Assessing the impact of improved agricultural technologies in rural Mozambique

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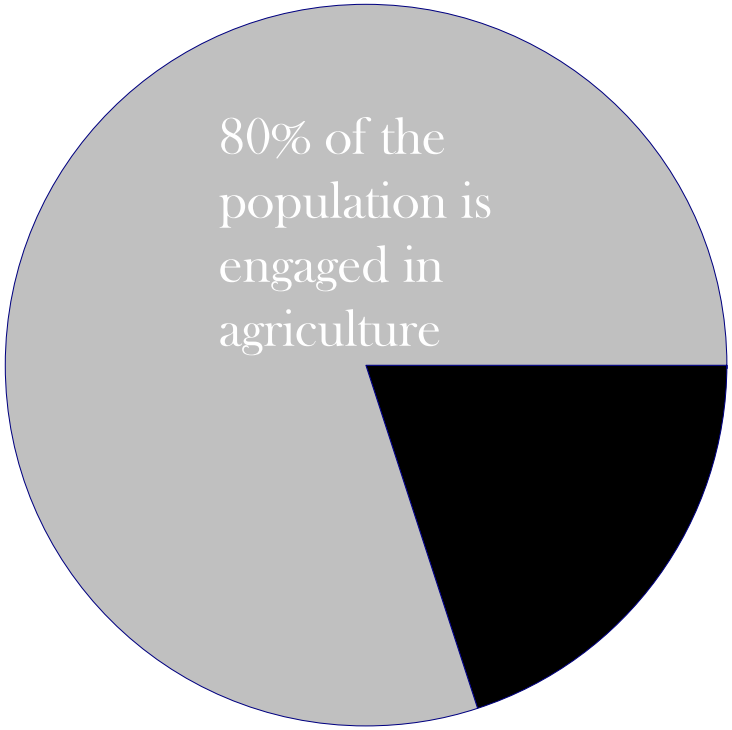
Outline

- Background
- Data source
- Descriptive statistics
- Methods
- Estimation results
- Summary of key findings

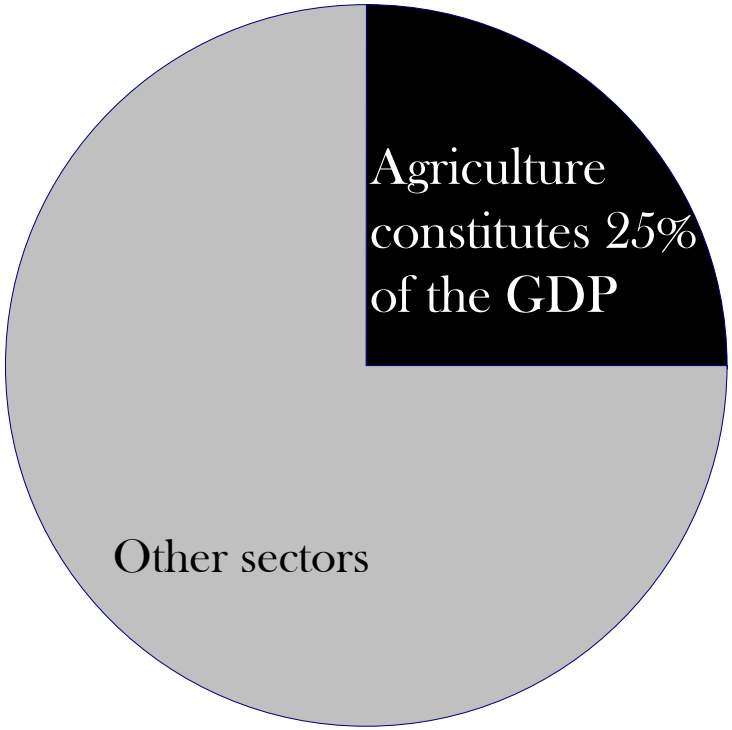
Why is agriculture important?

1. Source of employment:



Source: Government of Mozambique, 2006

2. Economic contribution:



Yet agricultural productivity is very low, even by SSA standards

Low productivity: Why?

- Cyclical droughts, rainfed agriculture
- Timing: Beginning of rainy season is planting time
  - Coincides with highest malaria rates, resulting in labor shortage, late agricultural operations
  - Farmer's nutritional status is debilitated: food from previous season either sold or all consumed
- Low density of basic infrastructure (eg roads)
- Low use of improved technologies
- Other reasons as well

Data source

- Nationally representative data from 2004/05 agricultural season in rural Mozambique (TIA05)
- 6149 households interviewed in 90/128 districts
- Complex survey sampling
- Survey designed to collect info on ag and nonag household incomes
- Total household incomes are calculated as the value of own production (crop and livestock) and off-farm earnings less any paid-out costs

Factors associated with the use of improved tech.

