharan Africa, agriculture is estimated to account for over 60% of GHG emissions, primarily due to land use change and enteric methane production in ruminants; and over 80% of agriculture (both area and production) is smallholder systems
    - No empirical studies on enteric CH4 emissions and very few studies on GHG emissions from soils in these systems
- Current national SSA inventories therefore are based on IPCC tier 1 methodology;
    - Using emission factors from OECD states with large industrial farming systems that likely do not represent smallholder systems where manure applications, not synthetic fertilizers are dominant source of nutrients, and where ruminant fodder is generally protein-poor and food availability is often limited (The only available study [S. Africa] estimated that the Tier 1 emission factors for ruminant CH_4 production is about 50% of actual emissions)

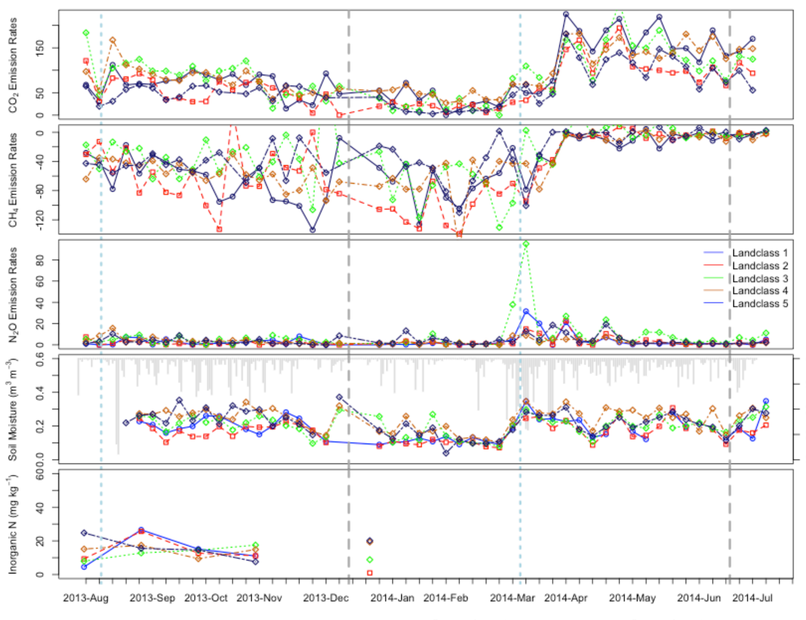
Materials and methods



- Stratified into 5 land classes (based on remote sensing); 3 field types (based on farm management); and 3 broad vegetation classes
- Sampled 1x per week for one year at 60 farms in western Kenya using static chambers (3 reps)
- Analyzed soils once for total C/N content, BD and texture and 4 times for soil IN concentration
- Classify livestock production systems and determine herd numbers within each class
- Plan to use enclosed respiration chambers for measuring ruminant CH_4 production

Results

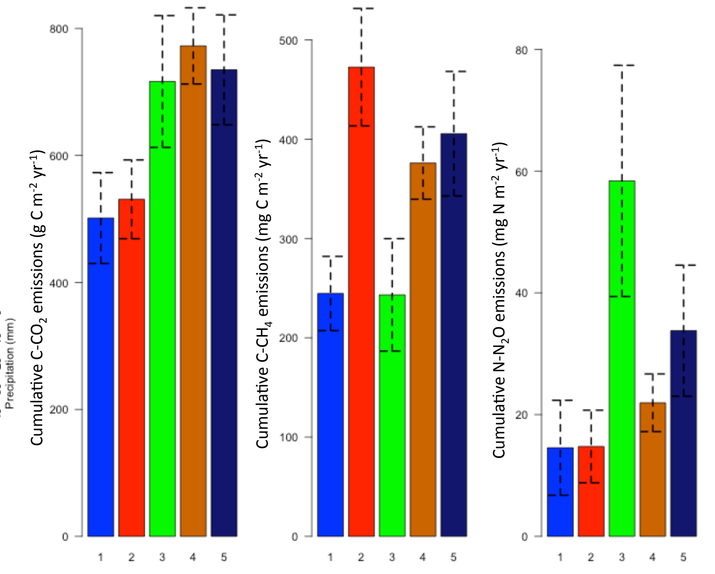
1. Soil GHG emissions from mixed smallholder farms did not vary by management ("intensive" vs extensive) however differences between land classes were noted
2. Soil cumulative emissions tended to be much lower than previous studies in OECD states
3. Still require measurements of enteric CH_4 production



Soil GHG emissions over time: a) mg C-CO_2 m^{-2} hr^{-1}; b) µg C-CH_4 m^{-2} hr^{-1}; c) µg N-N_2O m^{-2} hr^{-1}; d) Soil moisture content; e) soil IN (NH_4 + NO_3) concentrations

Note: Dotted vertical lines indicate planting, while dashed lines indicate harvesting

Landclass: 1 = lowland subsistence farming; 2 = cash crops; 3 = highland subsistence farming; 4 = highland mixed farming; 5 = grasslands / pasture



Cumulative soil GHG emissions over time for the 5 different land classes. Bars indicate 1 SEM

Research into use

- Can increase intensity of management (greater use of fertilizers) without increasing soil GHG emissions
    - Suggests that increased nutrient inputs that increase agriculture / livestock production could be considered mitigation as it also can decrease emissions per unit
- Development of emission factors for using Tier II methodology to calculate national GHG inventories
- Determine feed strategies for increasing animal production while reducing CH_4 emission intensities

David Pelster or Klaus Butterbach-Bahl
dpelster@cgiar.org ; k.butterbach-bahl@cgiar.org ● P.O. Box 30709-00100 Nairobi Kenya ● +254 20 422 3513
http://aghealth.wordpress.com ● www.ilri.org

Acknowledgements: The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and the International Livestock Research Institute (ILRI)

This document is licensed for use under a Creative Commons Attribution –Non commercial-Share Alike 3.0 Unported License