

Productivity Impact of Conservation Farming on Asset-Poor Households

Steven Haggblade and Stephen Kabwe
Michigan State University
Food Security Research Project
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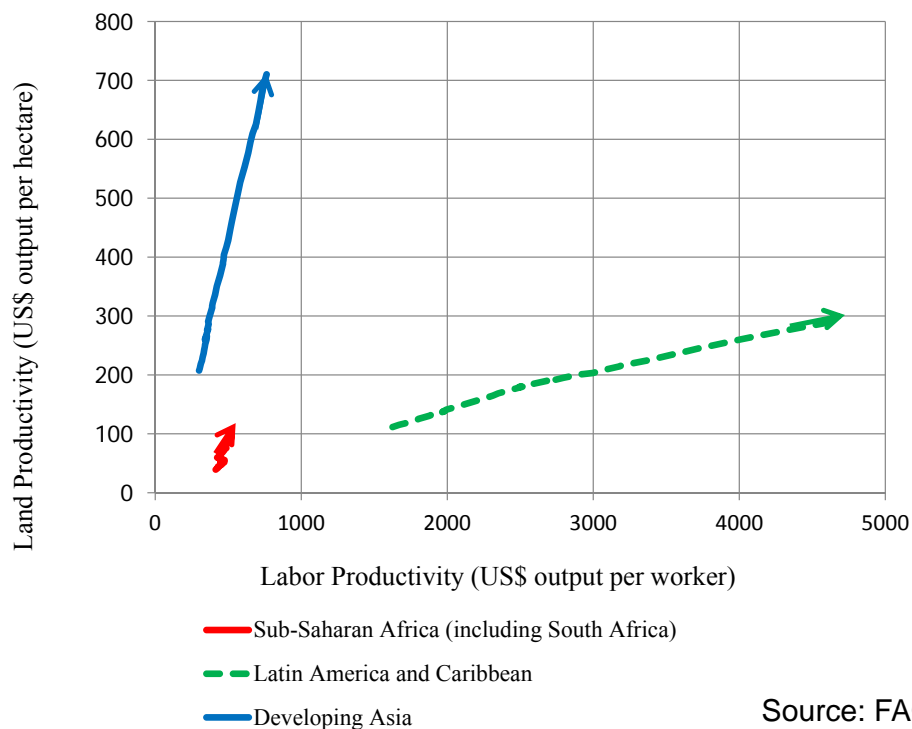
Asset-poor farm households



Agriculture

- Employs two-thirds of Africa's poor
- Increased farm productivity is key to poverty alleviation

Africa's agricultural productivity: lowest in the world



Source: FAOSTAT 2010

Objective: Evaluate impact of CF on asset-poor households

- With and without oxen
- With and without cash
- With and without herbicides

Outline

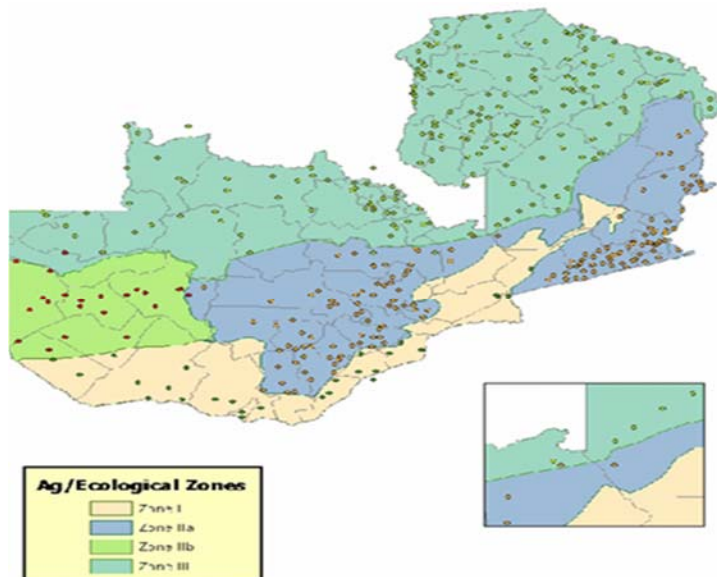
- Cotton farm household profile
- Sources of CF productivity gains
- Methods
- Results
- Conclusions

