LTRA 10: Kenya and Uganda

University of Wyoming AT Uganda Manor House Agricultural Center SACRED Africa Eldoret University Makerere University

East Africa SANREM Team

- University of Wyoming
 - Jay Norton, Principal investigator, soils
 - Eric Arnould, markets and market access
 - Urszula Norton, agronomy
 - Danelle Peck, Economics
 - Melea Press, markets and market access
 - Emmanuel Omondi, project manager, agronomy
 - Jeremiah Okeyo, PhD student, soils, Borlaug LEAP Fellow
 - Judith Odhiambo, PhD student, agronomy, Schlumberger Fellow
 - Moses Owori, MS student, ag economics, Borlaug LEAP Fellow
 - Erin Anders, BS agronomy, McNair fellowship
 - Kristi Bear, BS soils, McNair fellowship
- Kenya
 - Dominic Sikuku, project field manager, agronomy
 - Eusebius Mukhwana, director, SACRED Africa
 - John R. Okalebo, Chepkoilel University, Kenya
 - Patrick Oluko, MS student
 - Phanice Ogonga, MS student
 - Dennis Shibonje, Manor House site manager
 - Johnstone Odero, SACRED site manager
- Uganda
 - Rita Laker-Ojok, director, AT Uganda
 - Bernard Bashaasha, Makerere University, Uganda
 - Judith Asiimwe, MS student
 - Grace Tino, ATU project coordinator
 - Ketty Nambozo, Uganda study site manager

Farmers

Shadrack, Leonard, Opichu, Billia Omondi, Jackson, Barnar, Florence, Chris, Mary, others Many farmer group members



Simple, light, strong, paid for, and it prepares seed bed just the way farmers like it done.





Background & Methods

- One on-station and four on-farm study sites in each of four locations in Mt. Elgon region:
 - Two lowland sites with two cropping seasons;
 - Two highland sites with one cropping season;
- Factorial design with three cropping systems:
 - Current practice maize-bean intercrop;
 - Maize-bean/cover crop relay intercrop;
 - Strip-intercrop maize-bean-cover crop rotation;
- On three tillage systems:
 - Current practice ox plow and deep hand weeding x 3;
 - No-till with chemical weed control;
 - Reduced tillage with shallow tillage + chemical weed control

Study Design: 4 locations



Study Location



Kapchorwa, Uganda

Two highland sites; Two lowland sites; Each with one onstation trial and four on-farm trials

MBRID SO. OF P

• Busumbu

A104

Tororo

A 104

Sironko

Bungeina

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0°48'02 73" Nº 34°25'19 50" E elev 4924 ft

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Kitale C 48

High population density Sandy, low-potential soils Elevation = 1400 m Bi-modal precipitation totaling >1200 mm: long rains: March to August short rains: October to December Cropping systems: Intercropped maize and beans twice a year Groundnuts, casava, coffee, others Moldboard plow prior to each planting Deep hoeing for weed control



Bungoma, Kenya

Kapchorwa, Uganda Kapchorwa

Lower population density Degazetted from Mt Elgon NP in 1980's High-potential volcanic soils but with very high erosion Elevation = 2100 m Uni-modal precipitation totaling >1200 mm Cropping systems: Intercropped maize and beans once a year Wheat, potatoes, other crops Moldboard plow prior to planting Deep hoeing for weed control



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Data collected by the LTRA 10 team

- Crops: yield, biomass, weeds, LAI;
- Soils: labile & stable SOM pools, physical properties, trace-gas emissions, residue biomass and turnover, erosion modeling;
- Economics: baseline household data, CA cost data;
- Market systems research.

Collaborations

- Borlaug fellowships, Schlumberger faculty for the future, McNair undergraduate fellowship;
- CIAT Tropical Soil Fertility Institute on evaluation of long-term reduced tillage trials;
- Manor House: OPV maize performance under smallscale intensive production, long-term soil impacts of small-scale intensive methods;
- Soils CCRA: current analyses of CO2 emissions and SOM fractions due to three years of treatments;
- Technology networks CCRA;
- Gender CCRA;
- Impact assessment CCRA;

- Yields (Dominic Sikuku, Emmanuel Omondi, and HC partners): year 1 and 2 results indicate:
 - Cropping systems: either no effect or sometimes higher yields under strip intercropping;
 - Tillage systems: common year effect that indicates learning curve: CP higher in yr 1, no diff or RT higher in yr 2;
 - 2nd season yields are typically very low;
 - Still a lot of data to analyze, but farmers note lack of yield depression from new systems.



Weeds: (Judith Odhiambo, Urszula Norton) current tillage practices had fewer weeds in year 1 and more in year 2 and 3 than reduced and no till; Cost data indicate \$40-60 per ha less compared to typical practice



- Soils (Jeremiah Okeyo, Judith Okeyo, Jay Norton, Urszula Norton, Emmanuel Omondi):
 - SOM pools: no strong differences, but trending toward more labile C and N in reduced till;
 - Termites appear to be major constraint for no till;
 - Limited incorporation may actually conserve residues;
 - Now analyzing samples from end of year 3.
 - Erosion modeling: supports value of reduced tillage and residue retention;
- Crop residue utilization and replacement (Erin Anders, Urszula Norton, HC partners): cooperating farmers and orphanage collected weights on crop residue use:
 - Most used for forage and fuel;
 - Use of crop residues dropped by >75% within 1.5 years of planting planting fast-growing woody spp and perennial grasses;
 - Wood also provided alternative income stream.

