



SANREM CRSP: Cross-cutting research adapts conservation agriculture for dryland smallholders in developing countries

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The Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP) is sponsored by the U.S. Agency for International Development's Bureau of Food Security, participating U.S. universities, and host country institutions around the world.

Our research engages stakeholders at all levels to develop sustainable, localized farming practices. The multi-country program is comparative, with research identifying common elements that affect conservation agriculture adoption.

The research theme of 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.



CAPS minimize soil loss by leaving the crop residue on the ground.

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

In contrast to the in-depth, locally adapted LTRA research, the purpose of the CCRAs is to collect and analyze findings across LTRA sites for global application. The CCRAs are designed to elicit and organize common elements that will help generalize and expand findings to a wider range of sites and circumstances.

A balance between site specific requirements and standardized methodology across LTRA sites will ensure scientifically valid comparisons at the end of the study. A standardized research protocol developed by the each CCRA in collaboration with the LTRAs is integrated with LTRA activities.

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Gendered Perspectives for Conservation Agriculture

This project uses participatory research to address gender-related factors contributing to the success or failure of CAPS. Understanding women's and men's local knowledge, beliefs, and perceptions of soils is essential for the adoption of CAPS. Women have specialized agricultural knowledge in areas such as soil quality and crop-livestock management. Their knowledge often differs from that of men's based on women's practices, access to and control of assets, and other factors that may provide incentives (or disincentives) for their participation in 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?



Women participate in a mapping exercise in Kapchorwa, Uganda.

The Gender CCRA employs a series of qualitative research techniques: community-level focus group discussions and activities to map community soils; household visits to carry out the same activities at the farm level; transect walks; participant observation of farming practices. 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. In addition, after farmers identify soil types on their land through hand-drawn maps, plots will be mapped using GPS. In both mapping and soils knowledge, a participatory farmer-led approach will be linked to a technical, scientific perspective. Sources of knowledge, beliefs and perceptions of soil quality will be explored through household interviews and analyzed in conjunction with the Technology Networks CCRA.

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 CA 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 conservation agricultural production systems (CAPS) are implemented. We are coordinating the LTRAs' data collection in order to make meaningful and scientifically verifiable comparisons across all project sites.

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

We are building a soils library from all project countries at 0-5 and 5-10 cm depths from researcher-managed sites. These samples will be analyzed for pH, CEC, total organic C (TOC), total N, extractable P, K, Ca, Mg, Zn, Cu, B, Mn, and Fe. Since we may not find differences in TOC over the short term (<5 years), we will fractionate TOC into labile and recalcitrant fractions using size-based and density-based fractionation procedures.

We also facilitate LTRAs and host-country partners to build capacity regarding biophysical data collection from CA plots vs. current practice controls.



A Basotho graduate student learns to collect soil core samples

Economic and Impact Analysis

This project is developing an economic model that will serve as a template for economic impact analyses of SANREM CRSP Phase IV regional projects as well as future SANREM CRSP regional programs.

The economic challenges to CAPS adoption are among the most formidable obstacles that will confront LTRAs and their collaborating host country partners. While the benefits to participating smallholder farmers are short-term time savings and long-term increases in crop yields, income, and food security, there are also substantial short-term costs of adoption such as: applications of herbicides, soil amendments, specialized equipment, and risk and uncertainty associated with new, intensified management systems. Additional benefits, such as ecosystem services, accrue over time to the broader society. However, the CAPS farmers who produce these benefits may not be compensated for their efforts.

The relative importance, magnitude, and distribution of benefits and costs will likely vary widely over the geographical distribution of production systems covered by the LTRAs. However, in order for wide-scale adoption and impact to occur in any region, the fundamental economic research problem remains the same. This CCRA collaborates and assists the LTRAs in developing a common baseline and methodology for addressing this general question. Later, as relevant LTRA data become available, plans call for the analysis to be expanded to the higher level landscapes and a more comprehensive economic impact assessment of CAPS. It is expected that the resulting comparative analysis across LTRAs will provide significant insight into general strategies that promote wide-scale adoption of CAPS.

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

The goal of the SANREM CRSP Technology Networks cross-cutting research activity is to determine factors that facilitate innovation and scale-out CAPS to smallholders. Comparing technology network findings across LTRA research sites will reveal characteristics of the structure and functioning of agricultural networks that enable system-level problem solving for successful smallholder CAPS development.

Technological change leading to sustained adoption of smallholder CAPS involves more than just the introduction of CA 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

This research is designed to piggyback on LTRA baseline and follow-up surveys for years one and four. Two target groups (farm households; and agriculture service sector and community actors) need to be surveyed to obtain a minimum network analysis dataset at each site. Site comparisons of network parameters before and after the initiation of LTRA field research will provide the foundation for site-level hypothesis testing. Cross-site comparisons of network case studies will allow for assessing the differential impact of each site's network structure and functioning. Two sets of hypotheses will be explored in order to achieve study objectives. The first set tests the relationship between technological frames and agricultural practices. The second set addresses network relationships directly, testing them from the perspective of service sector actors, farmers, and the network as a whole.



A SANREM researcher conducts a survey in Cambodia.