



# Integrating economics, technology networks, soils and gender to remove constraints to conservation agriculture in the developing world

**Mulvaney MJ<sup>1</sup>, Moore K<sup>1</sup>, Christie ME<sup>1</sup>, Norton G<sup>2</sup>, Bertelsen M<sup>1</sup>, Sutphin LK<sup>1</sup>**

<sup>1</sup> Virginia Tech, SANREM CRSP, 526 Prices Fork Rd, Blacksburg, VA, USA. Corresponding author: mikemulvaney@vt.edu

<sup>2</sup> Virginia Tech, Agric. & Applied Economics, 205-B Hutcheson Hall, Blacksburg, VA, USA

The research theme of the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program's (SANREM CRSP's) current phase is to develop conservation agriculture production systems (CAPS) aimed at increasing smallholders' agricultural productivity and food security through improved cropping systems. In addition to increasing food security, CAPS will contribute to and take advantage of improved soil quality and fertility. Farming systems with CAPS will maintain a year-round soil cover, minimize soil disturbance from tillage, and utilize crop rotation systems.

The majority of SANREM CRSP research is conducted through long-term research award (LTRA) activities. Currently, there are seven projects developing CAPS in 13 countries across Africa, Asia, and Latin America. Each LTRA collaborates with and contributes to four cross-cutting research activities (CCRAs):

- Economic and impact analysis
- Gendered knowledge
- Technology networks
- Soil quality and carbon sequestration

**Gendered Perspectives for Conservation Agriculture:** This project uses participatory research to address gender-related factors contributing to the success or failure of CAPS. Research will draw comparisons between local knowledge/participatory techniques and scientific/technical methodologies.

This CCRA explores three questions:

1. What are men and women's local soil knowledge, beliefs, and perceptions; soil management practices; and access to agricultural resources, including land, information, and soil inputs?
2. What are the gendered landscapes linked to knowledge, beliefs, and perceptions of soil quality and soil management practices?
3. What is the gendered nature of access to and control over animals and animal by-products in context of crop-livestock interaction?

Farmers identify and describe different soil types, including their "best" and "worst" soils. Samples are then collected from those soils and analyzed in collaboration with the Soils CCRA. Farmers' soil descriptions will be compared with lab results and examined for gender differences. It is expected that women will use descriptors related to soil fertility while men will describe soil in terms of physical properties.



Women participate in a mapping exercise in Kapchorwa, Uganda.



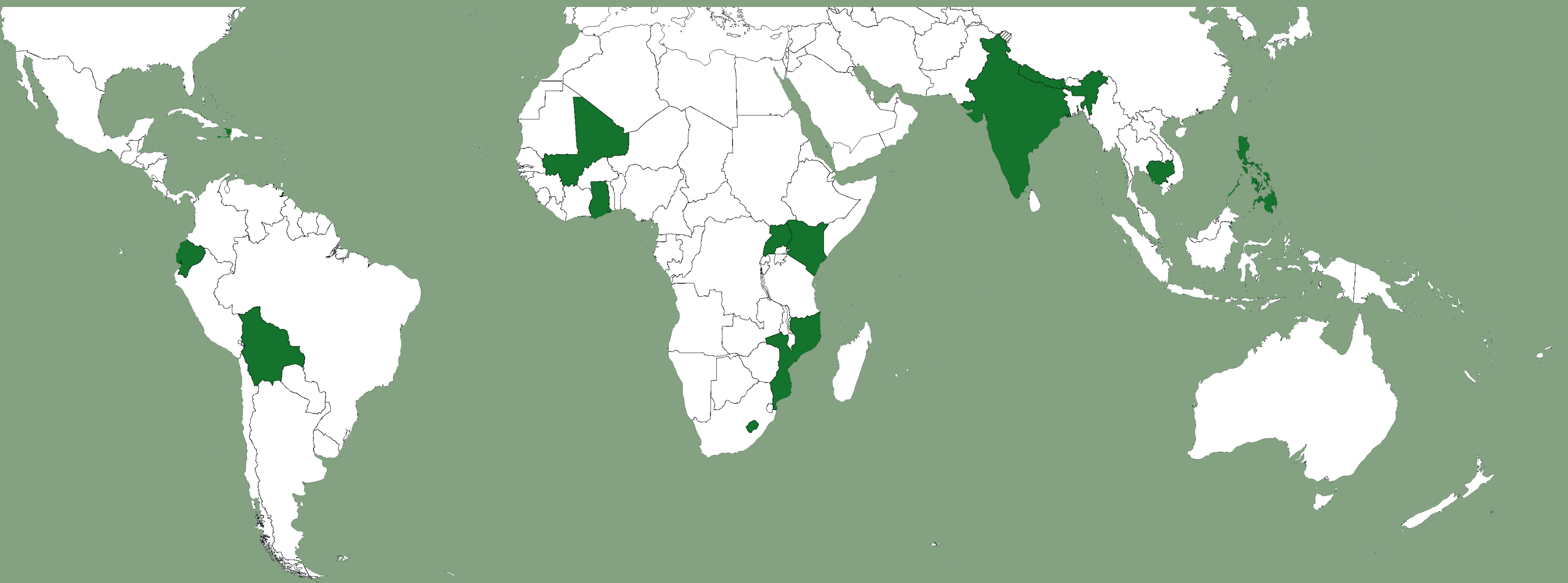
A Lesotho man shows proper soil sampling techniques.

