Taking stock of Africa’s second-generation input subsidy programs: Insights from 70+ empirical studies

Nicole M. Mason, Thomas S. Jayne, William J. Burke, & Joshua Ariga

Presentation based on

Presentation objectives

- To share the key insights from 70+ empirical studies on the targeting and impacts of input subsidy programs (ISPs) in sub-Saharan Africa (SSA) since the early 2000s
- To highlight the implications for the design/re-design of ISPs and agricultural development strategies more broadly
- To point IAPRI researchers to resources that can help them with potential future research on ISPs
Overview

- Proliferation of empirical studies on ISPs in SSA since the late 2000s
- Most focus on Malawi, Zambia, Nigeria, Tanzania, Kenya, or Ghana

**Broad themes**

- **Targeting**: Who receives subsidized fertilizer?
- **Household-level effects**
  - Fertilizer & improved seed use
  - Crop yields, production, & area planted
  - Other soil fertility and natural resource management practices
  - Crop income & marketing
  - Total HH income & poverty
  - Dynamic or enduring effects – i.e., do the effects of ISPs persist over time?
- **Aggregate-level effects**
  - National fertilizer use
  - Food prices
  - Wage rates & labor markets
  - Aggregate poverty rate
- **Political economy**: Targeting and effects on voting/election results

**TARGETING**
**Targeting: Who receives subsidized fertilizer? (1)**

- **Male- vs. female-headed HHs:**
  - Generally no major differences
  - But where differences exist, **female-headed HHs** are **LESS** likely to get it (e.g., some studies for Malawi Farm Input Subsidy Program (FISP), Tanzania National Agricultural Input Voucher Scheme (NAIVS), Nigeria Growth Enhancement Support Scheme (GES))

  *Sources: See Jayne et al. (2018) for details*

**Targeting: Who receives subsidized fertilizer? (2)**

- **Landholding size or area cultivated:**
  - Almost all studies suggest **HHs w/ more land get more**

<table>
<thead>
<tr>
<th>Hectares cultivated</th>
<th>% of total HHs</th>
<th>% of total FISP fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.49</td>
<td>17.0</td>
<td>2.5</td>
</tr>
<tr>
<td>0.5-0.99</td>
<td>72.5%</td>
<td>45.1% 13.0 (43 kg) 29.6</td>
</tr>
<tr>
<td>1-1.99</td>
<td>31.9</td>
<td></td>
</tr>
<tr>
<td>2-4.99</td>
<td>23.5</td>
<td>41.0</td>
</tr>
<tr>
<td>5-9.99</td>
<td>27.5%</td>
<td>54.9% 10.7 (346 kg) 3.2</td>
</tr>
<tr>
<td>10-20</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td><strong>All HHs</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Sources: See Jayne et al. (2011), Mason et al. (2013)*
Targeting: Who receives subsidized fertilizer? (3)

- **Assets, income, or poverty status prior to the program:**
  - **Malawi FISP:** Very mixed results (many different studies/measures used)
  - **Ghana Fertilizer Subsidy Program (GFSP):** asset wealth 44% higher among GFSP beneficiaries
  - **Zambia FISP:** richest 20% of HHs receive 43% of FISP fertilizer (income)
  - **Kenya (asset wealth):**
    - National Accelerated Agricultural Inputs Access Program (NAAIAP): richest 20% of HHs less likely to receive than poorest 80%
    - National Cereals and Produce Board (NCPB): no effect

Sources: Malawi (see Jayne et al. 2018), Ghana (Vandell et al. 2012), Zambia (Mason et al. 2017 supplemental tables), Kenya (Sheahan et al. 2014, Mother & Jayne 2015)

Targeting: Why does this matter?

