What Explains Minimal Usage of Minimum Tillage Practices in Zambia? Evidence from District-Representative Data

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Introduction and background

- Conservation Agriculture (CA) has potential for sustainable agricultural intensification amid heightened environmental challenges and population increase
  - CA improves yields, land and water resources use
  - Eases off peak season “labour bottlenecks” by transferring land prep. to off season.

- CA → land management practices based on minimum tillage (MT) basins, ripping & zero tillage, plus crop residue retention, rotation with legumes and agroforestry with N-fixing plants.
- We focus on MT in this study, excluding zero tillage

Sources: CIA (2013), CSO/FSRP
Introduction continues

- Planting basins
- Ox-drawn ripping
- Zero Tillage
- Mechanized ripping

Min. Till = planting basins & ripping in the context of this study

Source: CFU
Introduction continues

- Despite over 2 decades of active promotion of CA in Zambia and much of sub-Saharan Africa (SSA) & its benefits well known; evidence of CA adoption and impact is mixed:
  - 8% of farmers used basins and 0.5% used ripping in the 1999/00 season (Haggblade and Tembo, 2003), data issues may overstate estimates
    - CFU estimated 12% MT use in 2009/10 up from 2% in 2006/7 based on 17 districts; current CFU estimates indicate 41% MT use- project specific
- Aslihan et al., (2013) - 95% disadoption between 2004 and 2008 nationally
  - We find less than 5% MT use between 2008 and 2012 in Zambia!
- Low CA adoption in SSA with its impact contested (Giller et al., (2009); Grawboski and Kerr, (2013) CA heretics vs. proponents debates emerging
- It’s paradoxical that CA use or adoption is so low despite its “well known” profitability we explore reasons in this study.
Objectives

- To examine trends in use of planting basins and ripping between 2008 and 2012

- To determine factors influencing use of planting basins and ripping and,

- To determine factors influencing size of land cultivated under planting basins and ripping
Data

- District and nationally representative Crop Forecast Survey (CFS) data were used for 2008 – 2011, with a total of ca. 63,000 households over the 5 years

- District level rainfall data from 1996-2011 from Zambia Meteorological Department (from 36 stations → imputed for other districts) - generated measures of droughts and floods variables
  - FGDs in 3 districts with 69 farmers
  - Key informant interviews with CFU project staff, MAL extension officers and researchers
  - Literature review

- CFS collected data using semi-structured questionnaires on
  - Demographics, landholding, field size
  - Main tillage method used in each field
Methods

- Descriptive analysis used to generate trend tables and graphs

- Used a Control Function Double Hurdle model to determine factors influencing MT use and extent of use.

- Endogeneity of CF practices: Included an instrumental variable for being in a district where MT is promoted

- Average partial effects obtained via Delta method
Results & Discussions
Results and discussions cont.

Figure 1: Trends in the total weighted numbers of smallholder farmers using ripping and/or planting basins by year from 2008-2012 in Zambia

Source: Authors’ computations from MAL/CSO Crop Forecast Survey, 2008-2012
Results and discussion cont.

- Upward trend in MT use rates, but very low (< 5%) nationally (< 10% in top 10 districts*) between 2008 and 2012. Why is this so?
  - Increasing trend partly explained by increased donor CA supported projects over time
- And low use rates?
  - FGDs - provision of “material handouts” to “lure” farmers; high labor demands; & limited access to finance
- Key informant interviews and literature search;
  - CA yield boosting potential contested beyond experimental plots
    - *poor resource farmers may not afford purchased inputs*
  - Competing uses for crop residues, mulch vs. fodder; impracticalities of maintaining crop residues in communal grazing lands
- High labor requirements (esp. for women) and finance constraints faced by farmers

* Based on Ngoma et al (forthcoming)
### Table 1: Selected Double Hurdle results on determinants of, and extent of use of planting basins and ripping: 2008 - 2012