**Soil Quality and Carbon Sequestration:** The over-arching goal of this CCRA is to determine if dryland smallholders in the developing world who adopt conservation agriculture can increase soil organic carbon (SOC) and soil fertility. We know that conservation agriculture increases SOC under mechanized agriculture in the developed world, but it is unclear if such increases are feasible in developing countries. We will also look at the potential for carbon sequestration in these systems, which could lead to payments under carbon trading schemes.

This project coordinates soil and agronomic investigations in all of SANREM CRSP's 13 host countries to measure soil fertility and carbon sequestration before and after CAPS are implemented.

Our specific objectives are to:

1. Quantify SOC in host country project sites before and after CAPS implementation
2. Identify CAPS cropping systems or biophysical elements that improve soil fertility
3. Relate increased soil fertility to site-specific socioeconomic environments



**Economic and Impact Analysis:** The economic challenges to CAPS adoption are among the most formidable obstacles that will confront LTRAs and their collaborating host country partners. Benefits to participating smallholder farmers and their families are short-term time savings (e.g., land preparation, weeding) and longer-term increases in soil fertility and erosion control that result in greater yields, income, and food security. However, there are substantial short-term costs of adoption such as applications of herbicides, soil amendments, specialized equipment, risk, and uncertainty associated with new management systems. Additional benefits (e.g., ecosystem services, reduced siltation of streams, recharged aquifers) accrue over time to the broader society. However, the CAPS farmers who produce these benefits may not be compensated for their efforts.

The main objectives of this project are to:

1. Identify the costs and benefits of CAPS in cropping systems and related animal and forestry sub-systems.
2. Identify optimal CAPS and the sequencing of CAPS elements for each cropping system being researched.
3. Identify broader economic and social impacts of wide-scale CAPS adoption.
4. Identify any policy changes required to enhance CAPS adoption in each crop system.



A Bolivian woman sells produce in the market.

**Technology Networks:** Technological change leading to sustained adoption of smallholder CAPS involves more than just the introduction of conservation agriculture practices by an extension agent or NGO. It also includes shared understandings and supportive relationships with other partners in the community and agricultural service sector. Critical to these shared understandings is a shift toward conservation agriculture knowledge and attitudes and away from conventional and risk-averse agricultural production perspectives.

Our study focuses on three objectives:

1. Identify the knowledge and attitudes (technological frames) concerning agricultural production practices held by actors in the network
2. Describe the structure of information and physical resources flows between these actors
3. Determine critical network pathways and opinion leaders facilitating technological change among farmers and their service sector partners



A working group in Mali discusses the introduction of conservation agriculture into their farming practices.