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- **Cotton farm household profile**
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Map of Central Statistical Office Statistical Enumeration Areas (SEAs) Sampled

– Nation Wide Random Surveys (PHS/SS 99/00, 02/03 & 07/08= 364 SEAs)
(CFS 06/07 and onwards = 640 SEAs)



Zambian cotton farmers



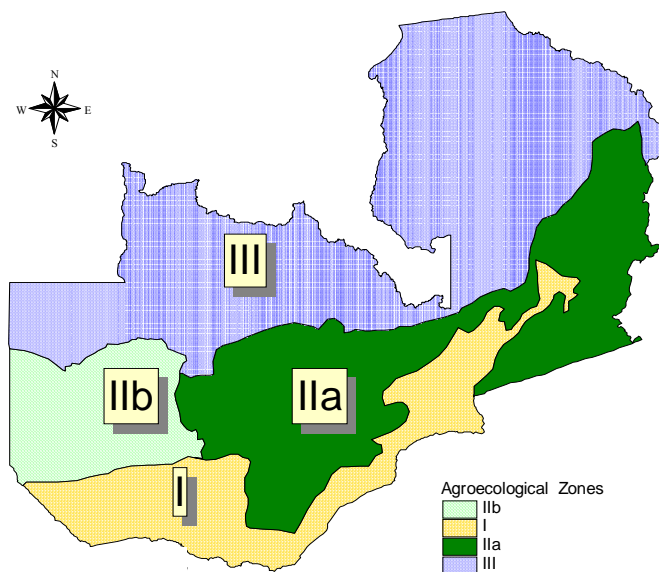
A cotton farmers (adopter) of CF basins

Zambian cotton farmers

	Agro-Ecological Zone				Total
	1	2a	2b	3	
Total farm households					
number	73,313	513,218	105,543	575,071	1,267,145
percent	6%	41%	8%	45%	100%
Cotton growing households					
number	5,008	126,096	0	127	131,230
percent	4%	96%	0%	0%	100%

Source: Supplemental Post-Harvest Survey of 2002/03.

Zambia Agro-ecological Zones



Farm size distribution in AEZ2a

Category	Farm Size	Households	Area per hh
All farming households in AEZ2a			
A1.	1.5 ha or less	46%	0.8
A2.	1.51 to 2.5 ha	26%	1.8
B.	2.51 to 5 ha	21%	2.8
C.	5 to 20ha	7%	6.6
Total		100%	1.9
Cotton farming households in AEZ2a			
A1.	1.5 ha or less	29%	1.1
A2.	1.51 to 2.5 ha	31%	1.9
B.	2.51 to 5 ha	30%	3.0
C.	5 to 20ha	10%	6.5
Total		100%	2.4

Asset holdings

	Land	Labor	Cattle	Cash Y
Farm Size	ha	FTE		Oct-Dec
Non-cotton farming households				
A1.1.5 ha or less	0.9	1.6	2.6	0.8
Total	2.1	1.9	3.5	1.1
Cotton farming households				
A1.1.5 ha or less	1.1	1.8	0.7	0.4
Total	2.7	2.0	0.7	0.5

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Sources of CF Productivity Gains

- Minimum tillage
- Dry season land prep
- Early planting
- Crop residue retention
- Precision layout and input application

