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U N I V E R S I T Y

Nigeria Input Subsidy Program Assessment: The case of fertilizer

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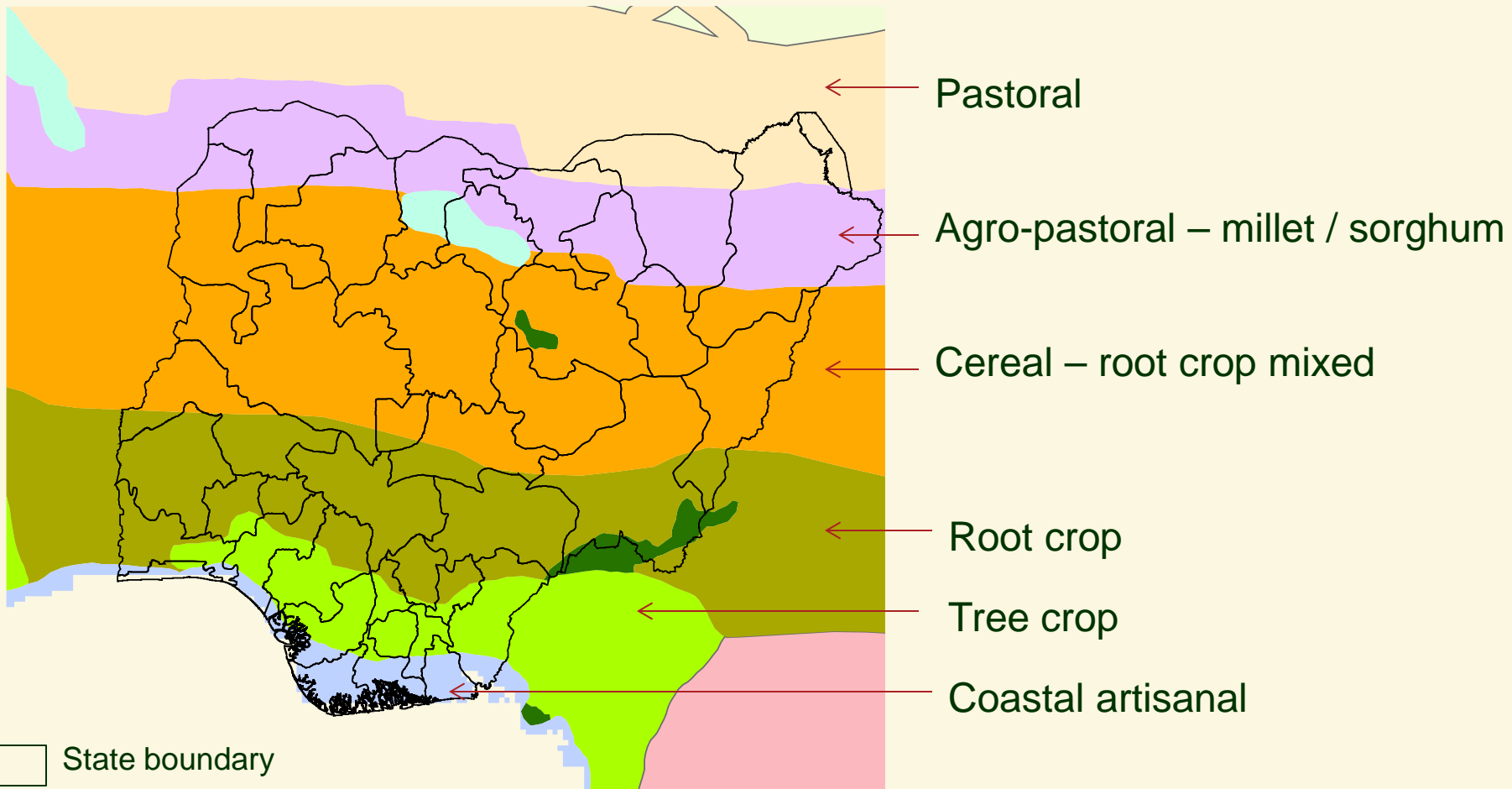
Nigeria

