Conservation Agriculture Adoption by Cotton Farmers in Eastern Zambia

Philip Grabowski, John Kerr, Steve Haggblade and Stephen Kabwe
Cotton is a key cash crop

- Contract farming
- Equipment and herbicides available on credit
- Private sector extension
Conservation agriculture

- Minimum tillage and mulching
  - early planting
  - reduce evaporation
  - increase infiltration of water
- Rotations, manure application and precise fertilizer
  - improved nutrient cycling
Adoption of CA by smallholder cotton farmers in Zambia

Percent of NWK farmers using CF on cotton in Eastern Province (Grabowski et al. forthcoming)
Spatial variation in adoption levels

Percent of NWK and Cargill farmers using CF on cotton by ward in Eastern Province (Grabowski et al. forthcoming)
Research Question

- What are the factors driving farmer decision making about their land preparation methods?

Hypotheses

- Labor, wealth, input availability, promotion, experience and soil characteristics affect the probability of CA use
Methods – Survey and Interviews

- 326 Farmers from NWK and Cargill
- 775 Plots of cotton and maize
- 12 Plot level variables
- 13 Household level variables
- 6 Community level variables
Opinions comparing basins with hoeing and ripping with plowing

- 80% or more said basins and ripping:
  - have better yields
  - do better on dry years
  - are better for the soil and have less erosion

- Results were divided on if CA or conventional was less work or had less weeds

- Over 50% said conventional did better than CA on wet years
Land preparation by crop

Cotton
- Basins
- Hoeing
- Ox-ripping

Hybrid Maize
- Direct seeding
- Basins
- Hoeing
- Ox-plowing

Groundnuts
- Hoeing
- Ox-ripping
- Ox-plowing

Local Maize
- Direct seeding
- Basins
- Hoeing
- Ox-ripping
- Ox-plowing
Adoption of three principles of CA

- Only 5% of basin plots and 13% of ripped plots had a legume the previous season.

- 96% of basin plots and 62% of ripped plots had the residues heavily grazed.

- 85% of ripped plots were “banked” – tilled to control weeds and reduce lodging.

- 52% of basin plots were in their first year in that location – often rotated with maize.
Multinomial logit model

Estimate how each variable affects the probability that a plot will be prepared using any one of these four methods:

1. Plowing (P)
2. Ripping (R)
3. Hoeing (H)
4. Basins (B)
## Abbreviated Regression Results

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Plow vs. Hoe</th>
<th>Ripping vs. Plow</th>
<th>Basin vs. Hoe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plot Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot area (ha)</td>
<td>0.39</td>
<td>-0.11</td>
<td>-2.34 *</td>
</tr>
<tr>
<td>Flat (Y/N)</td>
<td>-0.07</td>
<td>0.42</td>
<td>2.33 ***</td>
</tr>
<tr>
<td>RankRatio (low = good)</td>
<td>0.58</td>
<td>0.87</td>
<td>3.18 ***</td>
</tr>
<tr>
<td>Tenure Secure (Y/N)</td>
<td>-0.15</td>
<td>0.54</td>
<td>-2.24 **</td>
</tr>
<tr>
<td><strong>Household Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained in CA (Y/N)</td>
<td>1.96 ***</td>
<td>3.89 ***</td>
<td>2.16 **</td>
</tr>
<tr>
<td>Workers per hectare</td>
<td>1.02 **</td>
<td>-1.07</td>
<td>1.03</td>
</tr>
<tr>
<td>Wealth index</td>
<td>5.27 ***</td>
<td>0.98 *</td>
<td>1.67</td>
</tr>
<tr>
<td>Cotton experience (Yrs)</td>
<td>0.04</td>
<td>0.13 ***</td>
<td>0.13 **</td>
</tr>
<tr>
<td><strong>Community Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years CA promoted</td>
<td>-0.50 **</td>
<td>-0.15</td>
<td>-0.56 **</td>
</tr>
<tr>
<td>Buyer CA practice</td>
<td>0.61</td>
<td>0.91 ***</td>
<td>0.36</td>
</tr>
<tr>
<td>Herbicides avail. (Y/N)</td>
<td>5.56 **</td>
<td>-0.31</td>
<td>-1.15</td>
</tr>
<tr>
<td>Pop. density (1000/km²)</td>
<td>-1.84</td>
<td>15.7</td>
<td>-25.4 ***</td>
</tr>
</tbody>
</table>

* is for p < 0.1, ** for p < 0.05, and *** for p < 0.01
### Key plot-level variables

**Plot Area (ha)**

- **Std Coef**: 0/1

**Plot is Flat**

- **0/1**: 0/1

**Rank Ratio**

- **Std Coef**: 0/1

**Residues Burned**

- **0/1**: 0/1

**Residues Grazed**

- **0/1**: 0/1

**Secure Tenure**

- **0/1**: 0/1

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**Factor Change Scale Relative to Category hoeing**

<table>
<thead>
<tr>
<th>.11</th>
<th>.19</th>
<th>.34</th>
<th>.59</th>
<th>1.05</th>
<th>1.86</th>
<th>3.29</th>
<th>5.82</th>
<th>10.3</th>
</tr>
</thead>
</table>

**Logit Coefficient Scale Relative to Category hoeing**

<table>
<thead>
<tr>
<th>-2.24</th>
<th>-1.66</th>
<th>-1.09</th>
<th>-0.52</th>
<th>0.05</th>
<th>0.62</th>
<th>1.19</th>
<th>1.76</th>
<th>2.33</th>
</tr>
</thead>
</table>
Key household-level variables

- Trained in CA
  - 0/1

- Wealth Index
  - Std Coef

- Cotton Experience
  - Std Coef

- Previous Employment
  - 0/1

- No Non-Ag. Income
  - 0/1

Factor Change Scale Relative to Category hoeing

| .12 | .34 | .92 | 2.49 | 6.79 | 18.47 | 50.28 | 136.84 | 372.43 |

Logit Coefficient Scale Relative to Category hoeing

| -2.09 | -1.09 | -0.09 | .91 | 1.92 | 2.92 | 3.92 | 4.92 | 5.92 |
Key community-level variables

<table>
<thead>
<tr>
<th>Factor Change Scale Relative to Category hoeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>.15</td>
</tr>
</tbody>
</table>

- **Years CA Promoted**
  - Std Coef

- **Buyer's CA practice**
  - Std Coef

- **Herbicide Availability**
  - 0/1

- **% Farming with Oxen**
  - Std Coef

- **Pop. Density (thousands)**
  - Std Coef
Summary – how CA is used

- Basins tend to be used by labor abundant and land constrained households to make marginal land more productive for maize.

- Ripping tends to be used by wealthier farmers with oxen who can buy the equipment. Rental markets have not developed as expected because of concerns for oxen health.
Implications

- Basins meet a niche need but are unlikely to be adopted on a large scale

- Ripping has higher adoption potential especially if rental availability is increased
  - Ownership requires investments in equipment and animals
  - Rental markets require healthier oxen
  - Availability must be accompanied by training
Thank you!

- Any questions?

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