Smallholder Adoption of Conservation Agriculture and GHG Reduction Potential in Mozambique and Lesotho

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The views expressed here are those of the authors.

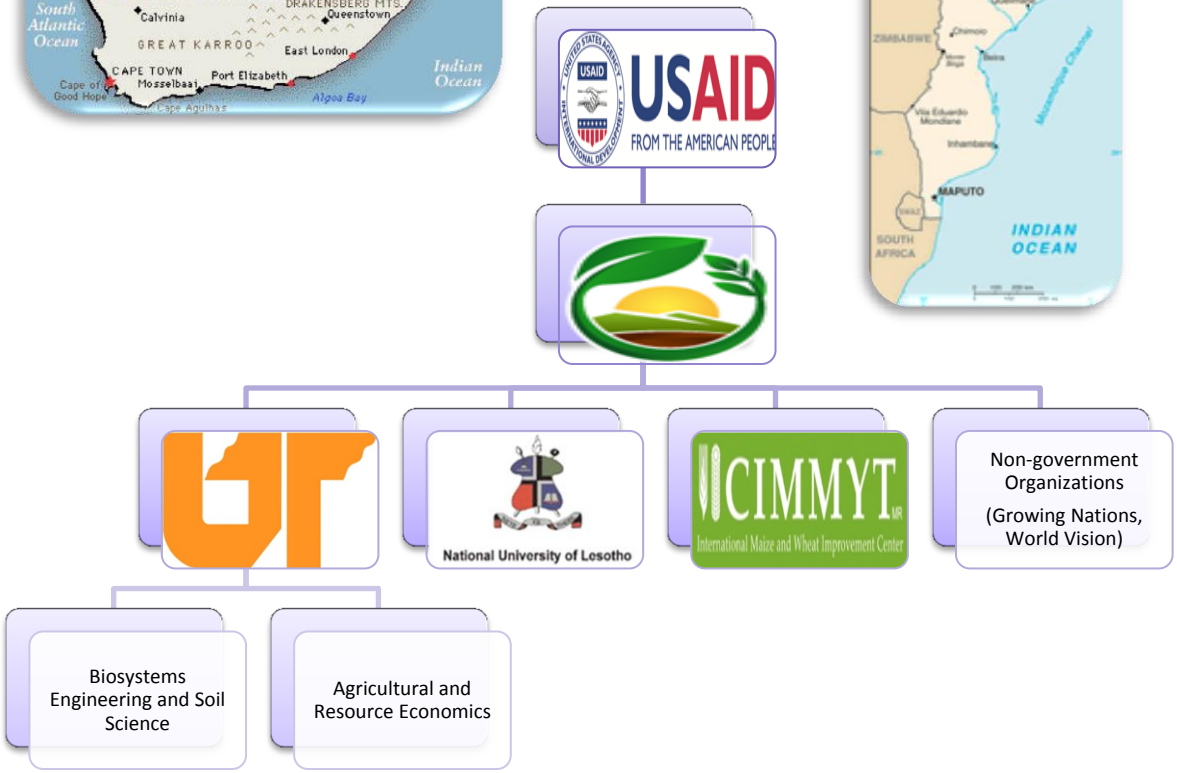
ACKNOWLEDGEMENTS

Background

- *Developing Sustainable Conservation Agricultural Production Systems for Smallholder Farmers in Southern Africa*
- Lesotho and Mozambique
- Five year project
  - Identify optimal input management regimes for CA systems
  - Characterize C:N soil/cover crop interactions
  - C sequestration potential of CA systems
  - CA adoption, income, and maize marketing
  - Maize production, input use and CA adoption

Lesotho

Mozambique



Mozambique profile*

- Ag sector employs 90% of the population
- Average farm size: 2.4 ha
- 98% of production occurs on farms less than 5 ha
- 16% of labor for agricultural production is hired
- 11% of the farmland cultivated with tractors or animal traction
- Maize yields range between 0.4 and 1.3 Mt ha^{-1}
- 4% of farms use fertilizer
- When fertilizer used, typically under-applied at 3.2 kg ha^{-1}.
- Estimated loss of 51 kg ha^{-1} yr^{-1} on tilled plots

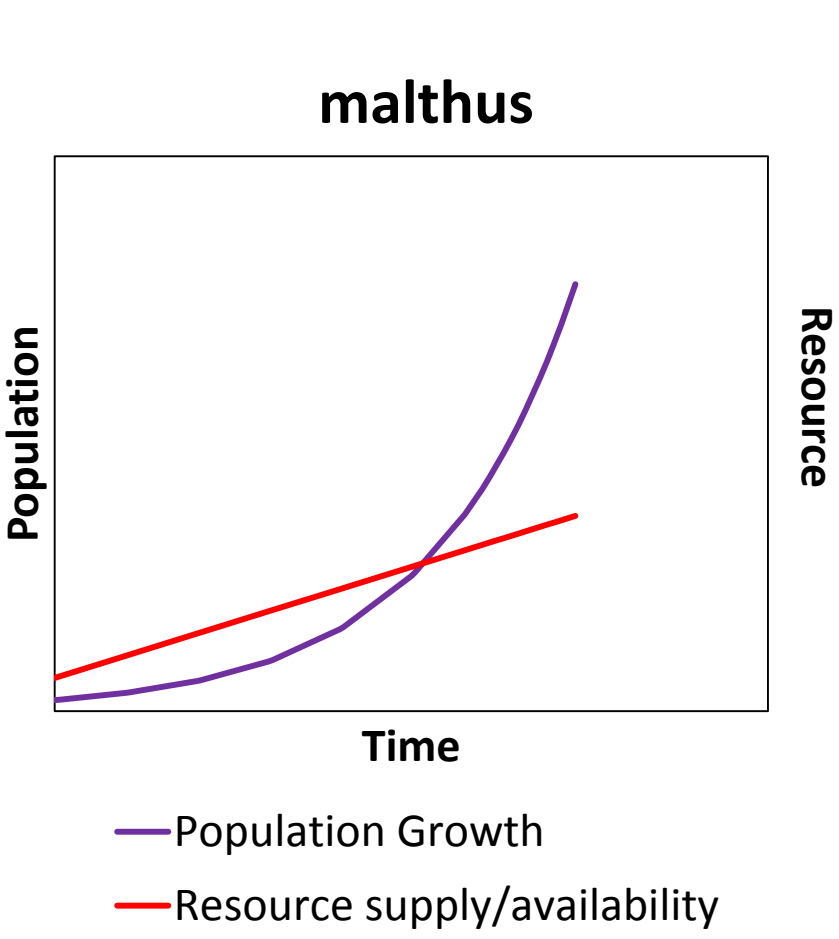
*Mozambique Ministry of Agriculture, 2008