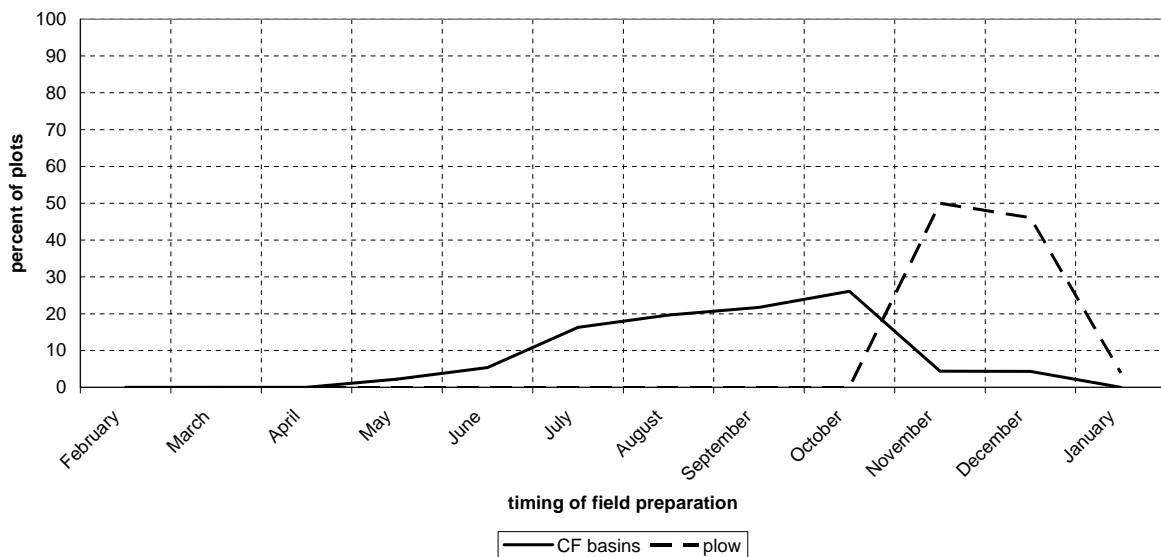
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Dry season land preparation

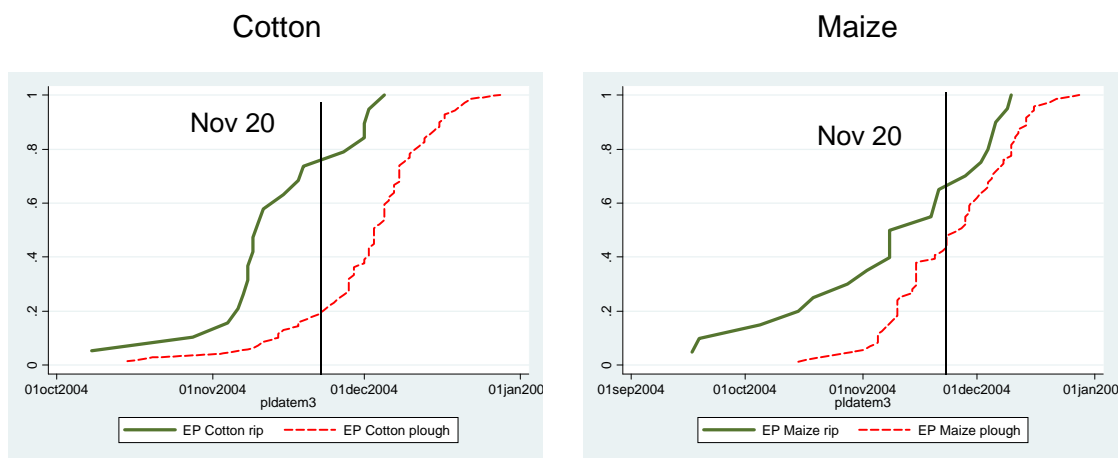


Source: Haggblade and Tembo (2003).

Sources of CF Productivity Gains

- Minimum tillage → 75% lower energy requirements for land preparation
- Dry season land prep → overcome peak season labour bottlenecks → increased area (F3) cultivable with fixed household labour
- Early planting → 1-2% yield increase per day

Planting dates: Eastern Province for CF farmers



Graphs show frequency distribution: Green solid line to the left means that ripping farmers planted earlier

Source: Kabwe *et al* 2007

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- Early planting → 1-2% yield increase per day
- Crop residue retention → SOM buildup → improved moisture retention

Sources of Maize Yield Gains under CF, 2002/3

	Yield kg/ha
Conventional plowing	1,350
Conservation farming basins	3,000
Sources of difference	
higher input use	500
early planting	400
water harvesting, precision	750
total difference	1,650

Source: Haggblade and Tembo (2003).