<table>
<thead>
<tr>
<th>Variable description</th>
<th>Participation APEs</th>
<th>Probability, D (Tier1)</th>
<th>Planting Basins APEs on the conditional expected value</th>
<th>Planting Basins APEs on the unconditional expected value (overall)</th>
<th>Land under basins Y(Tier2)</th>
<th>Ripping APEs on the conditional expected value</th>
<th>Ripping APEs on the unconditional expected value (overall)</th>
<th>Land under ripping Y(Tier2)</th>
<th>Minimum Tillage APEs on the conditional expected value</th>
<th>Minimum Tillage APEs on the unconditional expected value (overall)</th>
<th>Land under MT Y(Tier2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male headed household (=1)</td>
<td>-0.0025</td>
<td>0.1752***</td>
<td>0.0020</td>
<td>0.0031***</td>
<td>-0.2062</td>
<td>0.0041***</td>
<td>0.0003</td>
<td>0.1661**</td>
<td>0.0055**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land size (ha)</td>
<td>0.0023***</td>
<td>0.4870***</td>
<td>0.0136***</td>
<td>0.0049***</td>
<td>1.1201***</td>
<td>0.0194***</td>
<td>0.0071***</td>
<td>0.7461***</td>
<td>0.3180***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive rain deviation('000mm)</td>
<td>-0.0286***</td>
<td>0.4754*</td>
<td>-0.0165***</td>
<td>-0.0245***</td>
<td>-0.4401</td>
<td>-0.0478***</td>
<td>-0.0500***</td>
<td>0.3453</td>
<td>-0.0499***</td>
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<td></td>
</tr>
<tr>
<td>Negative Rain Deviation ('000mm)</td>
<td>0.0441***</td>
<td>-0.7163*</td>
<td>0.0259***</td>
<td>0.0134*</td>
<td>3.0830**</td>
<td>0.0532***</td>
<td>0.0573***</td>
<td>-0.0641</td>
<td>0.0674***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFU has operations (=1)</td>
<td>-0.0087***</td>
<td>0.0921</td>
<td>-0.0297***</td>
<td>0.0039***</td>
<td>0.0450</td>
<td>0.0072***</td>
<td>-0.0047**</td>
<td>0.1719**</td>
<td>-3.94E-04</td>
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<td></td>
</tr>
<tr>
<td>Cattle disease (=1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.0035***</td>
<td>-0.1345</td>
<td>-0.0074**</td>
<td>-0.0003</td>
<td>-1.273*</td>
<td>-0.0043**</td>
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<tr>
<td>Observations</td>
<td>62708</td>
<td>1,348</td>
<td>62,708</td>
<td>62708</td>
<td>604</td>
<td>62,708</td>
<td>62,708</td>
<td>1,927</td>
<td>62,708</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
On drivers of MT use:

- Increased land access $\rightarrow$ improves uptake of basins and ripping among those already using the practices
  - Unconditional land access influence is very small

- Following a season with droughts and floods, farmers would increase and reduce use of MT, respectively $\rightarrow$ linked to climate change adaptation – core focus of Climate Smart Agriculture (CSA)

- Incidences of cattle diseases a risk factor to uptake of MT, esp. ripping

- Little substantive influence of male headed households on MT uptake
Main Conclusions & Implications

- Despite more than 2 decades of active promotion, we find low but rising use rates
  - \( (<5\%) \) of total smallholder crop farmers used MT between 2008 and 2012
  - Similar results are reported for much of SSA

- Higher conditional covariate influences \( \Rightarrow \) there is potential to increase MT uptake if unique characters of farmers using/adopting these practices are taken into account
  - Maybe a focus on market–led development facilitation

- More support needed to collection and dissemination of weather which is crucial in facilitating farmer decision making

- Cattle diseases control need to be ramped up and promotion of tractor ripping services as an alternative to enhance uptake of ripping

- For a better understanding of drivers of CA adoption and not “use” in Zambia, there is need for a panel study
THANK YOU!
http://www.iapri.org.zm/

Or

http://www.aec.msu.edu/fs2/zambia/index.htm

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