- If large share of subsidized fertilizer is going to **HHs that were already relatively better off**, the program is **less likely to achieve poverty reduction goals**

- HHs with more land, assets, or wealth before the subsidy program (and male-headed HHs) are **more likely to have been using fertilizer**
  - → *Some of the subsidized fertilizer* allocated to them just **replaces what they would have purchased otherwise (“displacement”)*
Effects of ISPs on fertilizer use (1)

- Question: If Mr. Zulu, a Zambian farmer, receives 100 kg of fertilizer through FISP, by how much will his total fertilizer use increase?
  - a. 100 kg
  - b. Less than 100 kg
  - c. More than 100 kg
  - d. It depends

It depends!
## Effects of ISPs on fertilizer use (2)

- **8 of 10 country studies:**
  - 100 kg subsidized fertilizer $\rightarrow < 100 \text{ kg increase in fertilizer use}
  - Zambia FISP (similar for maize seed): 87 kg
  - Malawi FISP (similar for maize seed): 82 kg
  - Kenya NAAIAP & NCPB: 57 kg
  - Nigeria Federal Market Stabilization Program (FMSP): kg estimate not available

- **2 of 10 country studies:**
  - 100 kg subsidized fertilizer $\rightarrow > 100 \text{ kg increase in fertilizer use}
  - Tanzania NAIVS: 110 kg
  - Nigeria voucher pilot program in Kano State (KVSP): 126 kg

Sources: See Jayne et al. (2018) and Ariga et al. (2018) for details.

## Effects of ISPs on fertilizer use (3)

### What explains crowding out?

- Significant share of ISP fertilizer targeted to farm HHs that **would have purchased fertilizer at market prices even without the subsidy**
- These tend to be:
  - HHs with **more land** or other **assets**
  - **Male-headed** HHs
- Except for Kenya NAAIAP – all ISPs with crowding out only **minimally involved the private sector for fertilizer component of program**
Effects of ISPs on \textbf{fertilizer use (4)}

\section*{What explains crowding in?}
- \textbf{Both Tanzania/NAIVS & Nigeria/KSVP:}
  - Utilized \textit{vouchers redeemable at private sector} retailers’ shops
- \textbf{Tanzania/NAIVS:}
  - Did good job of \textit{targeting HHs that hadn't used fertilizer} on maize or rice in the last 5 years (75\% of beneficiaries)
- \textbf{Nigeria/KVSP:}
  - Subsidy for 3 X 50-kg bags. \textit{Not enough to meet full demand} → farmers purchase the rest at market price at agrodealer?
  - Input suppliers required to be \textit{physically present} in LGAs
  - Pilot program \textit{closely monitored} by IFDC

\section*{Effects of ISPs on \textbf{crop production & yields}}
- \textbf{Generally small, positive effects on maize production and yields}
  - 1.7 – 3.6 additional kg of maize produced / kg subsidized fertilizer
- \textbf{Why so small?}
  - \textit{Displacement/crowding out} (previous slides)
  - \textit{Late delivery}
  - \textit{Agronomic factors} (next slides)
Maize yield response to N on smallholders’ plots in SSA

- 5 to 26 kg maize/kg N, with most estimates < 15 kg maize/kg N
  - Based on 15 studies using data from smallholders’ fields over multiple years
  - Much lower than in researcher-managed trials (18 to 40 kg/kg)

- Low maize yield response → ↓ profitability of fertilizer use
  - In many cases, benefits < costs

Why is maize yield response so much lower on farmers’ plots?

1. Poor water availability (mostly rain-fed)
2. Poor soil quality (esp. high soil acidity and low soil organic matter)
   - Growing populations → continuous cultivation and reduced fallows
   - Fallowing, minimum tillage, manure/compost, intercropping or rotating with legumes, and crop residue retention can help but constraints
3. Uniform fertilizer types/recommendations
   - In many areas, increasing profitability of fertilizer use will require addressing underlying soil quality & agronomic issues. ISPs alone will not solve the problem.
Effects on ISPs on other soil fertility management & natural resource management practices

- ISPs might encourage or discourage farmers to make longer-term investments in soil and land - e.g.,
  - ↓ fertilizer prices → free up resources → ↑ investment
  - ↑ fertilizer use → ↑ labor needed for fertilizer & harvest → ↓ investment

- **Empirical evidence**
  - Most studies (Malawi, Zambia, Ghana) suggest **NO ISP effects** on use of manure, minimum tillage, or other SLM practices (e.g., terraces, stone bunds, vegetative strips, etc.)
  - But some evidence that **Zambia FISP ↓ fallowing and ↑ maize monocropping and continuous maize cultivation**


Effects on ISPs on crop area planted

- **Zambia (relatively land abundant):**
  - ↑ maize & total area; no adverse effects on area planted to other crops
  - Some of additional area = fallow land