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Method: Linear Programming (LP) Model

- Maximize Crop Income =
Revenue ($\sum P_i * Q_i$) - cost ($\sum P_n * Q_n$)
- Subject to household asset constraints
 - Seasonal labour availability
 - ANTRAC
 - Cash
 - Land

What crops to include?

Crops growth in AEZ2a	All Farms	Cotton Farms
maize	98%	99%
cotton	25%	100%
groundnuts	48%	56%
sweet potatoes	16%	7%
sunflower	11%	15%
beans	7%	4%
cassava	7%	3%
sorghum	6%	2%
soya beans	5%	3%
cowpeas	5%	2%
tobacco	3%	3%
millet	3%	1%
other crops	3%	2%

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Seasonal labour constraints

Season	Timing	HH Labour (FTE days)
peak (early rains)	Nov15-Dec 15	43
mid season	Dec15-Mar	151
harvest	Apr-July	173
dry season	Aug-Nov14	151
total		518

Alternate technologies

	Conventional	Conservation Farming
Hand hoe		
a)	low input	low input
b)	high input	high input
c)		+ herbicides
Animal traction rental		
d)	plow	ripper

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Results: a) Low-input hand hoe

	Conven- tional	Conservation Farming	CF gain
Ha cultivated	1.1	1.4	26%
Crop yields (kg/ha)			
maize	1,000	1,400	40%
cotton	800	1,150	44%
Crop income ('000 Kw)	882	1,640	86%
Input cost	0	0	0%
Labor inputs (days)			
peak	43	43	0%
total	117	206	77%

Results: b) High-input hand hoe

	Conven- tional	Conservation Farming	CF gain
Ha cultivated	1.1	1.5	30%
Crop yields (kg/ha)			
maize	2,200	3,000	36%
cotton	800	1,150	44%
Crop income ('000 Kw)	882	1,787	103%
Input cost	322	272	-16%
Labor inputs (days)			
peak	43	43	0%
total	117	225	93%

Results: c) Hand hoe + herbicides

Two herbicide regimes considered:

- (1) Heavy: 2-3 applications: pre-emergent non-selective herbicide (roundup); 1-2 rounds of selective herbicides (\$70/ha)
- (2) Light: single application pre-emergent non-selective herbicide plus hand weeding (\$35/ha)

Costings suggest that (2) is most profitable.

Results: c) Hand hoe + herbicides

	Conven- tional	CF + herbicides	CF gain
Ha cultivated	1.1	2.7	139%
Crop yields (kg/ha)			
maize	2,200	3,000	36%
cotton	800	1,150	44%
Crop income ('000 Kw)	882	2,918	231%
Input cost	323	706	118%
Labor inputs (days)			
peak	43	33	-23%
total	117	326	180%

Results: d) ANTRAC rental

	Plow rental	Ripper rental	CF gain
Ha cultivated	1.5	1.5	0%
Crop yields (kg/ha)			
maize	1,800	3,000	67%
cotton	800	1,150	44%
Crop income ('000 Kw)	959	1,614	68%
Input cost	263	445	n.a.
Labor inputs (days)			
peak	43	43	0%
total	139	182	31%

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Conclusions

- Hand hoe CF increases
 - income by 80% - 100%
 - area cultivable by 30% (from 1.1 to 1.5 ha)
- Herbicides + CF increase
 - Income by 230%
 - area cultivable by over 100% (from 1.1 to 2.7 ha)

Conclusions

- Herbicides
 - single application most profitable
 - cotton company financing lowers farmers' cash costs by two-thirds (706 to 272 thousand Kw)
- Nonfarm labour opportunities govern dry season labour and hence agr. tech. choices
- Cotton and CF
 - Disciplined farmers
 - Cash poor, have incentives to trade management for purchased inputs
 - Centered in AEZ2a

❑ Website for **Food Security Research Project (FSRP)**

<http://www.aec.msu/agecon/fs2/zambia/index.htm>

THANK YOU