Nigeria Input Subsidy Program Assessment: The case of fertilizer

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## Nigeria

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita GDP</td>
<td>$1,490</td>
</tr>
<tr>
<td>Per capita GDP (PPP)</td>
<td>$2,578</td>
</tr>
<tr>
<td>Poverty rate (% of population living below $1 / day)</td>
<td>61%</td>
</tr>
<tr>
<td>Population (million, 2012 Estimated)</td>
<td>167</td>
</tr>
<tr>
<td>Population density (person / km2 of total land)</td>
<td>183</td>
</tr>
<tr>
<td>Population density (person / km2 of arable land)</td>
<td>463</td>
</tr>
<tr>
<td>Agricultural GDP / Total GDP (2007)</td>
<td>33%</td>
</tr>
<tr>
<td>% of economically active population engaged in agriculture</td>
<td>37 ~ 70%</td>
</tr>
</tbody>
</table>

Source: FAOSTAT, WDI, IMF, National Bureau of Statistics of Nigeria

**Political system**: Federal system, with 37 states
Nigeria - farming system

Source: Dixon et al. (2001)
Among pub exp on ag, high share of pub expenditure on fertilizer

However, pub exp on ag only small % of total pub exp

Source: Calculated by authors based on Mogues et al. (2008).
Exchange rate of 1USD = 120 Naira was used.

(State governments provided roughly similar magnitude of support)
Fertilizer use trend in Nigeria & SSA regions

Source: Takeshima et al. (2013)
## Major crops with fertilizer application in Nigeria (Jan – Aug 2010)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Share (%)</th>
<th>Confidence interval</th>
<th>% of cropland&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum</td>
<td>20.9%</td>
<td>[17.9, 24.0]</td>
<td>17.0</td>
</tr>
<tr>
<td>Maize</td>
<td>18.3%</td>
<td>[15.5, 21.3]</td>
<td>9.4</td>
</tr>
<tr>
<td>Beans / cowpea</td>
<td>13.6%</td>
<td>[11.4, 15.6]</td>
<td>10.0</td>
</tr>
<tr>
<td>Rice</td>
<td>12.9%</td>
<td>[9.5, 17.1]</td>
<td>6.0</td>
</tr>
<tr>
<td>Millet</td>
<td>11.4%</td>
<td>[9.6, 13.4]</td>
<td>11.6</td>
</tr>
<tr>
<td>Cassava</td>
<td>4.5%</td>
<td>[3.5, 5.8]</td>
<td>9.2</td>
</tr>
<tr>
<td>Yam + water yam</td>
<td>3.6%</td>
<td>[2.8, 4.5]</td>
<td>7.6</td>
</tr>
<tr>
<td>Ground nut</td>
<td>3.2%</td>
<td>[2.5, 4.1]</td>
<td>6.1</td>
</tr>
<tr>
<td>Soybean</td>
<td>1.7%</td>
<td>[1.1, 2.5]</td>
<td>1.4</td>
</tr>
<tr>
<td>Pepper</td>
<td>1.2%</td>
<td>[0.8, 1.8]</td>
<td>0.7</td>
</tr>
<tr>
<td>Sesame</td>
<td>0.9%</td>
<td>[0.5, 1.3]</td>
<td>0.3</td>
</tr>
<tr>
<td>Cotton</td>
<td>0.3%</td>
<td>[0.0, 0.8]</td>
<td>0.7</td>
</tr>
<tr>
<td>Oil palm tree</td>
<td>0.3%</td>
<td>[0.1, 0.6]</td>
<td>0.2</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>0.3%</td>
<td>[0.0, 0.6]</td>
<td>0.2</td>
</tr>
<tr>
<td>Tomato</td>
<td>0.2%</td>
<td>[0.1, 0.4]</td>
<td>0.5</td>
</tr>
<tr>
<td>Cocoa</td>
<td>0.2%</td>
<td>[0.0, 0.5]</td>
<td>3.2</td>
</tr>
<tr>
<td>Ginger</td>
<td>0.1%</td>
<td>[0.0, 0.2]</td>
<td>0.3</td>
</tr>
<tr>
<td>Cashew</td>
<td>0.0%</td>
<td>[0.0, 0.0]</td>
<td>0.8</td>
</tr>
<tr>
<td>Other</td>
<td>6.7%</td>
<td></td>
<td>6.0</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation from LSMS data & from FAOSTAT (share of cropland).

