Evaluating Mozambique's Agricultural Investment Plan: **Round Two**

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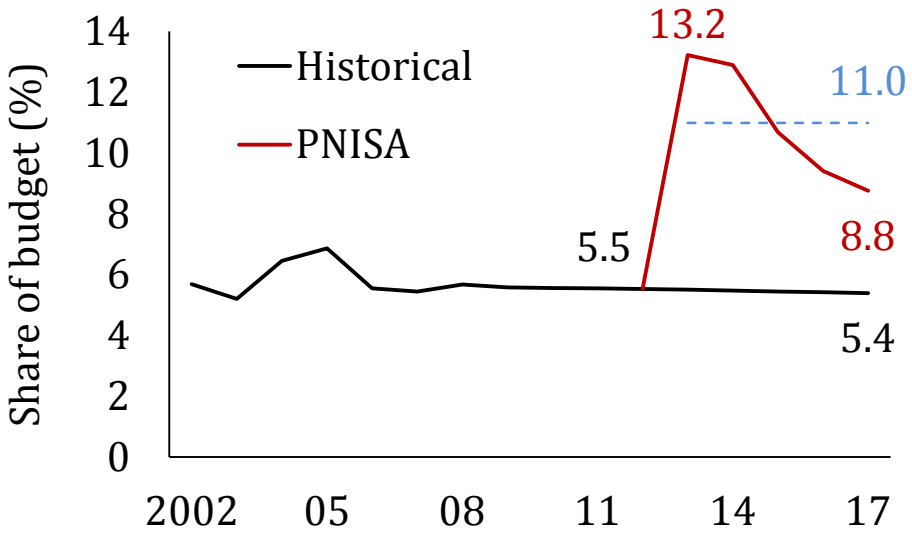
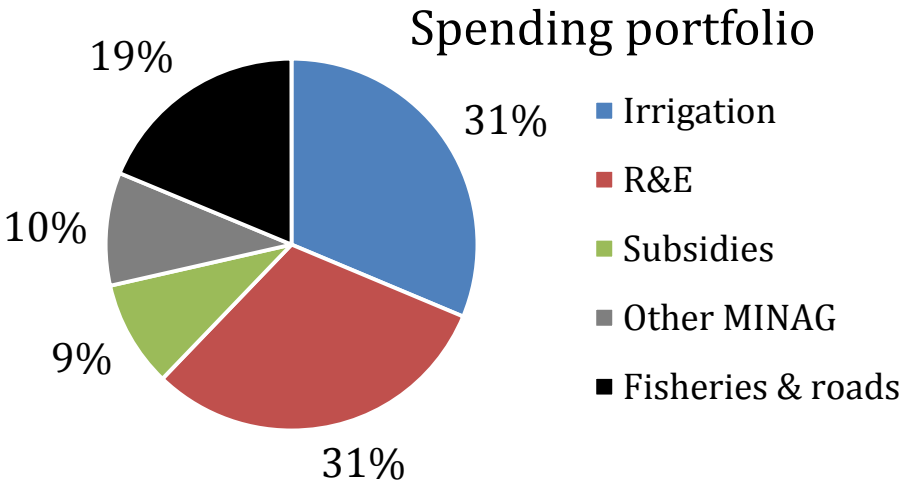
PNISA

- Ambitious investment plan for 2013-2017
- Doubles share of agricultural spending in the budget
- Diversifies investments relative to historical spending





Evaluating PNISA

- Evaluation questions:
  - What does PNISA mean for agricultural growth and poverty reduction?
  - Can outcomes be improved by re-prioritizing investment areas?
  - What is the relative importance of increasing spending vs. efficiency?

