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

ON STATION

1
1
2
2

ON FARM

3

4

3

4
Study Location
- Two highland sites;
- Two lowland sites;
- Each with one on-station trial and four on-farm trials
Bungoma, Kenya

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
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
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 small-scale 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;
Summary of Results

• 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;
  – 2\textsuperscript{nd} season yields are typically very low;
  – Still a lot of data to analyze, but farmers note lack of yield depression from new systems.
Summary of Results

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
Summary of Results

- 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 fast-growing woody spp and perennial grasses;
  - Wood also provided alternative income stream.
Summary of Results

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.
Summary of Results

• 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.
Summary of Results

• 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.
<table>
<thead>
<tr>
<th>Variable</th>
<th>T’ro</th>
<th>Kap</th>
<th>Bugo</th>
<th>Nzoia</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop production (%)</td>
<td>85.5</td>
<td>90.5</td>
<td>75.9</td>
<td>61.0</td>
<td>70.6</td>
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<tr>
<td>Salaried work (%)</td>
<td>14.4</td>
<td>9.0</td>
<td>19.1</td>
<td>30.0</td>
<td>18.1</td>
</tr>
<tr>
<td>Total land accessed (acres)</td>
<td>4.7</td>
<td>3.9</td>
<td>3.5</td>
<td>9.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Total land cultivated (acres)</td>
<td>3.4</td>
<td>2.8</td>
<td>2.6</td>
<td>5.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Use improved seed (%)</td>
<td>37.6</td>
<td>79.5</td>
<td>97.0</td>
<td>89.5</td>
<td>74.1</td>
</tr>
</tbody>
</table>
### DESCRIPTIVE SUMMARY OF HH characteristics BY DISTRICT

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

• 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
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).
• 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.