Factors Affecting Small Farmers' Use of Improved Maize Technologies: Evidence from Kenya and Zambia

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IAAE Meetings, Gold Coast, Australia,
August 12-18, 2006

Outline

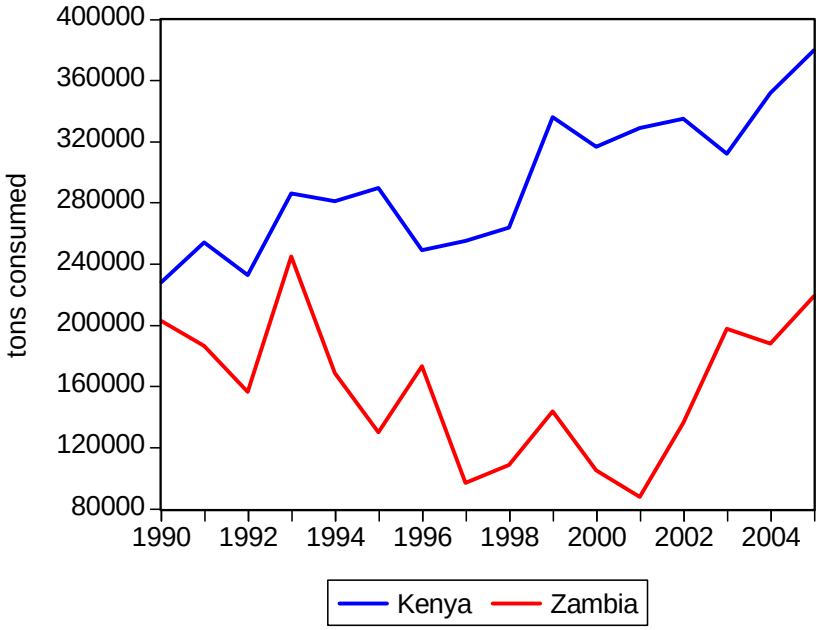
1. Problem statement
2. Objectives
3. Data and methods
4. Descriptive results
5. Estimation findings
6. Conclusions

Problem Statement

1. The “emerging” GRs of the 1970s-80s appear to been lost
2. Declining use of improved staple food technologies since liberalization
3. Stagnant maize yields
4. Discordant strategies being advocated
5. What to do?

- Invariably, discussions of how to promote uptake of productivity-enhancing technology raises issues of the appropriate role for the state in input/output markets
- Should we re-think “liberalization?”
- Contrasting cases of Kenya and Zambia

Fertilizer Consumption, Kenya and Zambia, 1990-2004



Kenya, 2003/04, nationwide sample (n=1,326)

		Use purchased hybrid seed		
		Yes	No	
Use fertilizer on maize	Yes	53.9%	7.4%	61.3%
	No	10.2%	28.5%	38.7%
		64.1%	35.9%	100%

Kenya, 2003/04, high-potential zones (n=428)

		Use purchased hybrid seed		
		Yes	No	
Use fertilizer on maize	Yes	73.3%	9.8%	83.1%
	No	9.6%	7.3%	16.9%
		82.9%	17.1%	100%

Zambia, 2002/03, national sample

		Use purchased hybrid seed		
		Yes	No	
Use fertilizer on maize	Yes			27%
	No			73%
		55%	45%	100%

Zambia, 2003/04, high-potential zones

		Use purchased hybrid seed		
		Yes	No	
Use fertilizer on maize	Yes	35%	16%	51%
	No	17%	32%	49%
		52%	48%	100%

Objectives

1. To understand why some small farmers use improved maize technologies while many others don't.
   - Country-level differences
   - Regional differences
   - Village-specific factor
   - Household-specific factors

Data

- Kenya: Tegemeo Rural Household panel surveys (1997, 2000, 2004)
  - n=1,326
- Zambia: Central Statistical Office panel surveys (2001, 2004)
  - n=5,420