- **Kenya (relatively land scarce):**
  - no effects on area planted

- **Malawi (relatively land scarce):**
  - mixed findings re: maize % of area

Effects of ISPs on crop income & marketing

- **Net crop income**
  - Generally small, positive effects
    - (Malawi FISP, Zambia FISP, Kenya NAAIAP (among poor))
    - Subsidy ↓ fertilizer price + ↑ maize output

- **Maize marketing**
  - Malawi FISP & Nigeria GES:
    - ↑ maize sales


Effects of ISPs on total HH income & poverty

- **Malawi**: mixed effects
- **Zambia FISP, Kenya NAAIAP, & Nigeria GES**: small ↑ in total HH income/expenditure and/or ↓ in poverty incidence, gap, or severity

Do ISPs have **enduring effects** on beneficiary HHs? (1)

- The hope is that by ↑ fertilizer use, yields, and incomes, ISPs will build beneficiary HHs’ assets & put them on a more positive yield & welfare trajectory

![Graph showing subsidy period and post-subsidy growth](source: Carter et al. 2010)

Do ISPs have **enduring effects** on beneficiary HHs? (2)

- Few studies, mixed results

- **Malawi:**
  - Commercial fertilizer demand: initial crowding-out but possible crowding-in in the longer run (e.g., 3 years later)
  - But no evidence of enduring effects on maize production, assets, or income

- **Mozambique:**
  - Positive effects on crop production and HH expenditures persist 3 years later
  - Much lower initial fertilizer use than Malawi; persistent effects could in part be due to learning and/or subsidy pilot program/IFDC efforts to improve fertilizer supply and expand agro-dealer networks

Sources: Malawi (Ricker-Gilbert & Jayne 2011, 2017), Mozambique (Carter et al. 2014)
Effects of ISPs on national fertilizer use

- Discussed earlier how 100 kg of subsidized fertilizer often increases HH fertilizer use by < 100 kg
- Diversion and resale of fertilizer intended for ISPs further reduces the effects of ISPs on national fertilizer use

- Malawi, Zambia, and Tanzania: Empirical evidence suggests 25-33% of ISP fertilizer is diverted
  - Increase in national fertilizer use given 100 MT increase in ISP fertilizer:
    - Malawi: 55 MT (82 MT w/o accounting for diversion)
    - Zambia: 58 MT (87 MT w/o accounting for diversion)
    - Tanzania: 83 MT (110 MT w/o accounting for diversion)

Sources: Malawi & Zambia (Jayne et al. 2015), Tanzania (Mather & Minda 2016)
Effects of ISPs on food prices

- By ↑ staple food production, might expect ISPs to ↓ food prices
  - Would positively affect urban consumers and rural net buyers

- Malawi & Zambia FISP: retail maize prices ↓ 1-4%
- Malawi FISP: overall food prices ↓ 2-3%
- Nigeria FMSP: no effect on maize or rice prices


Effects of ISPs on wage rates & labor markets

- If ISPs ↑ incomes → might ↑ demand for labor → could ↑ wage rates
  - Could positively affect laborers

- Malawi FISP:
  - ↑ wages but by how much varies across studies (1% vs. 5-8%)
  - Also some evidence of ↑ demand (and ↓ supply) for ganyu labor

Sources: Ricker-Gilbert (2014), Arndt et al. (2016)
Effects of ISPs on overall poverty rates

- Evidence base is thin
- Arndt et al. (2016): 2006/07 Malawi FISP reduced national poverty headcount ratio by 2-3 percentage points (against baseline poverty rate of 52%)

Sources: Ricker-Gilbert (2014), Arndt et al. (2016)
Political economy of ISPs: **Targeting**

- **Mounting evidence of politicized targeting of ISPs**
  - Politically connected HHs tend to get more subsidized fertilizer
    - Tanzania NAIVs: HHs w/ elected officials
    - Malawi FISP: HHs in villages w/ MP
    - Nigeria FMSP: HHs in villages closer to state governor’s district of origin

- **Mixed results re: which voters or constituencies are targeted**
  - Ghana: opposition strongholds
  - Zambia: core supporter constituencies
  - Malawi: mixed


---

Political economy of ISPs: **Effects on voting/elections**

- **Conventional wisdom** is that fertilizer subsides win votes, i.e.:
  - Assumptions:
    - Scaling up ISPs politically beneficial
    - Scaling down ISPs politically damaging

