Development and transfer of conservation agriculture production systems (CAPS) for small-holder farms in eastern Uganda and western Kenya

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The Issues

Information gathering and baseline surveying identified key issues :

- Agronomic practices like monocropping, residue removal, and heavy, repeated plowing deplete soil productivity;
- Economic realities prevent adoption of alternative practices, purchase of conservation agriculture equipment, or fallowing land for cover crops;
- Market structures and policies discourage innovation such as crop rotations, cover crops, or implementation of other CA practices.

Agronomic Practices

Objectives: Evaluate CAPS tillage, rotation, and cover-crop practices.
Tangible versus intangible effects: Many tangible effects of *status quo* practices are positive, while invisible, effects are negative:
Residue is valuable as firewood, fodder, and building material, but left in place builds soil productivity.
Cover crops take up valuable space needed for food crops, but they build soils and can increase yield.
Moldboard plows are paid for, rarely break, are easy to repair, are easy to transport and handle behind a team, and they create a mellow, weed-free seedbed. But they also accelerate loss of soil organic matter, compaction, and eliminate almost all soil cover. Adoptable minimum-tillage implements must retain advantages of moldboard plows.

Economic Realities

Objectives: Evaluate economic and socio-cultural performance of CAPS and economic tradeoffs necessary to improve soil fertility.
Constraints:
Farmers can't afford to sacrifice short-term yield for long-term sustainability, so CAPs must generate income at least equal to current practices immediately upon adoption;
Crop residues have value off the field, so CAPS must allow some removal and demonstrate the value of soil building;
Space is to precious to be occupied by cover crops, so CAPS must demonstrate yield increases that allow soil-building space without sacrifice;
Gender roles and labor allocation inhibit changes in the timing or amount of work, so CAPS must be developed with close involvement of all stakeholders.

Market Constraints

Objectives: To provide bases for policy review, revision, and development of marketing systems that encourage adoption of CAPS.
Constraints to agricultural and market innovation:
Policy and regulatory environments discourage small farm innovation;
Lack of technology prevents sensing innovative or emerging markets;
Logistical bottlenecks prevent sales of crops or purchase of inputs;
Gender roles and labor allocation inhibit changes in the timing or amount of work;
Inadequate storage infrastructure can cause high post-harvest losses;
Obligations or debt can restrict ability to create or exploit new opportunities.

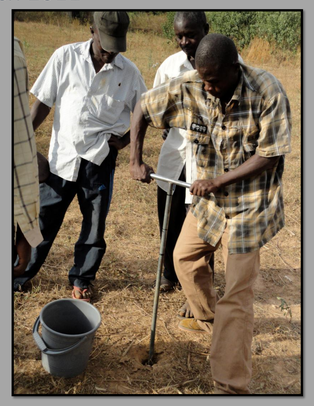
Activities and Progress

Study areas: two upland and two lowland areas in Mt. Elgon region of Kenya-Uganda border: Kapchorwa and Tororo Uganda; Trans Nzoia and Bungoma, Kenya.
CAPS experiment: one on-station and four on-farm factorial tillage x cropping system trials in each area.

Focus groups, baseline surveys and advisory groups for co-design of CAPS trials in each study area.

Demarcating and baseline sampling, March 2011

Preparing and planting plots, April 2011.



Flexibility: As trials progress farmers and advisory groups may determine different crops or rotations would be more relevant. We can respond to changing priorities while maintaining key tillage, cover cropping, and intercropping treatments.

		12-m width, 36 m total			10-m width, 60 m total
		Current Practices	Rotation 1	Rotation 2	
Current Tillage Practice	+N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans mucuna	
	-N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans mucuna	
No-till	+N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans Green manure	
	-N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans mucuna	
Minimum till	+N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans mucuna	
	-N fertilizer	Maize-bean intercrop	Maize-bean intercrop with mucuna relay	Maize, 4 rows Beans mucuna	

Data collection:
Soil fertility and carbon stores, including stable and labile pools and density fractions of soil organic matter;
Trace gas emissions and mineral nitrogen for soil carbon flux modeling;
Rainfall and temperature;
Crop growth and yield parameters.

Sampling soil gases for carbon dioxide, nitrous oxide, and methane quantification.

Soil sample processing and organic matter fraction procedures in the University of Wyoming Soil Resource Lab.

Tools for Conservation Agriculture
We believe that adoption of CAPS will depend largely on identifying or developing tools that accomplish soil preparation and weeding while reducing both soil disturbance and labor. As field trials progress, we work with farmer cooperators to develop and/or evaluate hand, animal-drawn, and tractor-drawn implements designed to retain residue cover.

Prototype tiller designed for easy manufacture and repair, and to compete with the oxplow with respect to handling, turning space, and ease of transport among fields.

Economic Data Collection: Co-design and implementation with cooperating farmers of on-farm data collection methodology proceeds in May 2011;
Market Issues: Identification of primary and secondary data sources followed by interviews and compilation proceeds in summer/fall, 2011.

Project Goals: At the end of this five-year project farmers and other stakeholders will have participated in development and evaluation of CAPS for long enough to determine whether soil-building practices result in healthier soils and economically higher yields. They will have identified, developed and tested tools for reducing soil disturbance. We will have defined policy and regulatory constraints to agronomic and market innovation.

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