Used selected improved technology (means)	Total	Animal traction			Tractor mechanization			Improved maize seeds			Improved granary		
		Yes	No	Pvalue	Yes	No	Pvalue	Yes	No	Pvalue	Yes	No	Pvalue
Head's years of schooling	2.56	3.07	2.48	0.005	3.89	2.54	0.000	3.45	2.52	0.000	2.87	2.51	0.007
Widow female headed	0.09	0.12	0.15	0.003	0.12	0.08	0.023	0.06	0.09	0.224	0.05	0.09	0.000
Non-widow female headed	0.17	0.13	0.18	0.000	0.14	0.17	0.039	0.12	0.17	0.031	0.12	0.18	0.000
Head is engaged in off-farm	0.60	0.56	0.60	0.000	0.69	0.60	0.099	0.66	0.60	0.14	0.61	0.60	0.713
HH used animal traction	0.09	1.00	0.00	NA	0.23	0.09	0.000	0.13	0.09	0.000	0.11	0.09	0.000
HH used fertilizers	0.04	0.05	0.05	0.224	0.13	0.04	0.000	0.09	0.03	0.000	0.07	0.03	0.000
Distance to the nearest tarred road (Km)	61.63	50.85	53.18	0.000	**19.67**	**62.27**	0.000	70.12	61.17	0.000	69.11	60.47	0.000
Tropical livestock units	0.98	4.24	1.20	0.000	2.46	0.95	0.000	1.71	0.94	0.000	1.65	0.88	0.000
Total landholding size (ha)	1.81	2.69	1.88	0.000	2.19	1.80	0.000	2.25	1.80	0.000	2.37	1.72	0.000
Membership to association	0.06	0.08	0.06	0.000	0.20	0.06	0.000	0.15	0.06	0.000	0.08	0.06	0.069
HH grows cash crops	0.23	0.16	0.21	0.000	0.21	0.23	0.166	0.34	0.23	0.000	0.32	0.22	0.000
HH received credit	0.04	0.03	0.03	0.105	**0.13**	**0.03**	0.000	0.05	0.03	0.266	0.03	0.04	0.980
Number of observations	6,087	1,210	2,390		205	5,882		351	5,727		1,004	5,074	

Source: Author's own calculations based on TIA05 data

Notes: Animal traction includes southern provinces only; Ha: The difference in means is not equal to zero; HH stands for household; cash crops include cotton, tobacco, tea, sunflower, sesame, sisal, soybeans, paprika, ginger, and sugar cane.

Simple relationships: Correlation between use of technology and other factors

- Head's education is correlated with adoption of all four technologies
- Landholdings and livestock ownership are correlated with all four technologies
- Use of animal traction: 9% HHs using
- Improves maize seeds: 5% HHs using
- Tractor mechanization: 2% using of which 50% in Maputo province, and 75% in the south, a region of relatively lower agricultural potential

Correlation is not necessarily causation

- Correlation:
  - eg.1 access to credit is highly correlated with tractor mechanization
  - eg.2 change in asset holdings is related to a change in adoption of improved technologies
- Causation:
  - If a farmer adopts an improved technology, how much does his/her income change?

Causal inference: how to assess the impact?

- Compare total household income of the same individual with and without adoption of improved technologies
  - $\alpha = (Y \mid P=1) - (Y \mid P=0)$
- But we never observe the same individual with and without technology X at same point in time
- Counterfactual: what would the incomes of adopters be had they not adopted the technology?
- As a robustness check, 3 econometric approaches:
  - Doubly robust estimator;
  - Sub-classification and regression;
  - Matching and regression

Assumptions

- Overlap assumption
  - Distribution of adopters and non-adopters overlap very well
  - Assessed both thru graphical illustration and normalized differences
- Unconfoundedness assumption
  - Beyond the observed covariates, there are no unobserved characteristics of the individual associated both with the potential outcome and the treatment
  - Assessed by estimating the pseudo causal effect that is known to be zero
- Both the overlap and unconfoundedness assumptions were assessed/tested and are plausible

The impact of selected technologies

Technology	Econometric approach	Coefficient (Meticais)	Std. Error	P-value
Tractor	Doubly robust	13 549.86	3 131.15	0.000
	Sub-classification and regression	11 332.82	608.06	0.000
	Matching and regression	8 148.71	2 767.16	0.003
Animal traction	Doubly robust	-613.29	997.08	0.538
	Sub-classification and regression	-1 599.53	1 758.23	0.486
	Matching and regression	407.96	1 220.54	0.738
Improved maize seeds	Doubly robust	4 596.61	1 649.63	0.005
	Sub-classification and regression	4 687.87	157.54	0.000
	Matching and regression	3 324.68	1 466.34	0.024
Improved granaries	Doubly robust	2 762.14	870.85	0.002
	Sub-classification and regression	2 782.54	21.56	0.000
	Matching and regression	2 603.29	772.09	0.001

Sources: Author's own calculations based on TIA05 data

Notes: Exchange rates in 2005 ($1.00=24.5 Meticais)

Why animal traction was not significant?

- Results may be confounded by vagaries of the weather in 2005, particularly in the south where drought was more severe and animal traction is more predominant;
- Scope exists to enhance the impact of animal traction (and other technologies) in view of very low use of other inputs (fertilizer, irrigation, ...), poor access to credit and poor infrastructure.

Adoption puzzle? e.g. only 5% used improved seeds but impact was positive.

		Household income per adult equivalent			
		Mean (Meticais)		Median (Meticais)	
		2002	2005	2002	2005
Household income quintiles per adult equivalent	Lowest	494	376	469	351
	2	1,086	986	1,027	901
	3	1,792	1,822	1,736	1,669
	4	2,941	3,310	2,728	2,960
	Highest	8,221	10,243	5,673	6,753
National		2,906	3,348	1,751	1,708

Sources: Cunguara (2008)

Mean/median household incomes are smaller than the impact of some of the improved technologies, especially among the poor who also lacks collateral to access the extremely thin credit market.

Summary of key findings

- Even if improved agricultural technologies were riskless, more than half of the population would not adopt due to cash constraints.
- Development challenges are exacerbated by global warming. More investments are needed on irrigation and basic infrastructure, and research on conservation agriculture technologies.
- Efforts to increase agricultural productivity should be in tandem with those to improve food storage.

Thank you

6:30am – corn meal almost the exclusive food

Photo taken in Maringue district, Mozambique

References:

- Government of Mozambique. 2006. Poverty Reduction Strategy Plan. Council of Ministers, Maputo
- Cunguara, B. 2008. Pathways out of poverty in rural Mozambique. MSc Thesis, Michigan State University, East Lansing, MI.

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