<sup>a</sup>Although fertilizer use for dry season crops in some region may not be included due to the selection of sampling period

<sup>b</sup>Average crop area in 2005-2010.
Fertilizer use

- Consumption higher in the North
  - Low soil nutrients
  - Environmental concern by the colonial government (Mustapha 2003)
- Prevalence of cereals in the North (root crops in the South – less fertilizer)
Nigerian fertilizer sector (recent)

- Importation/Procurement by private Fertilizer companies
  - Raw Materials
  - Domestically Blended Fertilizer
  - Total supply
- Imported Fertilizer
  - State Government (Ministry of Agriculture)
  - Private sector Distributors
  - Retailers
  - Local Agents
  - Large-scale farmers
  - Small-scale farmers
  - State Input Supply Companies
  - ADPs
Fertilizer is expensive in Nigeria


We re-categorized FDF (2010) to be consistent with Gregory & Bumb (2006). For dealer costs and margin in 2010, we assumed 5 percent to be consistent with 2003 figures.

Major origin: Ukraine, Belgium (Hernandez & Torero 2011)
Past policies on fertilizer support

- **General policies to stimulate fertilizer use**
- **Fertilizer use stimulation: 1940s ~** (Mustapha 2003)
- **1960s**: less focus on food crop (export crop – less fertilizer)
  - Indigenous method to maintain fertility (Welsch 1965 *AJAE*)
- **1970s ~**
  - More focus on food crops <=
    - Biafran War (1967-70), Drought (1972-74)
  - National Accelerated Food Production Program (NAFPP), WB-led Agricultural Development Project (ADP), Operation Feed the Nation (OFN)
  - **Ag Credit program**-
    - Credit serious impediment for fertilizer use (Ogunfowora & Norman 1973 *JAE*)

**Insufficient Outcome**
- untimely distribution of fertilizer (Shimada 1999)
- High labor cost under NAFPP (Ezeh 1988)
- Diversion to unintended beneficiaries under OFN (Okuneye 1992)
- **General failure to reach majority of smallholders** (Okolie 1995)
Fertilizer subsidy policy

Sources: Nagy & Edun (2002)

• ~ 1976: Subsidy rates (State) = 25 ~ 50%
  • state governments in Nigeria procured fertilizer independently and distributed the fertilizer through sales agents and the extension system (ADPs) (Nagy & Edun 2002)

• 1976 ~ 1986: Subsidy rates (Federal) = 28 ~ 83%
  • Federal Government centralized procurement and distribution to state depots

• 1986 ~: SAP (Structural Adjustment Program)

• 1987~ 1996: Subsidy rates (Federal + State) = 65 ~ 87%
  • 1987 ~ 1991: States became responsible for procuring fertilizer – substantial state subsidy; Federal Government reduced subsidy due to SAP
  • 1992: Federal Gov reinstated fertilizer procurement <= rising fertilizer price due to SAP
  • Fertilizer consumption however increased constantly upto 1993
Fertilizer subsidy policy

• 1997 ~ 1999: Deregulation of fertilizer sector: Subsidy rates = 0%
  • Growing fiscal burden since 1986 SAP (Mogue et al. 2008; Lewis & Stein 1997)
  • Import tariff reduced
  • Private sector – did not fully respond
    • Uncertainty, poor infrastructure, obsolete port facilities, inefficient custom clearing
    • Inadequate establishment of distribution channels, promotion activities (Banful 2011)
• 1999 ~ 2011: Federal pan-territorial subsidy reinstated, with states providing their own subsidies (Subsidy rate = 25 ~ 75%)
• 2004 ~: Pilot voucher schemes
• 2011 ~: Fertilizer subsidy reform - Growth Enhancement Support (GES)

Estimated state subsidy rates (%) in 2008
Source: Banful et al. (2010)
Figure 3. Fertilizer consumption (in nutrients), subsidized quantity (in products), and agricultural production trends in Nigeria

Source: Consumptions and agricultural production index are from FAOSTAT, while subsidized quantity is from Federal Department of Fertilizer.