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

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

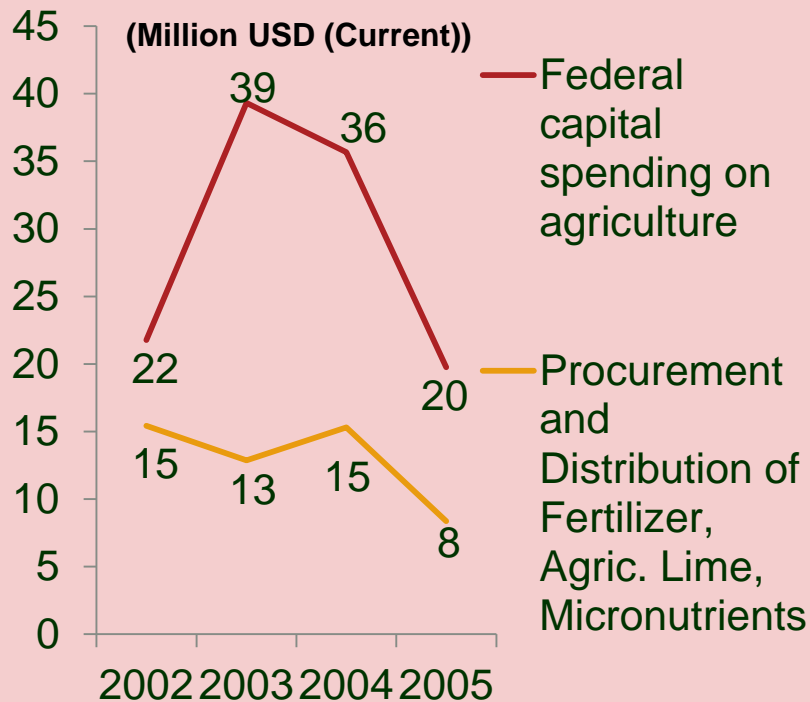
Political system: Federal system, with 37 states

Nigeria - farming system



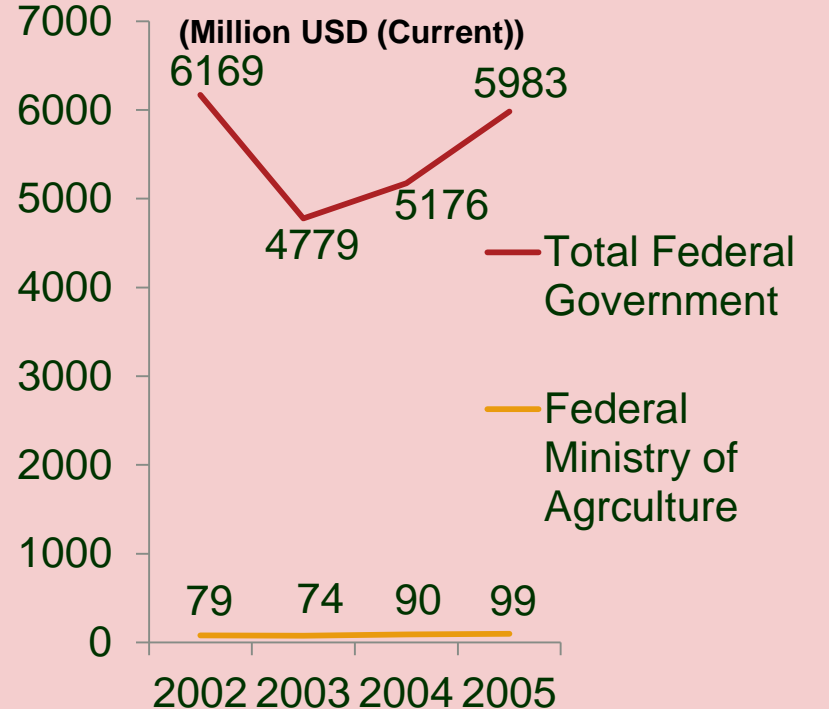
Source: Dixon et al. (2001)

Public expenditure on agriculture and fertilizer (Federal Government only)