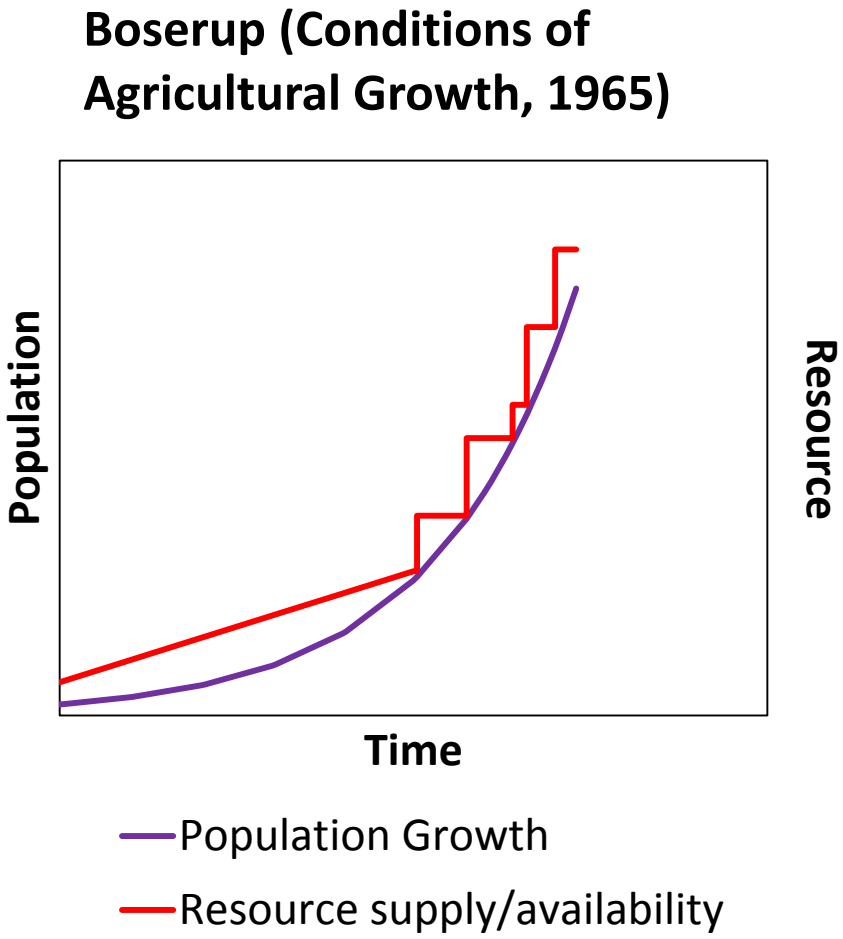
PRIVATE ACTIONS → LOCALIZED EXTERNALITIES → SYSTEMATIC "MACRO" EROSION

FARMING TO THE EDGE…

COMPETING FOR LIMITED RESOURCES…

SEASONAL WEATHERING & EROSION…





Two points of view (among many…)

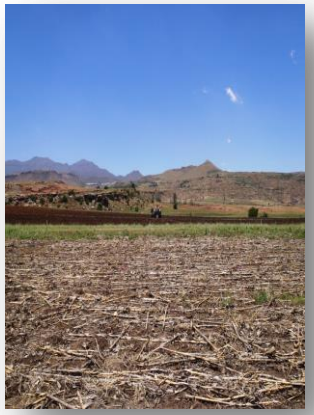
Conservation agriculture

Actions:

- Reduced, minimal, and no-till
- Residue management
- Intercropping and crop rotation

Expected Outcomes:

- Improve soil fertility
- Less yield variability
- Food security
- Surplus
- Moderate erosion
- Sequester carbon