Penetration resistance: (Jeremiah Okeyo) tillage reduces PR in the plow layer, but two years of reduced and no till resulted in lower PR below that: indicates better root penetration.



- Trace gases: two-season study site had much higher emissions than one-season site.
 - Very high emissions during the second season may be due to tillage of fresh residues in very warm temperatures and high moisture.



 Economics: (Dannele Peck, Moses Owori, Bernard Bashaasha, Judith Asiimwe) preliminary modeling results from baseline survey indicate that efforts aimed at improving household wealth through changes in knowledge about soils are more effective than efforts aimed at institutional changes;

Cost analyses are still under way.

DESCRIPTIVE SUMMARY OF HH characteristics BY DISTRICT

Variable	T'ro	Кар	Bugo	Nzoia	Pooled
Crop production (%)	85.5	90.5	75.9	61.0	70.6
Salaried work (%)	14.4	9.0	19.1	30.0	18.1
Total land accessed (acres)	4.7	3.9	3.5	9.3	5.3
Total land cultivated (acres)	3.4	2.8	2.6	5.9	3.7
Use improved seed (%)	37.6	79.5	97.0	89.5	74.1

DESCRIPTIVE SUMMARY OF HH characteristics BY DISTRICT

	Toro	Kap	Bugo	Nzoia	Pooled
Use inorganic fertilizer (%)	0.00	27.0	78.7	78.5	45.4
Av maize yield (kg/ha)	263	2500	997	4641	2113
HH learned/heard of CA (%)	34.3	37.0	32.8	33.5	34.5
Reside in Temporary house (%)	32.2	35.0	14.4	0	20.5
Reside Semi-permanent house (%)	48.5	62.0	71.8	56.5	59.5
Reside Permanent house (%)	18.8	1.5	11.7	42.5	18.7

- Marketing systems: (Eric Arnould, Melea Press, HC partners) primary and secondary research described challenges to meeting subsistence requirements and producing/marketing surplus crops ecologically sustainable fashion, including:
 - policy and regulatory environments punitive of small farm innovation;
 - lack of tools and technology for sensing market demand in innovative or emerging markets;
 - logistics bottlenecks;
 - high post-harvest loses;
 - inadequate storage infrastructure;
 - long-term contractual relationships (debt or production quotas, that restrict ability to create or exploit new opportunities).
- Resulted in recommendations for all levels of value chain.

Outputs

- Degrees/theses
 - Wyoming: Judith Odhiambo (PhD, Kenya), Jeremiah Okeyo (PhD, Kenya), Moses Owori (MS, Uganda);
 - HC: Patrick Oluko (MS, Kenya), Phanice Ogonga (MS, Kenya), Judith Asiimwe (MS, Uganda)
- Peer-reviewed articles/proceedings
 - Odhiambo, J., U. Norton, E.C. Omondi, D.S. Ashilende, D.N. Sikuku, and J.B. Norton (in review). Effect of maize-bean intercropping on GHG emissions in small holder farming in Kenya. Agriculture, Ecosystems and Environment (Submitted in February 2014).
 - Moore, K.M., J.N. Lamb, D.N. Sikuku, D.S. Ashilenje, R. Laker-Ojok, J.B. Norton. 2014. Multiple knowledges for agricultural production: Implications for the development of conservation agriculture in Kenya and Uganda. J Ag Ed Extension 20:291-307.
 - Omondi, E.C., J.B. Norton, D.S. Ashilenje. 2014. Performance of a local open pollinated maize variety and a common hybrid variety under intensive small-scale farming practices. African Journal of Agricultural Research 9:950-955.
 - Okeyo, M.J., J.B. Norton, and S. Saidou. (in prep) Eight years of reduced tillage and crop residue retention impact soil properties and crop yields in western Kenya. Soil Tillage Res.
 - Odhiambo, J., U. Norton, E.C. Omondi, D.S. Ashilende, and J.B. Norton. (in prep) Alternative soil and crop management strategies control weed population during early transition in maize (Zea mays L.) production in western Kenya. Field Crops Research.

Outputs

- Co-designed technologies and farming systems
 - Reduced tillage with strip intercropping is favored by farmers:
 - Can combine with the relay approach;
 - Facilitates chemical and mechanical weed control (compared with intercropping).
 - Reduced tillage tools: animal-drawn multifunction tool bar: exploring African mfg.
- Training and field days: hundreds of participants





Ongoing and future work

- Fertility trials;
- Resource & effort concentration;
- Impact assessment;
- More on-farm trials for training and refining systems: seeing is believing;
- Overtly integrate livestock in cropping system work;
- Expanded farmer to farmer workshops, marketing, pamphlets;
- HC mfg of MFI and microfinance partnerships;
- University collaborative research and degree programs: students as link between scientists US and HC countries.