Among pub exp on ag, high share of pub expenditure on fertilizer

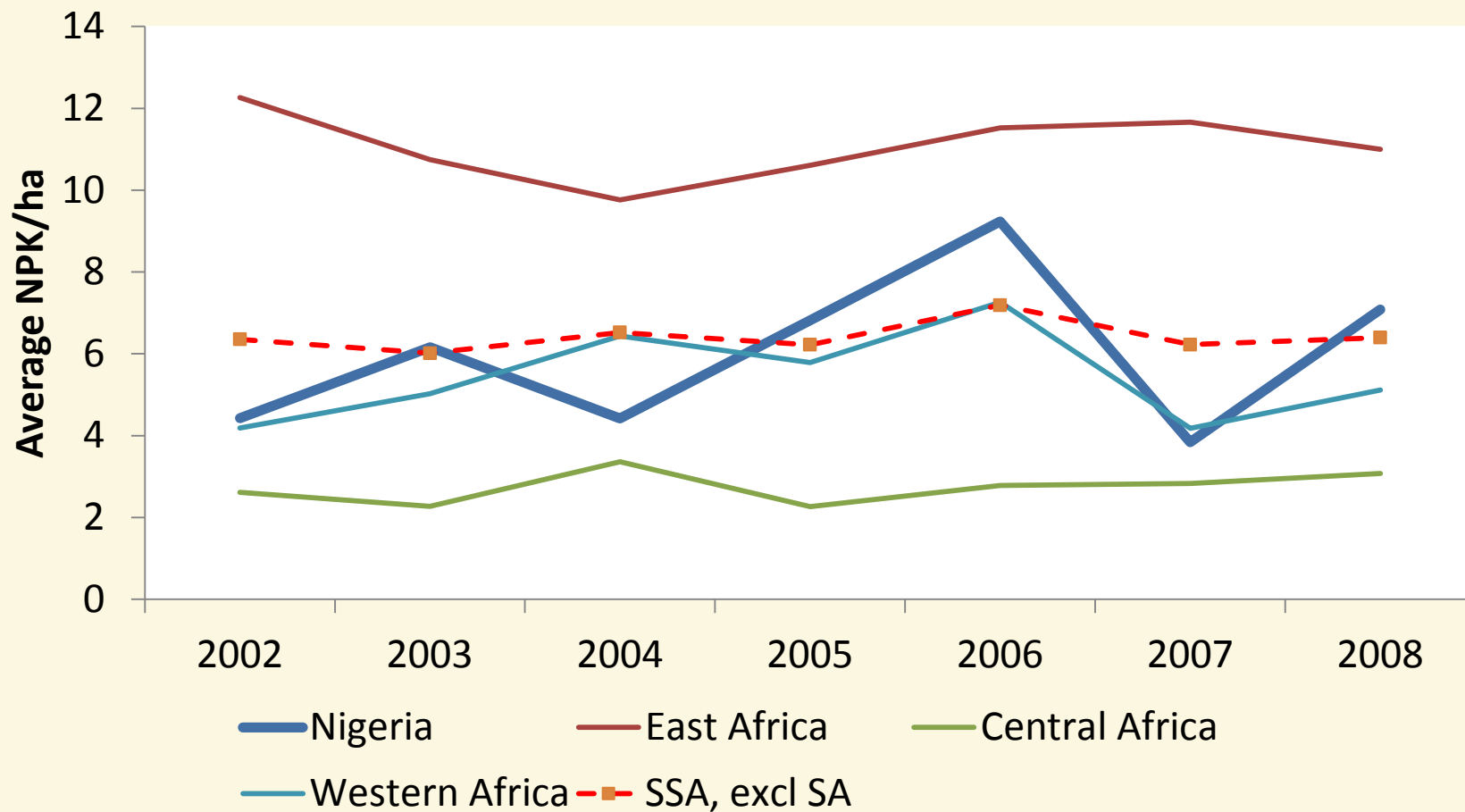
Source: Calculated by authors based on Mogues et al. (2008).
Exchange rate of 1USD = 120 Naira was used.