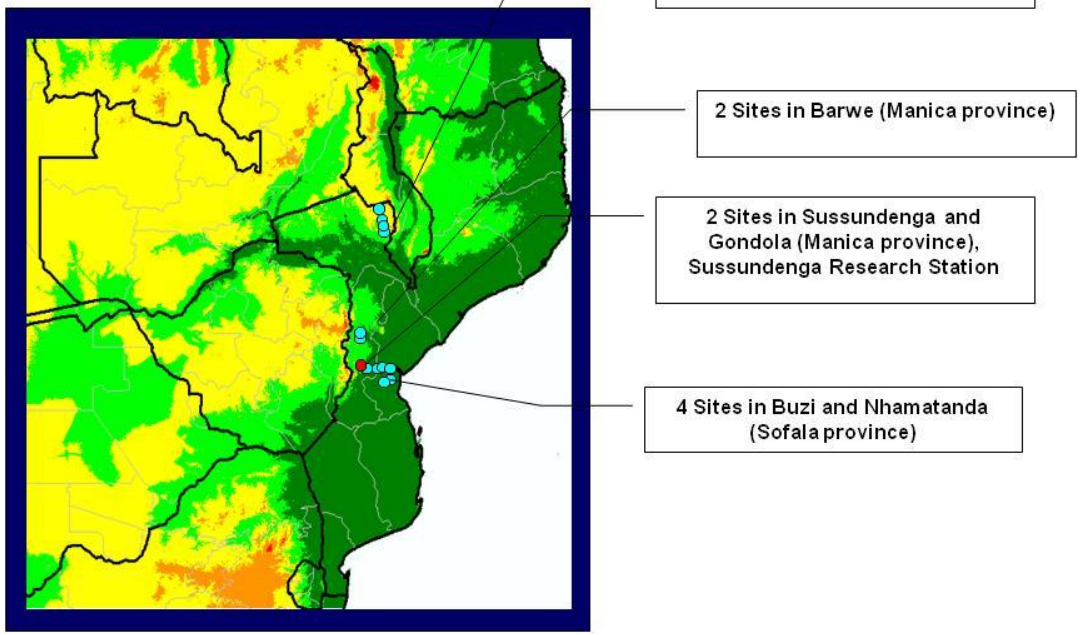


Source: FAO

Demonstration plots

Tete, Manica, and Sofala Provinces, Mozambique 2008 – 2011

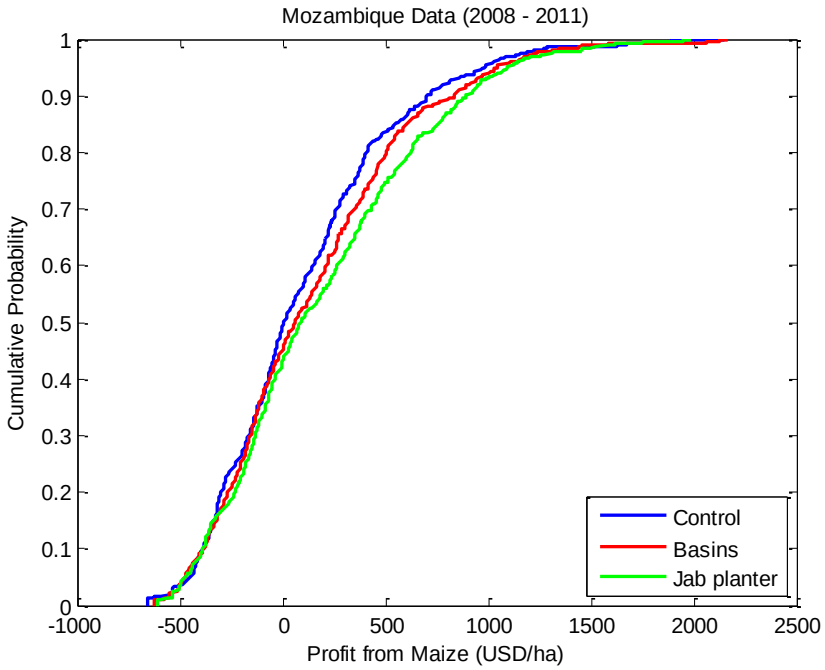
- Demonstration plots (CIMMYT/USAID, IFAD)
- Check, Basins, Jab planter
- Maize/cowpea rotations
- N = 638 farmers, 22 villages
- NPK/Urea (all plots)
- Herbicide on CA plots



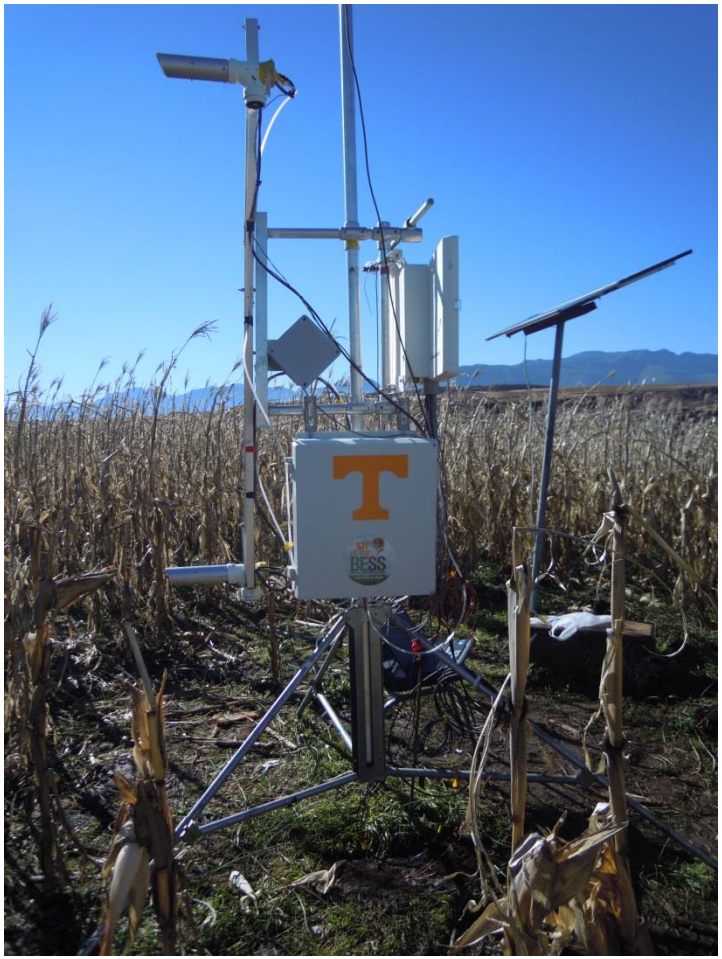
Net returns: conventional tillage treatments and CA planting technologies, Mozambique, 2008 – 2011 (N = 631 farms)

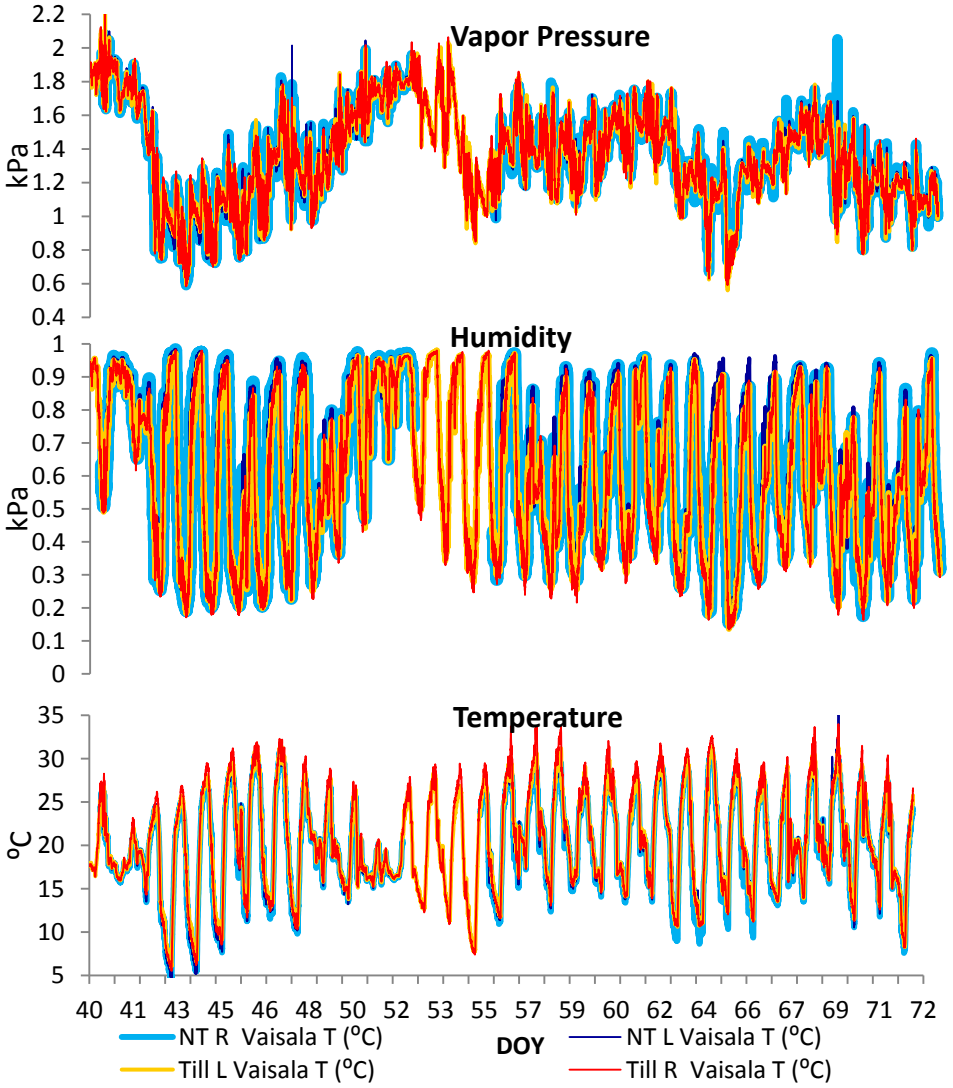
Net returns (USD ha^{-1})	Control	Basin	Jab planter
Mean	104	148	195
Std. Dev.	452	478	499
CV	435	323	257
----H_0: distributions not different*----			
Control		0.07 (0.0776)	0.12 (0.0002)