- Mixed methods approach:
  - Econometric estimates of farm-level impacts using historical data
  - Economywide model then measures growth and poverty outcomes

Last Year's Findings

- We used farm-level impact estimates from other countries
  - Small-scale irrigation program in Mali (Dillon 2011)
  - Research and extension system in Uganda (Benin et al. 2011)
  - Farm input subsidies from Malawi (Ricker-Gilbert et al. 2011)
- Main findings:
  - PNISA exceeds targeted agricultural growth (8.5% vs. CAADP's 6%)
  - Reduces poverty rate (35% by 2017 vs. 42% without PNISA)
  - Could scale back PNISA and still achieve objectives
- Major concern:
  - Mozambique may not be able to achieve the outcomes of other countries

New Approach

- Use survey data (TIA2008) to estimate productivity gains from investments
- Measure change in farmers' crop-level revenues when they…
  - Use irrigation
  - Receive extension visits
  - Use chemical fertilizers/improved seeds
- New results are based entirely on Mozambican data
  - Far more robust approach

Step 1: Impacts on Productivity

- Outcomes from current spending:
  - E.g., number of households receiving extension services

$$\text{Investment outcome} = \text{Spending level} / \text{Unit cost}$$

- Intervention coverage:
  - E.g., share all households receiving extension

$$\text{Extension coverage} = \text{Outcome} / \text{Farm households}$$

$$\text{Input subsidy coverage} = \text{Outcome} / \text{Crop land area}$$

$$\text{Irrigation coverage} = (\text{Outcome} + \text{Past coverage}) / \text{Crop land area}$$

- Productivity change:

$$\text{Change in TFP} = \text{Base} + \sum \text{Impact coefficient} \cdot \text{Change in coverage}$$

Estimating Impact Coefficients

- Propensity score matching approach (Cunguara et al. xxx; xxx)
  - Compare two farmers who are similar in almost every way, except one uses irrigation and the other does not

- Estimate the change in production value when farmers use irrigation, fertilizer, and extension
  - Separate regional estimates (North, Center, South)
  - Five crop groupings:
    - Cereals (maize and rice)
    - Pulses (common beans, cowpeas, mung beans, pigeon peas, earth peas)
    - Roots (cassava, sweet potatoes)
    - Cash crops (tobacco, cotton, seseme, soybeans)
    - Horticultural crops (use sales rather than production value)

Results: Extension Visits

Change in crop revenues farmer reports receiving an extension visit

	North	Center	South	National
Cereals	0.282***	0.152*	0.402**	0.089
Roots	0.271***	0.594***	0.232	0.163***
Pulses	0.245**	0.371**	0.062	0.150***
Horticulture				0.646*
Cash crops	0.627**	0.479**		0.684*

Significance levels: *** 5%; ** 10%; * 20%
Missing coefficient means insufficient observations

Example: Receiving an extension visit increases cereal crop revenues for Northern farmers by 28.2%

Results: Fertilizers

Change in crop revenues farmer reports using chemical fertilizer

	North	Center	South	National
Cereals		0.443***		0.493***
Roots				
Pulses		1.345***		1.123***
Horticulture			0.470	1.271***
Cash crops	1.349***	0.770***		1.086***

Significance levels: *** 5%; ** 10%; * 20%
Missing coefficient means insufficient observations

Results: Irrigation

Change in crop revenues farmer reports using irrigation

	North	Center	South	National
Cereals				
Roots				
Pulses				
Horticulture		0.419*	1.034***	0.281
Cash crops	0.435***			1.288***

Significance levels: *** 5%; ** 10%; * 20%
Missing coefficient means insufficient observations