Methods

- Probit models of improved maize technology adoption (fertilizer+maize hybrids)
- Truncated OLS / Tobits on quantity of fertilizer used per ha maize

Sources of explained variation in fertilizer use on maize (kgs per hectare)

	Kenya	Zambia
Year	**1.5%**	**27.5%**
agro-ecological zone	**69.0%**	**41.0%**
household characteristics	**30.5%**	**31.5%**
Total Variation	**100.0%**	**100.0%**

Findings:

1. Kenya: Probability of using improved tech:
   - Eastern Lowlands: 46%
   - High-Potential Maize Zone: 89%
   - Western Highlands: 82%
   - Coast: 4%
- Zambia:
   - High-potential areas: 52% (28% of sample)
   - Low-potential areas: < 10% (72% of sample)

Findings (cont.)

2. Application rates –users only (kgs per ha):
   - High-potential (Kenya): 160-180 kg
   - High-potential (Zambia): 180-200 kg
   - other areas (Kenya): 98 kg
   - Other areas (Zambia): 81 kg

Findings (cont.)

3. Proximity to fertilizer retailer / paved road
   - Zambia: 25 km change: probability of using fertilizer 17% → 25% (+47% increase)
   - Use of fertilizer is supported by investment by rural retailers

Kenya: change in distance to nearest fertilizer retailer (1997-2004)

		Households not using fertilizer	HHs applying more than 50kgs per acre maize	National sample
Distance to nearest fertilizer retailer (kms)	**1997**	**18.65**	**4.38**	**8.39**
	2004	**8.23**	**2.54**	**4.14**

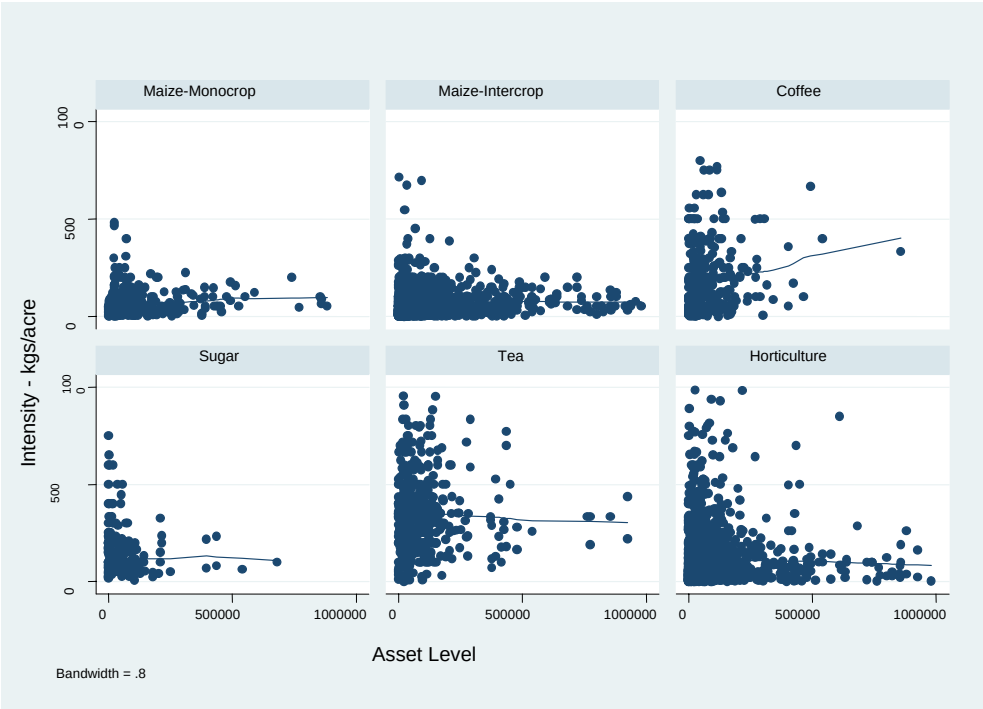
Dose Rates and Percent of Households Applying Fertilizer on Maize

	1995/96	1996/97	1999/00	2003/04
Mono-Crop Maize				
kgs/acre (users only)	59	69	72	67
% households using fertilizer	47%	47%	50%	59%
Inter-Crop Maize				
kgs/acre (users only)	57	59	62	66
% households using fertilizer	55%	56%	63%	66%

Findings (cont.)