*Kolmogorov-Smirnoff test; D-statistic (p-value)

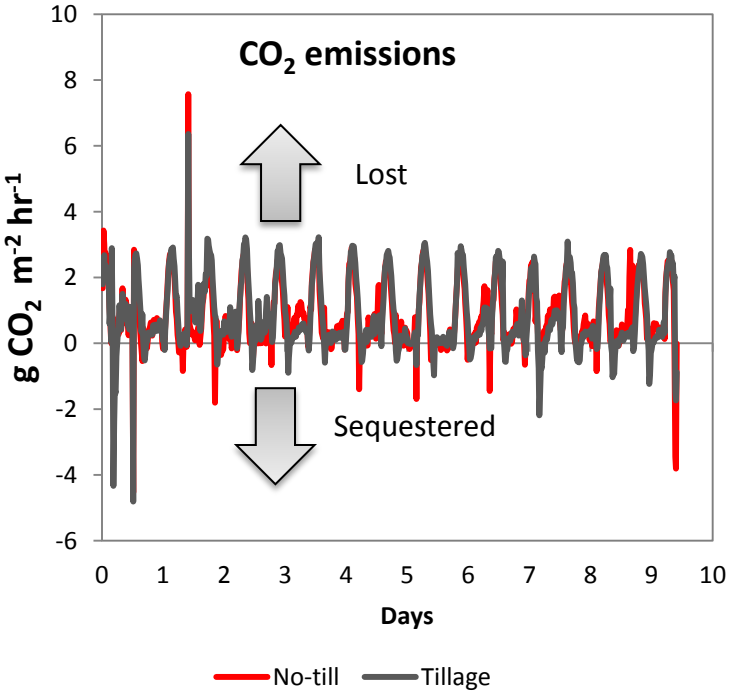


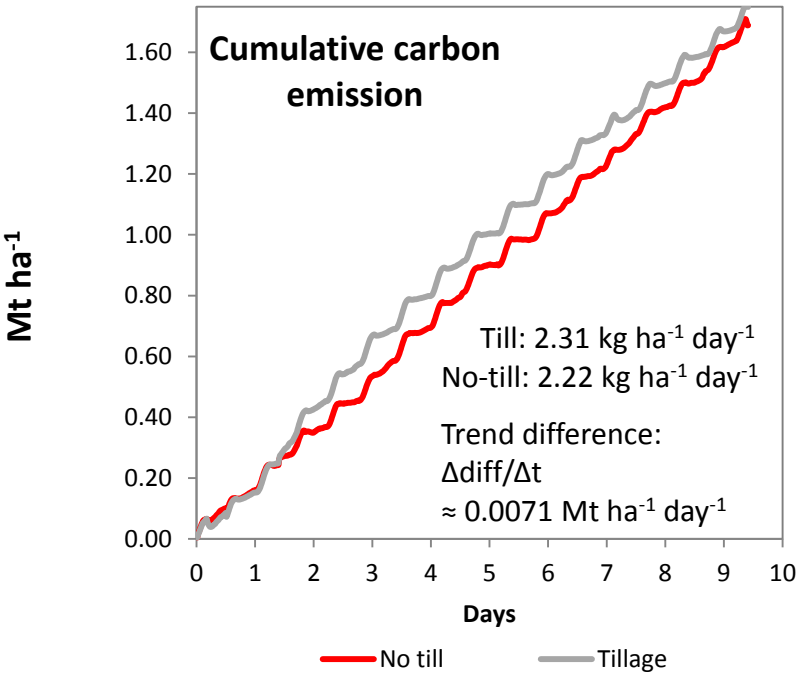
Bowen's Ratio Energy Balance and CO_2 flux : no-till/residue management and conventionally managed fields





No-tillage and tillage GHG profiles





Mozambique Household Survey

March 16-31, 2012

Tete, Manica Provinces

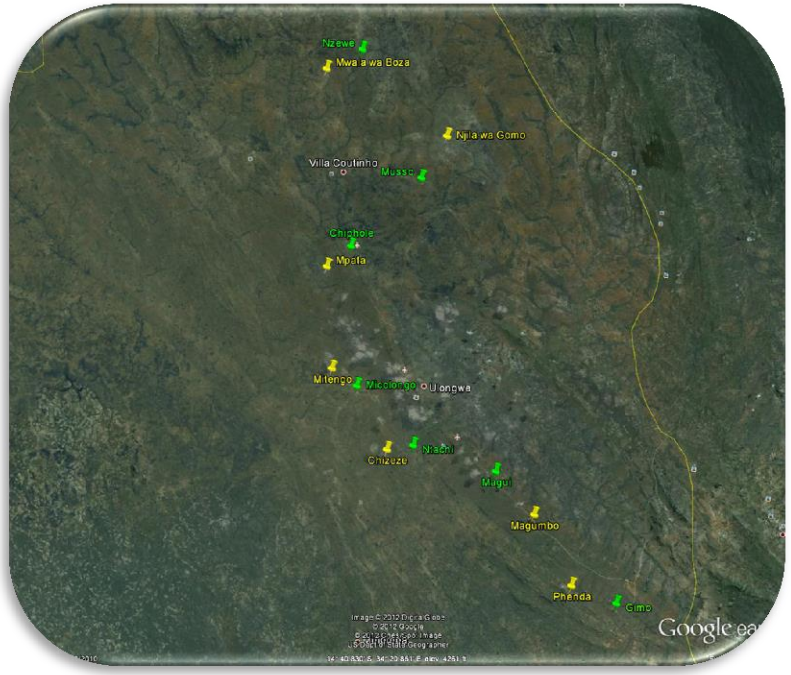
10 enumerators from provinces; 2 females/8 males

Sample 10% of 5,265 households (HH)

8% M.O.E. (95% CI)