Old fertilizer subsidy scheme - outcomes

• **Localized success**
  - northern Nigeria, supported with IITA improved OP maize, animal traction (Smith et al. 1994; Goldman & Smith 1995; Alene et al. 2009) and possibly cheap labor
  - Fertilizer still relied on subsidy, no evidence of private agro-inputs sector growing

• **General**
  - Limited response by private sector under liberalization (late 90s)
  - Timely availability
  - Under-developed dealer networks
Old fertilizer subsidy scheme - outcomes

- Rent seeking => diversion of fertilizer from intended beneficiaries
  - Less than 30% reaching target (Takeshima et al. 2013), 11% (FMARD 2011)
  - In theory, 70% of intended fertilizer users should have received (Takeshima et al. 2013)
- Lack of development in complementary factors
  - Insufficient R&D on variety development (by NARI)
  - Weak extension programs
  - Regulatory environment
- Government failure in mechanization, irrigation
Experience with paper vouchers based subsidy (Liverpool-Tasie 2013)

Pilot voucher scheme by IFDC in 2 states (2009)
- 55 ~ 60 % subsidy for 150 kg
- Voucher distribution:
  - Kano state: through farmer group
  - Taraba state: individual farmers

Assessment
- 1000 households
- Propensity score matching (PSM) techniques

Main Findings
- Participants received more bags of subsidized fertilizer than non-participants.
- Participants paid significantly lower prices.
- Timeliness of fertilizer – worsened.
- No improvement in fertilizer quality

Main Conclusion:
Private sector involvement in distribution necessary to assure timeliness
Effect on commercial fertilizer sector development

Recent empirical assessment

- Takeshima, Nkonya & Deb (2013) - government direct procurement and distribution (Old fertilizer subsidy)
Crowding out in old subsidy scheme (Takeshima et al. 2013)

Conceptual framework
• Xu et al. (2009), Ricker-Gilbert et al. (2011)

Data: National Household Surveys
• LSMS:ISA data (2010) – cross section

Methods
• Similar to Xu et al. (2009), Ricker-Gilbert et al. (2011) except:
  • Endogenous commercial fertilizer price <= affected by subsidy
Subsidy depressed commercial price

Source: Authors’ calculations.
Open market and subsidized prices are median of each region in LSMS data. No subsidized price was obtained for the South West region.

- North => lower subsidized price, though slightly higher theoretical price
- Open market price < Theoretical price => Subsidy depressed open market price
Estimation method - Old subsidy scheme
Takeshima et al. (2013)

1. **Bivariate probit** - control for self-selection
   \[(\Pi_C, \Pi_G) = f(x)\] => Obtain \(\lambda\) (inverse mills ratio)

2. **Endogenous Tobit** – crowding out among single-source users
   Censored regression (Tobit) 1: \(G^* = f(x_G, \lambda)\)
   Censored regression (Tobit) 2: \(C^* = f(x_C, G^*, \lambda)\)

3. **OLS** – difference in fertilizer use between single- and dual-source users
   \(T^* = f(x_G, x_C, \delta)\)
   \(\delta\): probability of being dual-source users – estimated from bivariate probit

**Correlated Random Effects:**
- Interact variables \(x\) with year dummies – to minimize bias from pooled cross section data
Results (Takeshima et al. 2013)

- Estimated crowding-out (mean of all sample) = 19 ~ 35%
- 10 kg of subsidized fertilizer
- => demand for commercial fertilizer 1.9 ~ 3.5 kg ↓
- Using both sources (commercial & subsidized), instead of one, => no increase in fertilizer use
- For farmers with large household size, residing closer to the town
- => More subsidy was given to them although they were more likely to buy fertilizer at commercial price even in the absence of subsidy
- *Caution: Due to small quantity of fertilizer, this crowding out effect is small in absolute term
Estimation method (Liverpool-Tasie, 2012)

1. **Control function Approach**
   1. Estimate the determinants of the quantity of subsidized fertilizer using a tobit model
   2. Then the generalized residual is constructed as:
      \[ \hat{g}r_i = -\hat{\tau} \left[ QFert_{si} = 0 \right] \lambda (-Z_{i\hat{\gamma}}) + \left[ QFert_{si} > 0 \right] (QFert_{si} - Z_{i\hat{\gamma}}) \]
      Where \( \hat{\tau} \) and \( \hat{\gamma} \) are the Tobit MLEs and \( \lambda \) is the inverse Mills ratio.
   3. Then the generalized residuals are included in the second stage estimations (a Double hurdle model)