3. Education of household head:
   - (+) in both Zambia and Kenya
4. Wealth / landholding size:
   - (+) in Zambia and Kenya
   - But after controlling for agro-ecological zones, no correlation in Kenya

Kenya: Fertilizer use by Household Assets



Findings (cont.)

5. Zambia: HH purchase of fertilizer **from private retailers** adversely affected by government fertilizer subsidy programs
   - Predicted prob. of purchase declines from 16.7% to 13.8% (21% decline) in villages where govt. programs were operating at relatively high level
   - Evidence of “crowding out”

Findings (cont.)

5. “Crowding out” partially driven by poor targeting

Zambia	Total Income	Assets	Landholding size
Fertilizer source:	‘000 kwacha per capita		ha per capita
Households not acquiring fertilizer:	266	173	.15

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Cash purchases from private retailers:	774	342	.20
Government Fertilizer Support Program (50% subsidy)	804	425	.23

Findings (cont.)

6. Households with civil service employee were 32 percentage points more likely to receive fertilizer in Zambia.
   - 16.7% vs. 49% probability

Conclusions:

1. Within both Kenya and Zambia: regional variation is greatest source of variation in fertilizer / hybrid seed use
   - Most likely reflects underlying profitability
2. Relationship between wealth and fertilizer use:
   - Wealth effect disappears in Kenya after controlling for regional differences
   - Wealth effect still important in Zambia

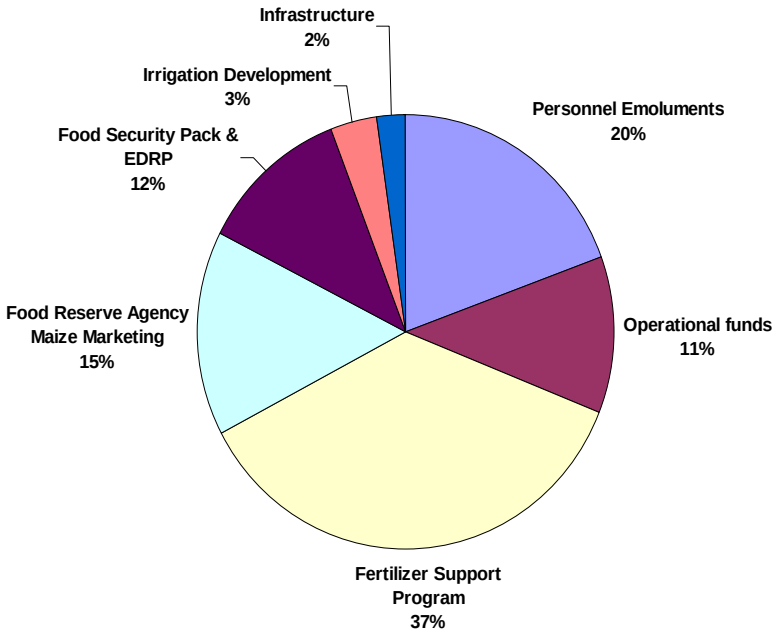
Conclusions (cont):

3. Importance of education
4. Importance of proximity to fertilizer retailer / paved roads
   - Need policy environment that supports investment in rural retailing
   - Investment climate markedly different in Zambia and Kenya

Conclusions (cont):

5. Private sector response to reform depends very much on
   - how reform is implemented
   - Investment in complementary public goods