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

(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)

Crops	Share (%)	Confidence interval	% of cropland ^b
Sorghum	20.9%	[17.9,24.0]	17.0
Maize	18.3%	[15.5,21.3]	9.4
Beans / cowpea	13.6%	[11.4,15.6]	10.0
Rice	12.9%	[9.5,17.1]	6.0
Millet	11.4%	[9.6,13.4]	11.6
Cassava	4.5%	[3.5, 5.8]	9.2
Yam + water yam	3.6%	[2.8, 4.5]	7.6
Ground nut	3.2%	[2.5, 4.1]	6.1
Soybean	1.7%	[1.1, 2.5]	1.4
Pepper	1.2%	[0.8, 1.8]	
Sesame	0.9%	[0.5, 1.3]	0.7
Cotton	0.3%	[0.0, 0.8]	1.3
Oil palm tree	0.3%	[0.1, 0.6]	8.2
Sugar cane	0.3%	[0.0, 0.6]	0.2
Tomato	0.2%	[0.1, 0.4]	0.5
Cocoa	0.2%	[0.0, 0.5]	3.2
Ginger	0.1%	[0.0, 0.2]	0.3
Cashew	0.0%	[0.0, 0.0]	0.8
Other	6.7%		6.0

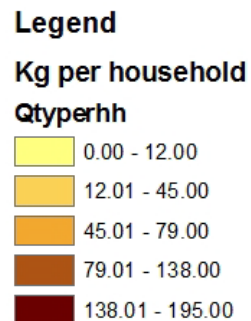
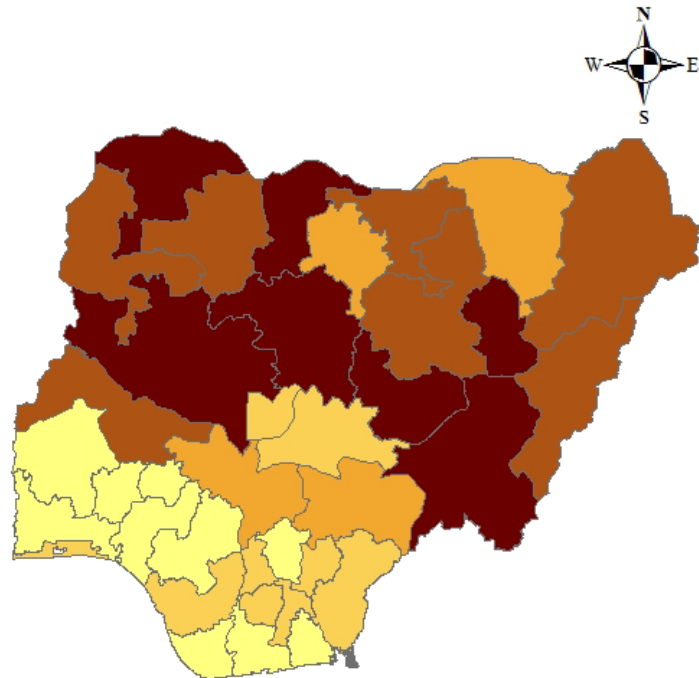
Source: Authors' calculation from LSMS data & from FAOSTAT (share of cropland).

^aAlthough fertilizer use for dry season crops in some region may not be included due to the selection of sampling period

^b Average crop area in 2005-2010.