Step 1: Parameter Estimates

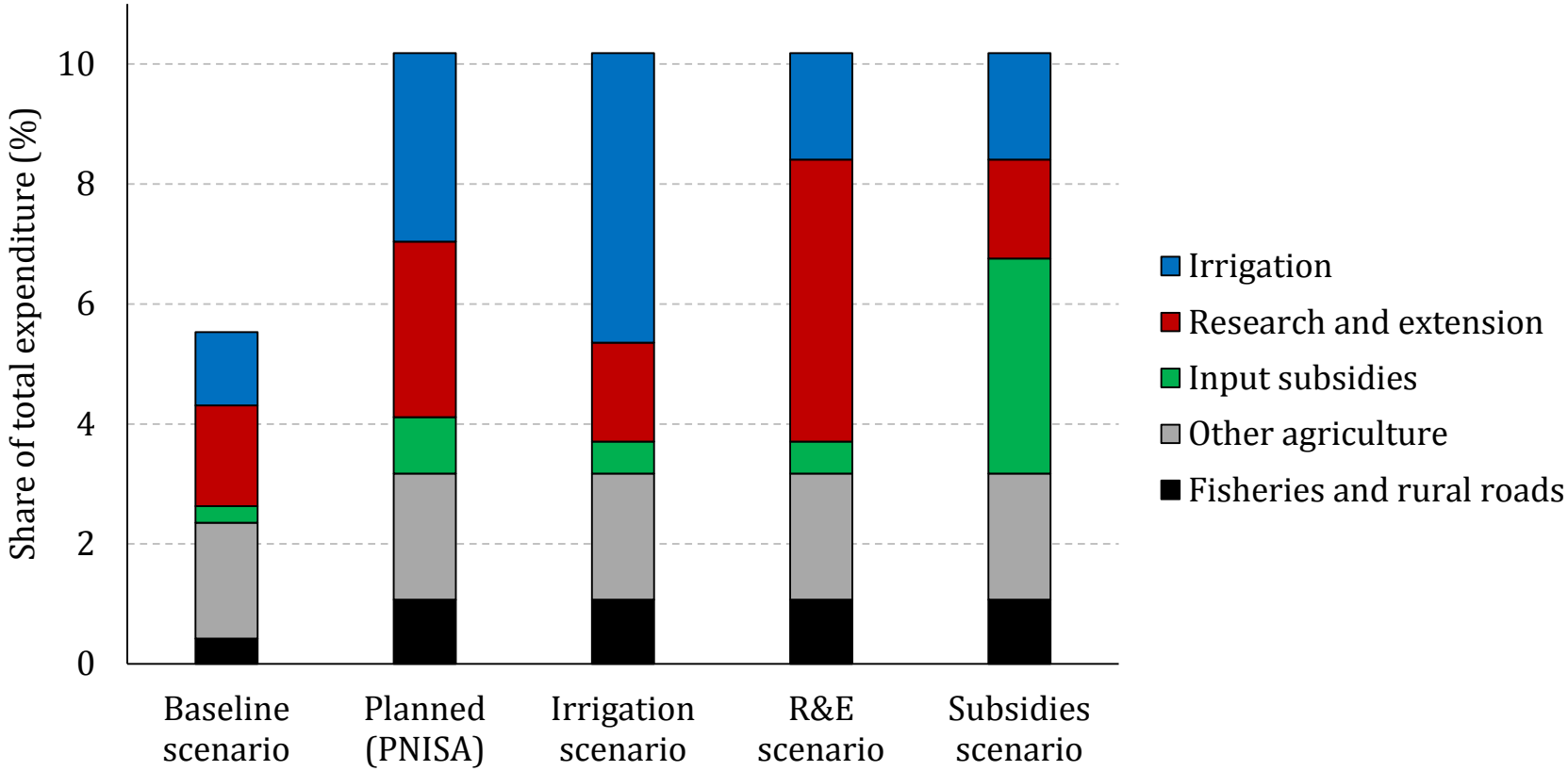
	Intervention	National value		Source
Initial coverage rates	Irrigation	8.3%	of crop land	TIA 2008
	R&E	8.4%	of farmers	TIA 2008
	Inputs	5.2%	of crop land	TIA 2008
Unit costs	Irrigation	$2,287	per hectare	You et al. (2010)
	R&E	$231	per farmer	PNISA & Ext. Master Plan
	Inputs	$121	per hectare	Dorwood et al. (various)

	Intervention	Old	New
Productivity gains	Irrigation	72.8%	34.3%
	R&E	67.0%	38.4%
	Inputs	54.7%	26.5%