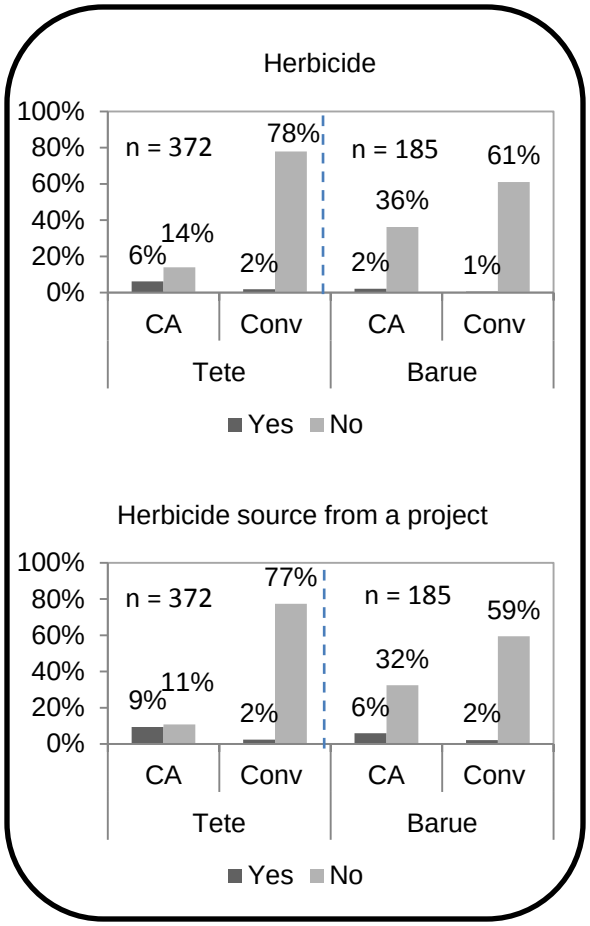
Stratified sampling of villages

- Exposed/CA (204 HH)
- Exposed/Non-CA (3,001 HH)
- Unexposed (2,244 HH)
- Systematic sampling

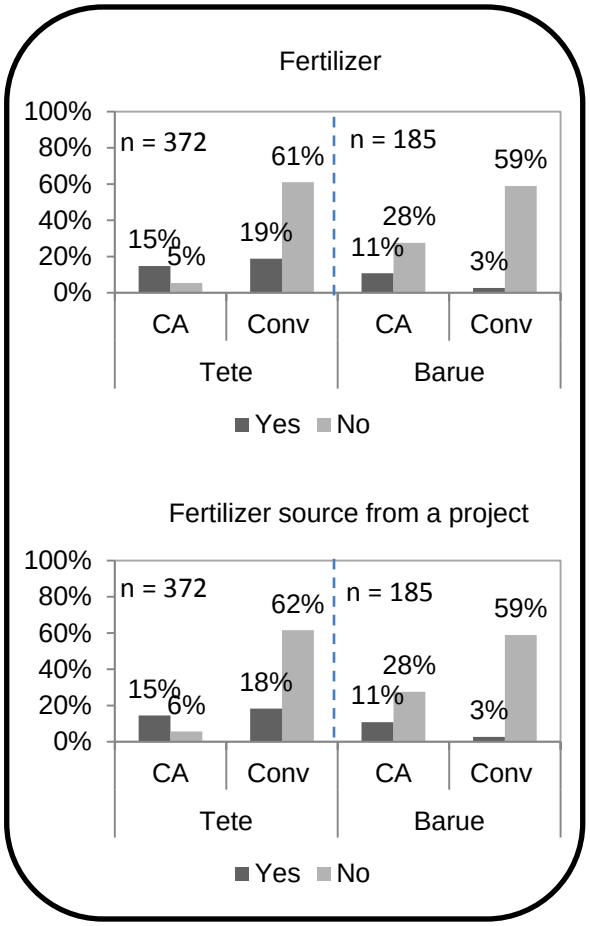


Profile		N
Distribution of groups:		
Adopters	27%	153
Abandoners	3%	15
Conventional farmers	70%	383
Aware of conservation agriculture	44%	553
Participated in farmer groups before adoption	58%	149
Years conservation agriculture practiced	3.2 (0, 15)	151
Increased planting area, 2011-2012:		
Conventional plots	45%	67
Conservation agriculture plots	55%	82
Plan to manage additional area under CA, 2013	95%	148

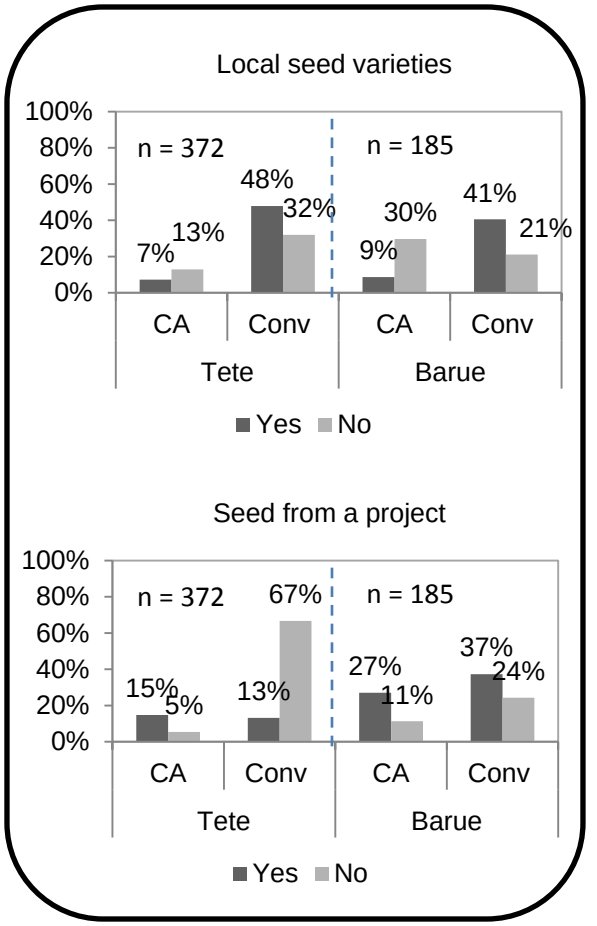
Input use


Herbicide
100%
80%
60%
40%
20%
0%
n = 372
n = 185
6%
14%
2%
78%
2%
36%
1%
61%
CA
Conv
CA
Conv
Tete
Barue
Yes
No

Herbicide source from a project
100%
80%
60%
40%
20%
0%
n = 372
n = 185
9%
11%
2%
77%
6%
32%
2%
59%
CA
Conv
CA
Conv
Tete
Barue
Yes
No