Fertilizer use

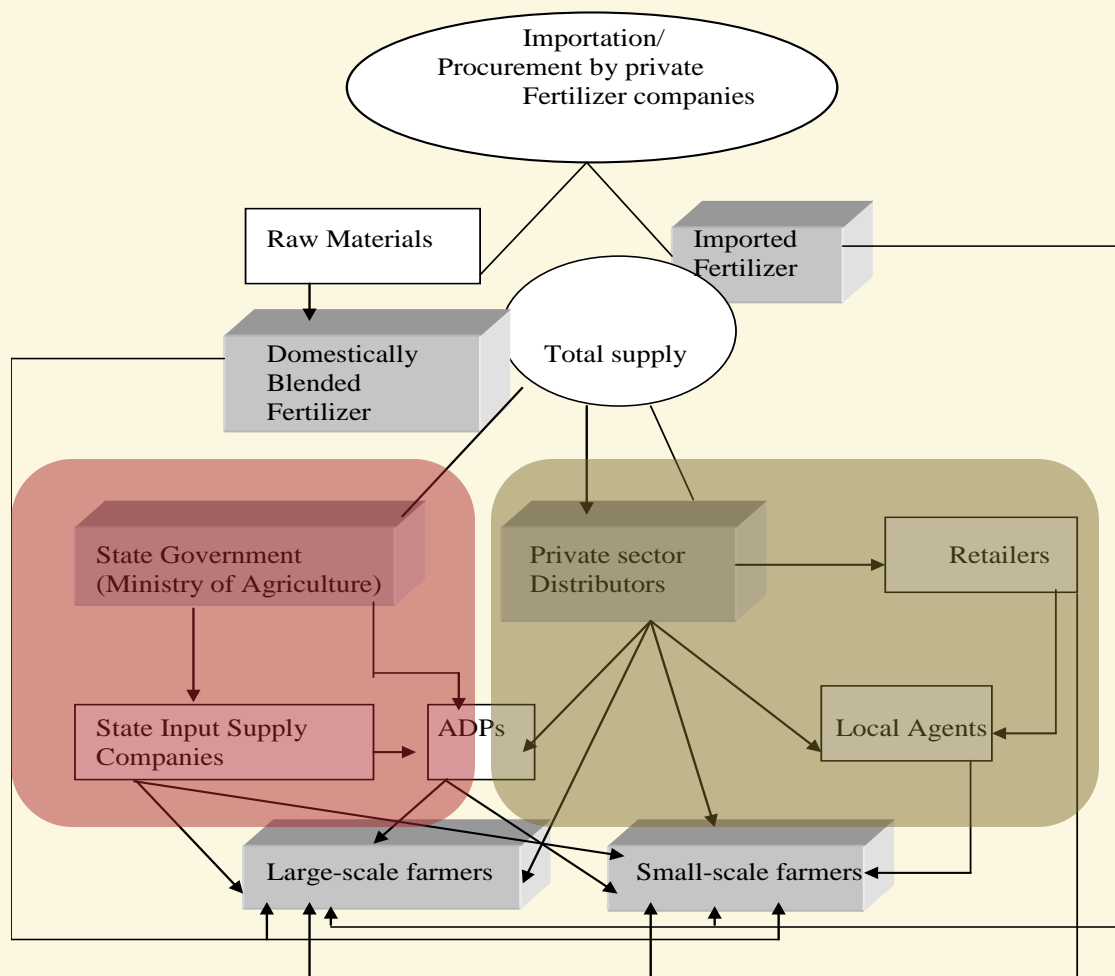
Fertilizer use across Nigeria in 2010



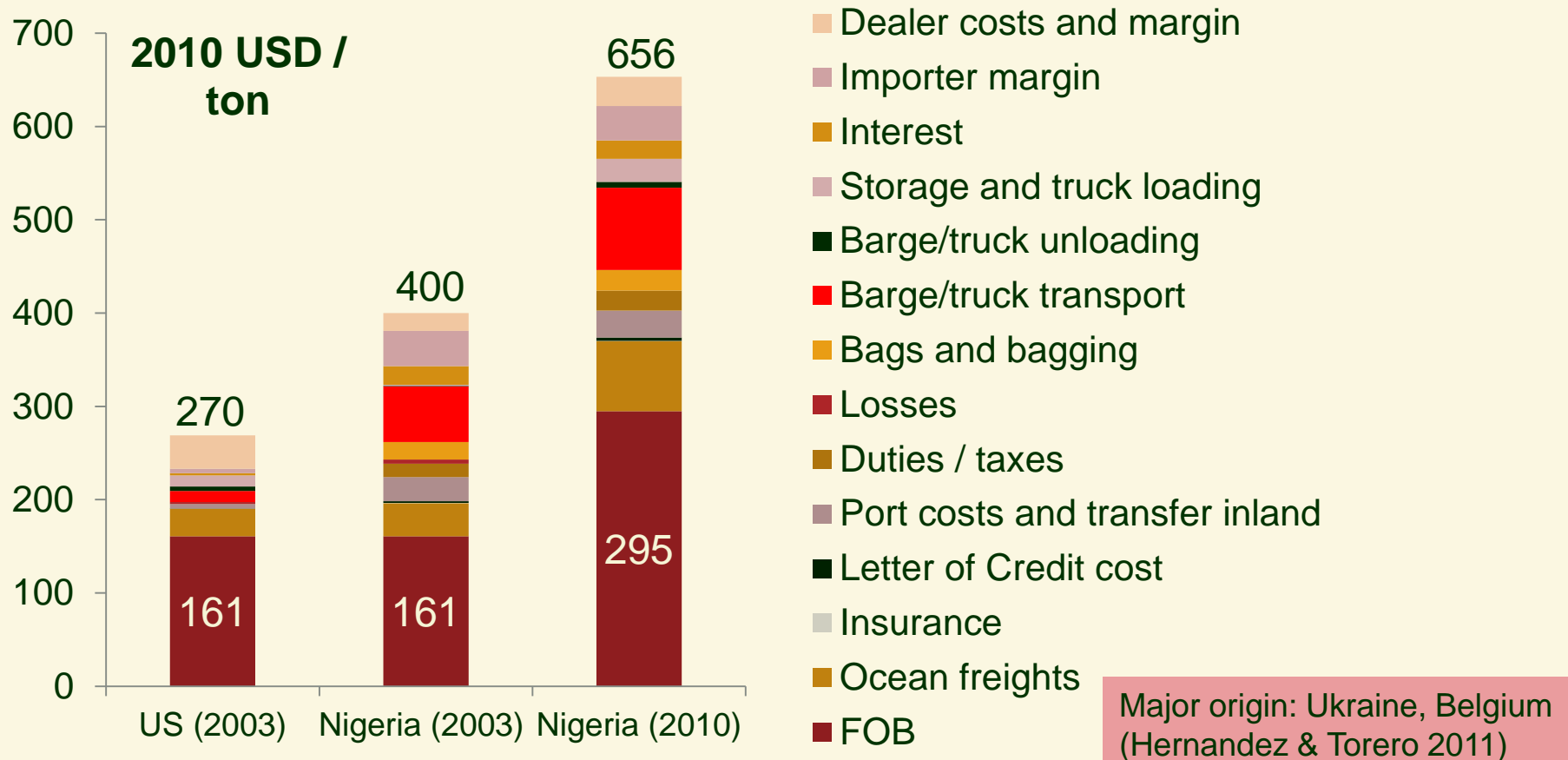
3 1.5 0 3 Decimal Degrees

- 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)



Fertilizer is expensive in Nigeria



Source: Gregory & Bumb (2006) for 2003 figures and FDF (2010) for 2010 figure.