- **Does the empirical evidence support this?**
  - **Not really!**
    - Some evidence that Malawi FISP increased support for President Mutharika and his Democratic Progressive Party in the 2009 election
    - BUT evidence from Zambia suggests the Zambia FISP had NO EFFECT on presidential election results in 2006 and 2011

Sources: Brazys et al. (2015), Dionne and Horowitz (2016), Mason et al. (2017)
Conclusions & Policy implications (1)

- **Bottom line**: ISPs can raise fertilizer use and crop production in the short-run but impacts have been smaller than expected, largely due to:
  - Displacement of unsubsidized fertilizer purchases
  - Low crop yield response to fertilizer

- **Targeting HHs that were not using fertilizer before the program can help** reduce displacement and increase ISPs’ impacts — e.g.,
  - Female-headed HHs
  - HHs with enough land to use the input packet but on the lower end of the landholding size and wealth spectrum
  - Work through private agro-dealers rather than parallel ISP distribution system

Conclusions & Policy implications (2)

- **Need to address underlying soil issues** that constrain crop yield response to fertilizer or ISP effects on crop yields will continue to be disappointing and profitability of fertilizer use will remain low
  - Low soil organic matter
  - High soil acidity

- **Need to move beyond blanket recommendations & uniform input packs**

- **Need efforts to ↓ farm gate fertilizer prices and ↑ farm gate crop prices**
  - Bulk procurement of fertilizer (?), invest in rural roads, promote competition
Conclusions & Policy implications (3)

- Remember that ISPs are just one option and that heavy expenditures on ISPs = less $$ available for other important programs/investments to improve ag productivity and reduce rural poverty

<table>
<thead>
<tr>
<th>Investment or subsidy (Source: Fan et al. 2008)</th>
<th>Rank w.r.t. returns to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ag growth</td>
</tr>
<tr>
<td>Agricultural R&amp;D</td>
<td>1</td>
</tr>
<tr>
<td>Roads</td>
<td>2</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
</tr>
<tr>
<td>Irrigation investment</td>
<td>4</td>
</tr>
<tr>
<td>Credit subsidies</td>
<td>5</td>
</tr>
<tr>
<td>Irrigation subsidies</td>
<td>6</td>
</tr>
<tr>
<td>Power subsidies</td>
<td>7</td>
</tr>
<tr>
<td>Fertilizer subsidies</td>
<td>8</td>
</tr>
</tbody>
</table>

Investments & subsidies in rural India during the 1990s ranked by ag growth & rural poverty returns (↑ in ag GDP or ↓ in # of poor people per rupees spent)

Suggestions for IAPRI researchers

- Paper is open access and available for free download here:
  - Appendices are available at the bottom of the link at the page above or directly here: https://www.sciencedirect.com/science/MiamiMultiMediaURL/1-s2.0-S0306919217308618/1-s2.0-S0306919217308618-mmc2.docx/271787/html/S0306919217308618/4fd066b4a6fba07342a2d5bb681e6e84/mmc2.docx

- Check out the main paper but also the appendices
  - Appendix B has very rich information on the nearly 80 studies covered in the lit review, including main findings, data used, gist of methods, etc.
  - This appendix can also point you to knowledge gaps in the literature

- Please get in touch if you’re interested in collaborating with me on research on FISP!
Thank you! Questions or comments?

Nicole M. Mason (masonn@msu.edu)
Assistant Professor
Department of Agricultural, Food, & Resource Economics
Michigan State University

Acknowledgements

The authors gratefully acknowledge funding support from the World Bank, the Bill and Melinda Gates Foundation under the Guiding Investments in Sustainable Agricultural Intensification Grant (OPP1039151), the US Agency for International Development (USAID) Bureau for Food Security under the Food Security Policy Innovation Lab [AID-OAA-L-13-00001], and the USAID Missions to Zambia [grant number 611-A-00-11-00001-00] and Kenya [grant number AID-623-A-12-00022]. Mason is also supported by funding from the US Department of Agriculture National Institute of Food and Agriculture and Michigan AgBioResearch [project number MICL02501].
References


- For the full citations for all other works cited in this presentation, see Jayne, T. S., Mason, N. M., Burke, W. J., & Ariga, J. (2018). Taking stock of Africa’s second-generation agricultural input subsidy programs. Food Policy. https://doi.org/10.1016/j.foodpol.2018.01.003