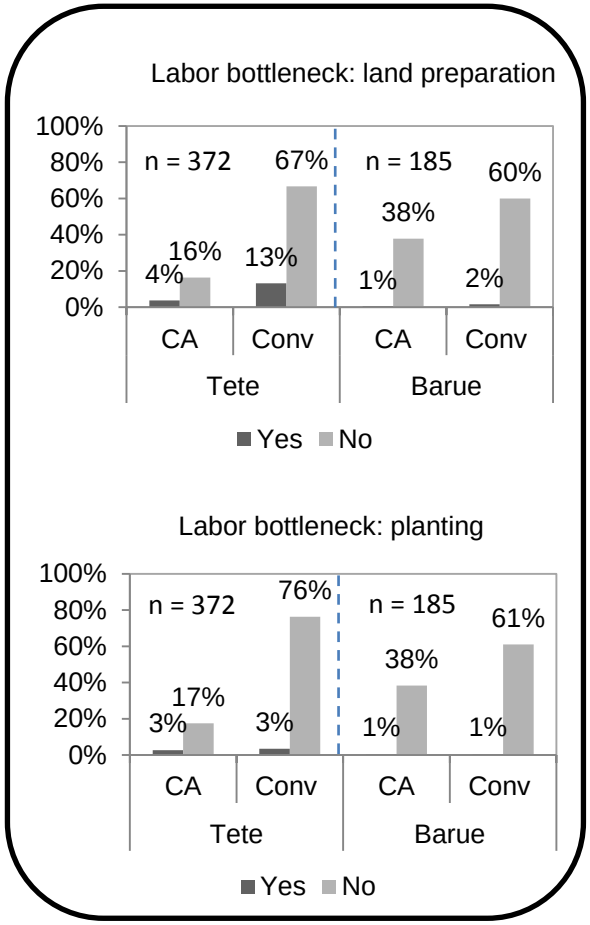

Fertilizer
100%
80%
60%
40%
20%
0%
n = 372
n = 185
15%
5%
19%
61%
11%
28%
3%
59%
CA
Conv
CA
Conv
Tete
Barue
Yes
No

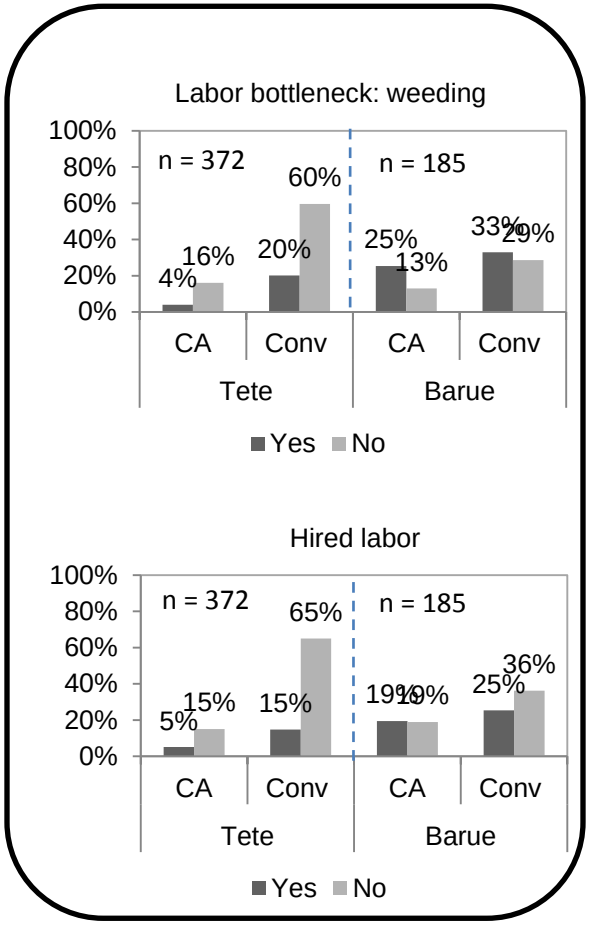
Fertilizer source from a project
100%
80%
60%
40%
20%
0%
n = 372
n = 185
15%
6%
18%
62%
11%
28%
3%
59%
CA
Conv
CA
Conv
Tete
Barue
Yes
No


Local seed varieties
100%
80%
60%
40%
20%
0%
n = 372
n = 185
7%
13%
48%
32%
9%
30%
41%
21%
CA
Conv
CA
Conv
Tete
Barue
Yes
No

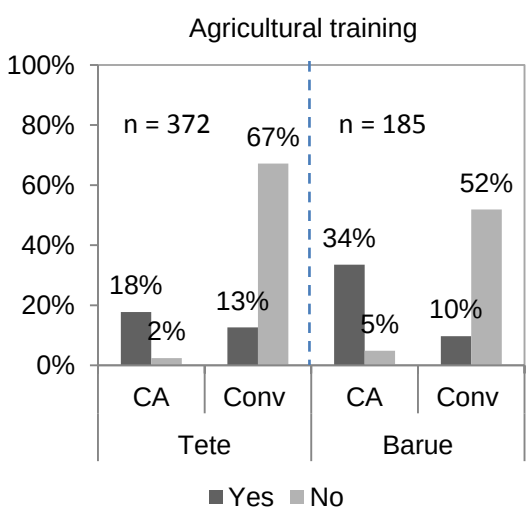
Seed from a project
100%
80%
60%
40%
20%
0%
n = 372
n = 185
15%
5%
13%
67%
27%
11%
37%
24%
CA
Conv
CA
Conv
Tete
Barue
Yes
No