^aWe 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.

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)**

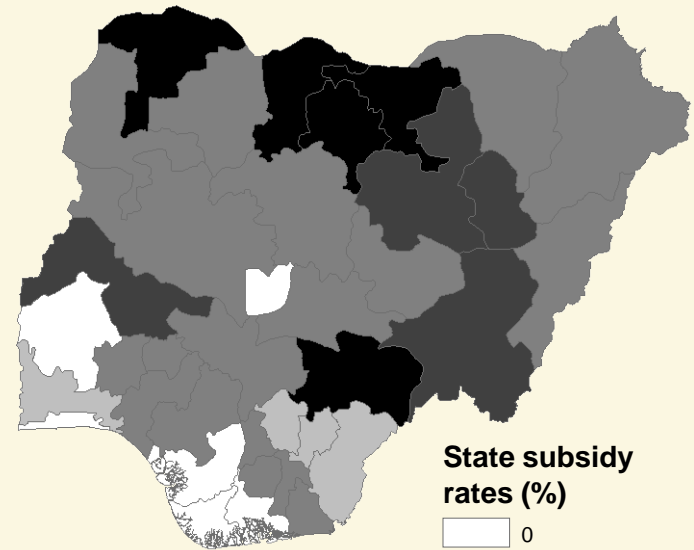
Fertilizer subsidy policy

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 \leq 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 set 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)