Public budget allocation to agricultural sector, Zambia, 2005



zikomo, asante sana

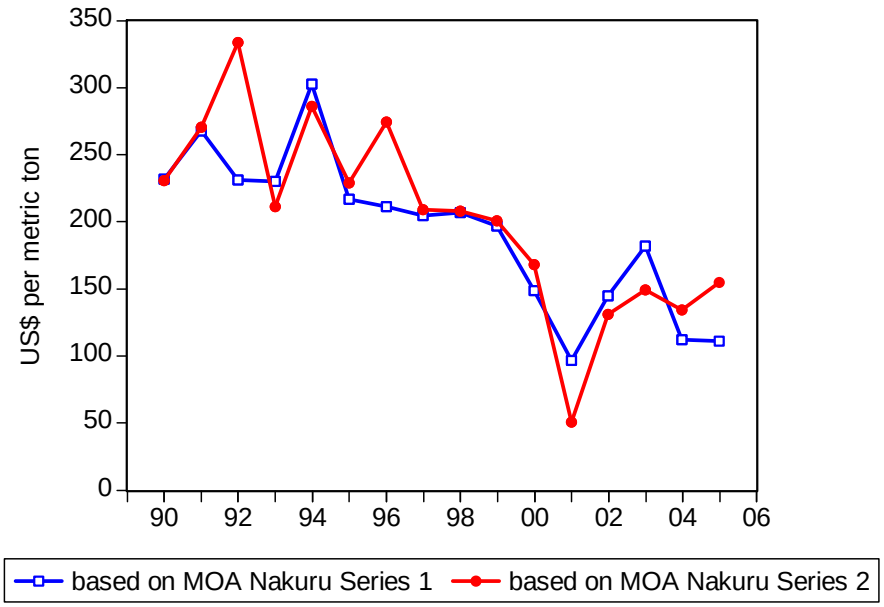
Fertilizer Consumption Changes (mean 1996-2002 / mean 1990-95)

Fertilizer use intensity	**% growth in fertilizer use intensity (kg/ha cultivated) (mean 1996-2002 / mean 1990-95)**	
	< +30%	**> +30%**
< 25 kg/ha	DRC (0.5, -47%) Angola (0.7, -69%) Niger (0.9, +5%) Guinea (2.0, -4%) Burundi (2.3, -6%) Madagascar (2.9, -8%) Mauritania (4.0, -64%) Tanzania (4.8, -47%) Gambia (5.2, +15%) Nigeria (5.6, -73%) Burkina Faso (5.9, -28%) Zambia (8.4, -34%) Mali (9.0, +7%)	Uganda (0.6, +237%) Rwanda (1.8, +89%) Mozambique (3.2, +142%) Ghana (3.6, +68%) Chad (4.3, +93%) Cameroon (5.9, +77%) Togo (7.0, +30%) Cote d'Ivoire (11.8, +53%) Botswana (11.8, +294%) Senegal (13.2, +67%) Ethiopia (14.4, +71%) Benin (17.6, +76%) Lesotho (23.2, +35%)
> 25 kg/ha	Swaziland (30.5, -40%) Malawi (30.8, +9%) Zimbabwe (48.3, +9%)	**Kenya (31.8, +33%)**

Characteristics of smallholder farmers, Zambia 1999/00

	N=	Farm size (ha)	Asset values (US$)	Gr. Rev., maize sales (US$)	Gr. Rev., crop sales (US$)	Total hh income (US$)
Top 50% of maize sales	14,261	9.0	1,160	690	729	2,534
Remaining maize sellers	272,805	3.9	233	74	97	607
Households not selling maize	839,855	2.8	163	0	26	362

Nakuru - Mombasa Cost Differences (Di-Ammoniun Phosphate, US$/tonne nominal)



Price ratios, wholesale maize / DAP fertilizer at Nakuru (Ksh 90kg maize / Ksh 50kg fertilizer)