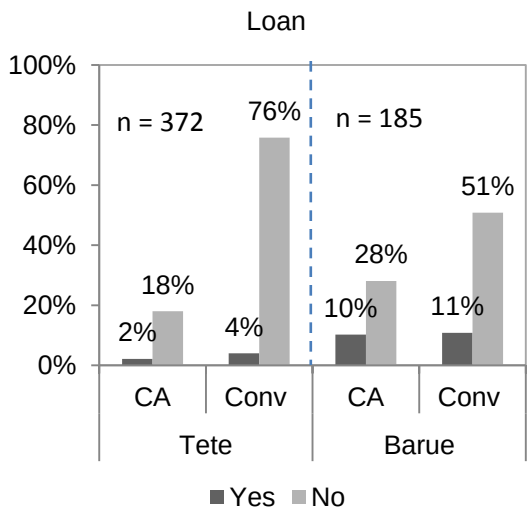
Labor constraints, training, and credit

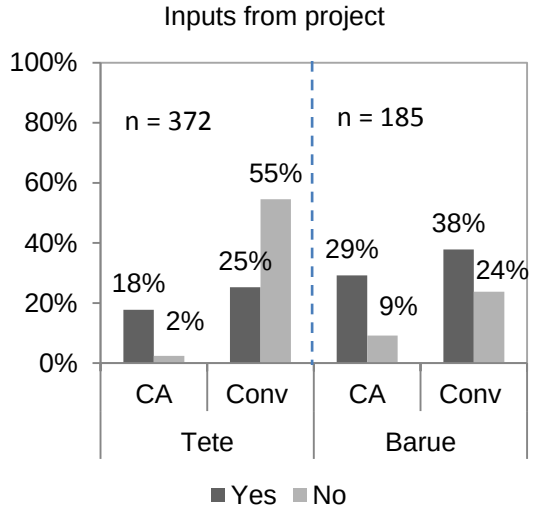




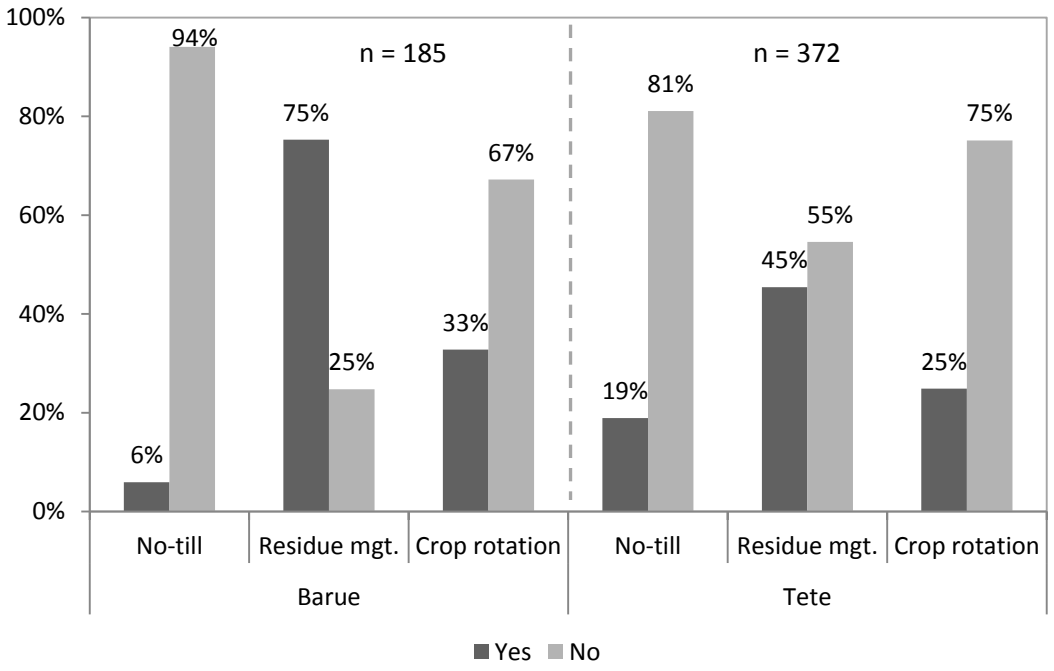
Training, credit, and project support







Adoption patterns by practice: 3 or more consecutive years, 2008-2011

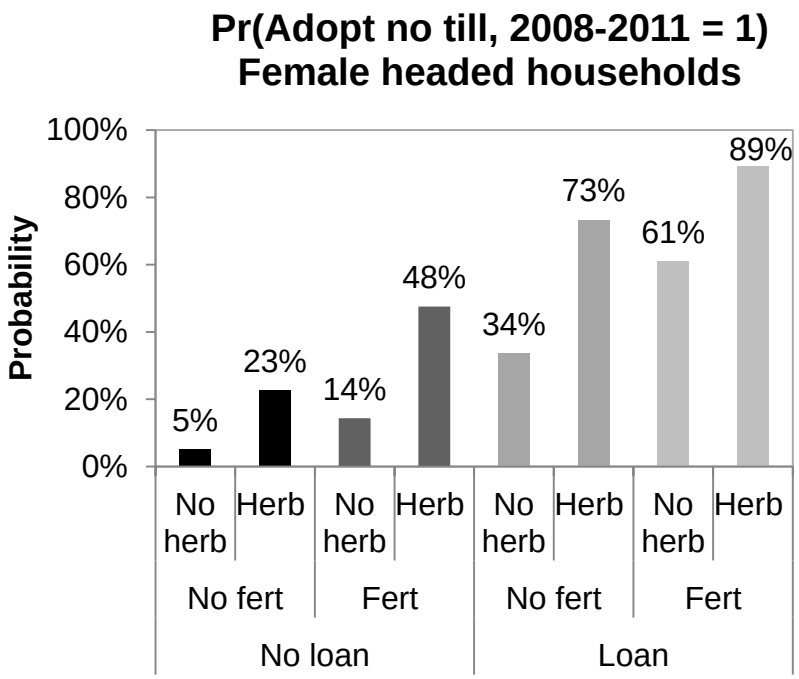


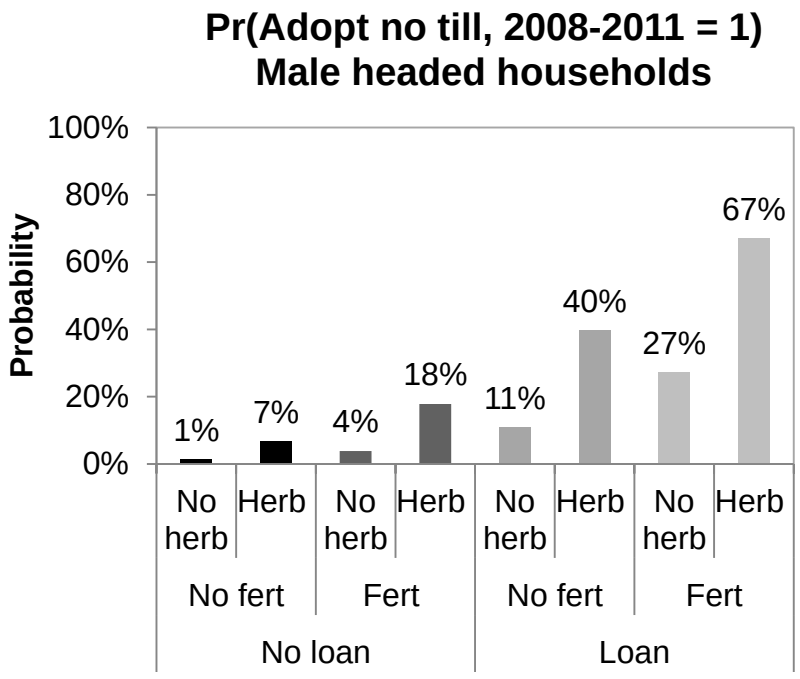
Probability of continuous use (3 – 4 year period)

Practice (dependent variables)*	Respondent attributes	Household characteristics	Farm management	Markets
No-till	Household Head Age	Size	Herbicide use	Distance to market
Crop rotation	Household Head Sex	% age 15-65	Fertilizer use	Labor shortages: land preparation
Residue management	Education	% staple produced	Seed variety	Labor shortages: weeding
			Farm size	Female primary vendor
			Livestock	HH net maize seller
			Distance to fields	Ag. Training
				Hired-in labor
				Barue

