Evaluating Mozambique’s Agricultural Investment Plan

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Agriculture and Poverty Reduction

- Poverty persisted despite rapid economic growth
  - Mainly due to external shocks, but also slower agricultural growth

![Graph showing poverty rates from 2003 to 2009](source: Arndt et al. (2012))

- Higher fuel prices
- Higher food prices
- Slower agricultural growth
- School enrolment
- Anticipated poverty reduction
PNISA (1)

- Ambitious agricultural investment plan for 2013-2017
- Doubles share of agricultural spending in the budget
  – From a baseline that continues 2002-2012 spending growth

Source: World Bank (2010); Benin et al. (2013); GOM (2012)
PNISA (2)

• Diversifies investments relative to historical spending
  – Focus for MINAG on irrigation, R&E and subsidized inputs

• Strategic research questions:
  – Is the increase in spending enough to achieve growth and poverty goals?
  – Can outcomes be improved by altering the investment portfolio?
Ex Ante Impact Evaluation

• Sector-wide evaluations are challenging
  – Limited historical data (no data for new interventions)
  – Past performance ≠ future performance (program design changes, improved implementation, etc.)

• We adopt a “hybrid” approach (Pauw and Thurlow 2013)
  – Mozambican data whenever possible
  – Farm-level impact estimates from other countries

• Foreign programs
  – 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)
Stage 1: Impacts on Productivity

• Outcomes from current spending:
  – E.g., number of households receiving extension services
    
    \[
    \text{Investment outcome} = \frac{\text{Spending level}}{\text{Unit cost}}
    \]

• Intervention coverage:
  – E.g., share all households receiving extension
    
    \[
    \text{Extension coverage} = \frac{\text{Outcome}}{\text{Farm households}}
    \]
    \[
    \text{Input subsidy coverage} = \frac{\text{Outcome}}{\text{Crop land area}}
    \]
    \[
    \text{Irrigation coverage} = \frac{(\text{Outcome} + \text{Past coverage})}{\text{Crop land area}}
    \]

• Productivity change:
  
  \[
  \text{Change in TFP} = \text{Base} + \sum \text{Impact coefficient} \cdot \text{Change in coverage}
  \]
## Stage 1: Parameter Estimates

<table>
<thead>
<tr>
<th>Intervention</th>
<th>National value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial coverage rates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>8.3% of crop land</td>
<td>TIA 2008</td>
</tr>
<tr>
<td>R&amp;E</td>
<td>8.4% of farmers</td>
<td>TIA 2008</td>
</tr>
<tr>
<td>Inputs</td>
<td>5.2% of crop land</td>
<td>TIA 2008</td>
</tr>
<tr>
<td><strong>Unit costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>$2,287 per hectare</td>
<td>You et al. (2010)</td>
</tr>
<tr>
<td>R&amp;E</td>
<td>$231 per farmer</td>
<td>PNISA &amp; Ext. Master Plan</td>
</tr>
<tr>
<td>Inputs</td>
<td>$121 per hectare</td>
<td>Dorwood et al. (various)</td>
</tr>
<tr>
<td><strong>Productivity gains</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>72.8%</td>
<td>Dillon (2011)</td>
</tr>
<tr>
<td>R&amp;E</td>
<td>67.0%</td>
<td>Benin et al. (2011)</td>
</tr>
<tr>
<td>Inputs</td>
<td>54.7%</td>
<td>Ricker-Gilbert et al. (2011)</td>
</tr>
</tbody>
</table>
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 scenario**
- **Planned (PNISA) scenario**
- **Irrigation scenario**
- **R&E scenario**
- **Subsidies scenario**

**Share of total expenditure (%)**
- **Input subsidies**
- **Research and extension**
- **Irrigation**
- **Other agriculture**
- **Fisheries and rural roads**
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 14%)
  – Extension (8% to 13%)
  – Inputs (5% to 7%)

• Development outcomes:
  – National GDP grows at 6.4%
  – Agriculture grows at 4%
# PNISA’s Impacts

<table>
<thead>
<tr>
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<th>Baseline</th>
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<tbody>
<tr>
<td>Annual public spending per rural farm household</td>
<td>$153.4</td>
<td>$72.8</td>
</tr>
<tr>
<td>GDP growth rate</td>
<td>7.6%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Agricultural growth rate</td>
<td>8.5%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Poverty rate in 2017</td>
<td>35.2%</td>
<td>41.2%</td>
</tr>
<tr>
<td>Increase in total GDP per dollar spent</td>
<td>$1.6</td>
<td></td>
</tr>
<tr>
<td>People lifted above pov. line per $1000 spent</td>
<td>2.9</td>
<td></td>
</tr>
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- Doubling of public agricultural spending
- More than doubles agricultural growth
- Positive return on investment (BCR)
- Doesn’t target poor, but reduces poverty
# Altering PNISA’s Portfolio

Reallocating funds towards...

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<td><strong>Agricultural growth rate</strong></td>
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<td>7.2%</td>
<td>9.0%</td>
<td>11.1%</td>
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<td>38.2%</td>
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<td>$1.1</td>
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<td><strong>People lifted above pov. line per $1000 spent</strong></td>
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## Altering Spending Efficiency

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Conclusions

• PNISA exceeds plausible growth target
  – Not surprising given the large scale of the program ($153 per farmer)
  – AND we ignore spending on fisheries, rural roads, marketing etc.

• PNISA substantially reduces poverty
  – Almost meets 2014 poverty target of 42%

• Altering portfolio improves program outcomes
  – Irrigation generates lower returns than R&E and subsidies
  – Reprioritizing portfolio could reduce program costs without sacrificing program outcomes

• Improving efficiency is as important as raising spending levels in promoting growth