2. **Endogeneity of subsidized fertilizer received.**
   To satisfy the exclusion restriction of the control function approach, the study uses a respondent being related to the leadership of their farm group president as an instrument for the quantity of subsidized fertilizer that a farmer received
Experience with paper vouchers based subsidy (Liverpool-Tasie 2013)

Receiving subsidized fertilizer through voucher
- probability of participating in the private fertilizer market – unchanged
- However, once the decision to participate had been made, increased the quantity of fertilizer purchased from the private market

Crowding-in (average partial effects): for each 50kg of subsidized fertilizer received, farmers purchased approximately 40kg more from the private market.

Some evidence of successful pro-poor targeting

Reduced leakages
- No effect of quantity of subsidized fertilizer on commercial fertilizer price
Current fertilizer subsidy reform in Nigeria

- **Agricultural Transformation Agenda (2011 ~)**
  - New Minister of Agriculture, Dr Akin Adesina
  - Fertilizer subsidy reform
    - No direct procurement / distribution by the Government
    - Electronic voucher
    - Plan: Target 5 million farmers per year, reaching all 20 million farmers in 4 years
  - However, each state can decide whether to participate in this federal initiative
## Old and new subsidy schemes

<table>
<thead>
<tr>
<th></th>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price discount mechanism</td>
<td>Fertilizer sold by public institutions at discounted price</td>
<td>Voucher given to targeted recipients</td>
</tr>
<tr>
<td>Subsidized quantity</td>
<td>Rationed at aggregate level</td>
<td>Quota at beneficiary level</td>
</tr>
<tr>
<td>Maximum subsidized quantity</td>
<td>About 0.5 million ton</td>
<td>About 0.5 million ton (5 million farmers * 100 kg)</td>
</tr>
<tr>
<td>Subsidy rate</td>
<td>25% Federal + 0 ~ 50% State subsidy rates</td>
<td>Similar to old scheme</td>
</tr>
<tr>
<td>Fertilizer distribution</td>
<td>Subsidized - Government</td>
<td>Private sector</td>
</tr>
<tr>
<td></td>
<td>Un-subsidized – Private sector</td>
<td></td>
</tr>
</tbody>
</table>
Progress in 2012 (informal sources – need to be confirmed)

• About 20 states (out of 37 states) participated
  • Remaining states continued with the old scheme

• Register farmers
  • Sensitization conducted in 2012, farmers who showed up were registered => total 4.2 million registered
  • In 2012, 1.2 million farmers received subsidized fertilizer = 120,000 tons

• 900 Voucher redemption centers within participating states
Key issues with new subsidy schemes

- Risk / uncertainty
  - Voucher redemption (uncertainty for dealers)
    - Timeliness, delay, rejection of vouchers
  - Entitlements –
    - Defect of mobile phones, phone signal
- Information asymmetry
  - Fertilizer quality (Adulteration)
  - Previously more trust in government distributed fertilizer (?)
- Market structure
  - Insufficient number / density of redemption centers (only 900 in 2012)
  - Monopoly by certain dealers
    - vouchers may be accepted only at the certain dealers
    - high entry cost for new dealers if new facility needed for voucher redemption
Conclusions

- Relatively little effect of past government policy in stimulating fertilizer demand and improving fertilizer access in Nigeria
  - Old Subsidy scheme
    - Untimely distribution
    - Inefficient targeting / Leakages
    - Slow response of private fertilizer sector
  - Neglect on R&D / infrastructure, government failure on complementary technologies (mechanization, irrigation) => slow growth in fertilizer demand
  - Successful outcomes, if exist, were rather localized

- Potential in fertilizer subsidy reform under ATA
  - Voucher could improve targeting, and crowd in commercial fertilizer sector
  - However, challenges remain in
    - Fertilizer quality regulation
    - Access to redemption facilities
    - Entitlement risk (mobile phone)
    - Speed of private sector response

- Overall fertilizer demand still depends on broader ag policies, factor endowments, farming systems