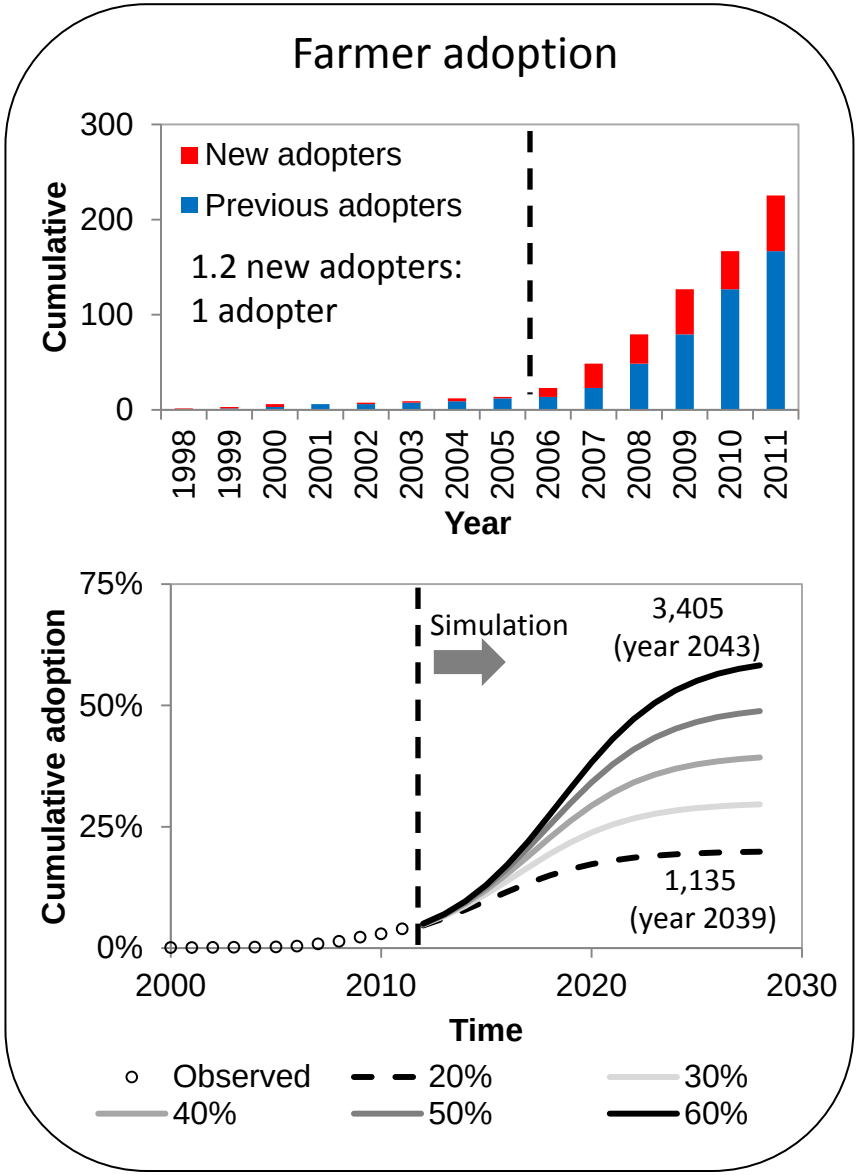
*Continuous practice for 3+ years, 2008 - 2011

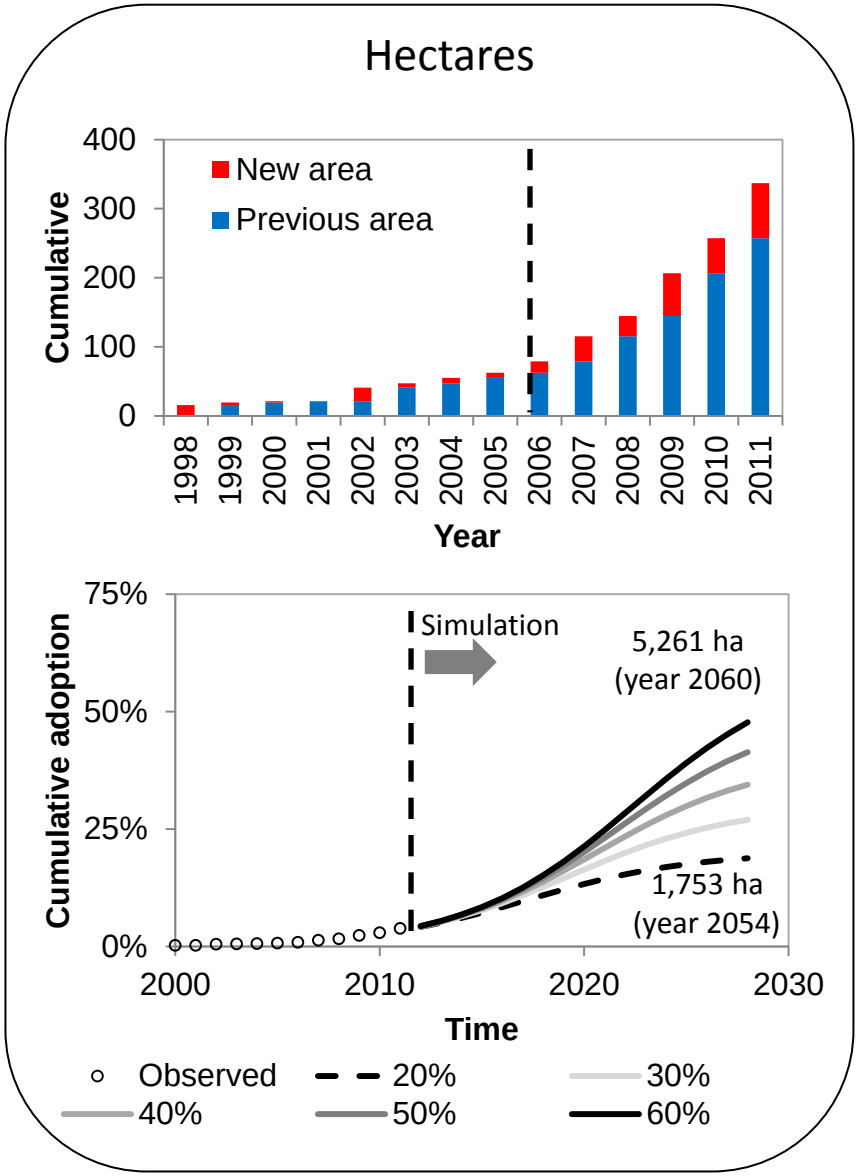
No-till adoption: credit, herbicide/fertilizer use





Conservation agriculture adoption and hectares managed: Tete and Barue, Mozambique area survey





Directions

- Additional C measurement collection
  - Plant growth stages
  - Cover crops (wheat, vetch, oats)
- Conservation agriculture technology and on production efficiency
- Adoption of CA technology, maize production, and participation in local maize markets
- Input use, maize production, and adoption of CA technology