Stage 2: Economywide Model

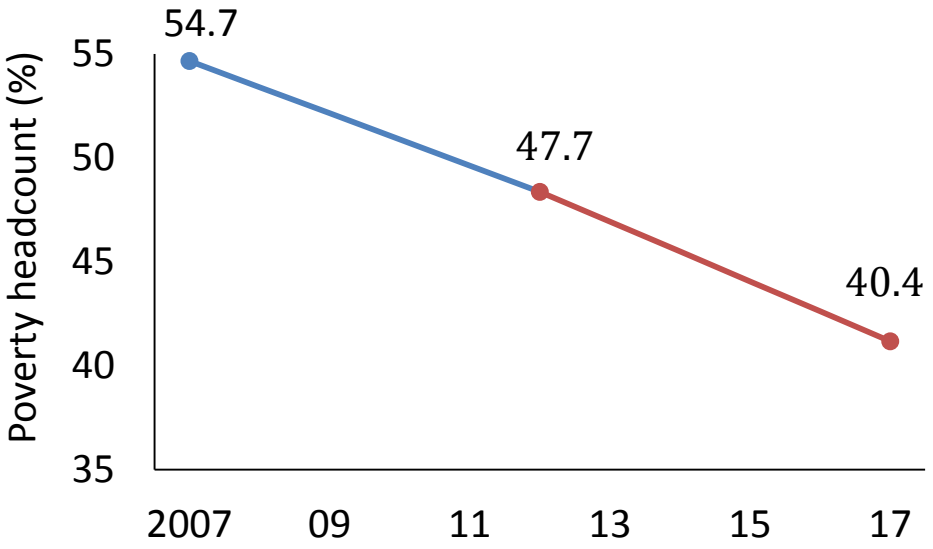
- Detailed economic structure (from a 2007 SAM):
  - 56 sectors (22 in agriculture) in 3 regions (north, center, south)
  - 10 regional household groups (rural/urban; expenditure quintiles)
- Factor markets
  - Land can be allocated across crops based on relative prices
  - Labor mobile across farm/nonfarm sectors, but not regions
  - New capital is mobile, but once invested, is fixed in place ("putty-clay")
- Government spending may crowd-out private investment
- Recursive dynamic
  - Previous period investment determines new capital available
  - Run over 2007-2017, but focus only on 2012-2017 period

Investment Scenarios



Baseline

- Continue historical trends (as in Arndt et al. 2012)
  - 2.5% population and labor supply growth
  - 1% annual land expansion
  - TFP growth favors non-agriculture
- Investment outcomes:
  - Irrigation (8% to 11%)
  - Extension (8% to 17%)
  - Inputs (5% to 6%)
- Development outcomes:
  - National GDP grows at 6.9%
  - Agriculture grows at 4.4%



PNISA's Impacts

	PNISA	Baseline
Annual public spending per rural farm household	$153.4	$72.8
GDP growth rate	7.0%	6.9%
Agricultural growth rate	5.6%	4.4%
Poverty rate in 2017	39.5%	40.4%
Increase in total GDP per dollar spent	$1.3	
People lifted above pov. line per $1000 spent	0.5	

Doubling of public agricultural spending

Increases agricultural growth

Positive return on investment (BCR)

Doesn't target poor, but reduces poverty

Altering PNISA's Portfolio

Reallocating funds towards…

	PNISA	Irrigation	Extension	Subsidies
Annual public spending per rural farm household	$153.4	$153.4	$153.4	$153.4
Agricultural growth rate	**5.6%**	**5.2%**	**6.0%**	**5.5%**
Poverty rate in 2017	39.5%	40.1%	38.7%	39.5%
Increase in total GDP per dollar spent	$1.3	$1.1	$1.6	$1.3
People lifted above pov. line per $1000 spent	**0.5**	**0.1**	**1.0**	**0.5**

Altering Spending Efficiency

	PNISA	Irrigation	Extension	Subsidies
Average annual agricultural growth rate (%)	5.6	5.2	6.0	5.5
20% lower costs	6.4	5.9	7.0	6.3
+ 20% larger impacts	7.0	6.4	7.9	6.9
Increase in total GDP per dollar spent	$1.3	$1.1	$1.6	$1.3
20% lower costs	$1.6	$1.3	$2.0	$1.6
+ 20% larger impacts	$1.9	$1.5	$2.4	$1.8

Conclusions

- Agricultural investments have a smaller effect on farmer productivity than in other countries
- PNISA increases agricultural growth and reduces poverty
  - But falls short of targets (e.g., CAADP 6% agricultural growth)
- PNISA is already a large scale program ($153 per farmer)
  - Little scope to further increase spending
- Altering portfolio improves program outcomes
  - Reducing emphasis on irrigation generates better returns
  - But still does not achieve growth target
- Improving investment efficiency is absolutely essential