Fertilizer use and agricultural production indices

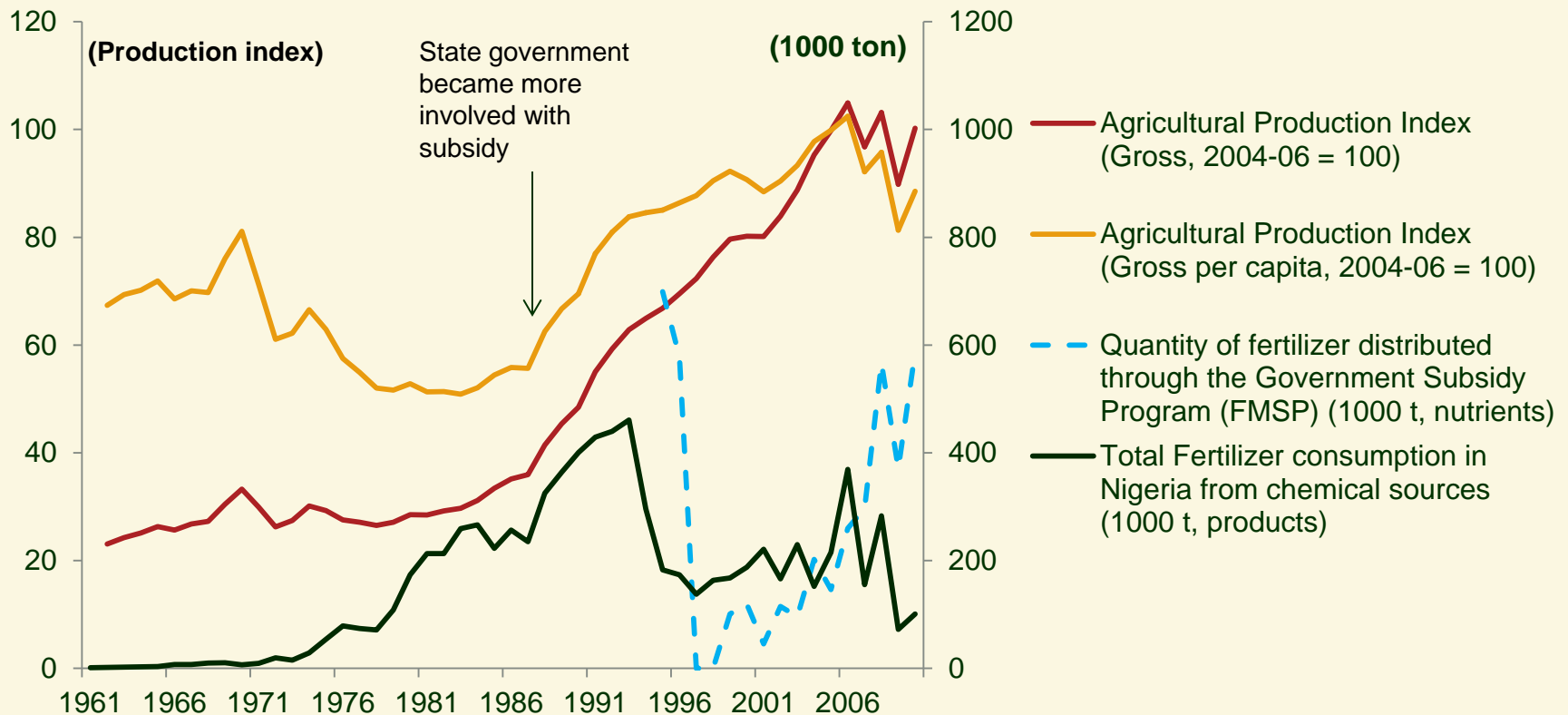


Figure 3. Fertilizer consumption (in nutrients), subsidized quantity (in products), and agricultural production trends in Nigeria

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

^aConsumption numbers from 2006 are projections. Nagy & Edun (2002) cautions against the reliability of subsidized quantity figures between 1990 and 1994.

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)
- Liverpool-Tasie (2012) – Paper voucher based subsidy

Crowding out in old subsidy scheme (Takeshima et al. 2013)

Conceptual framework

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

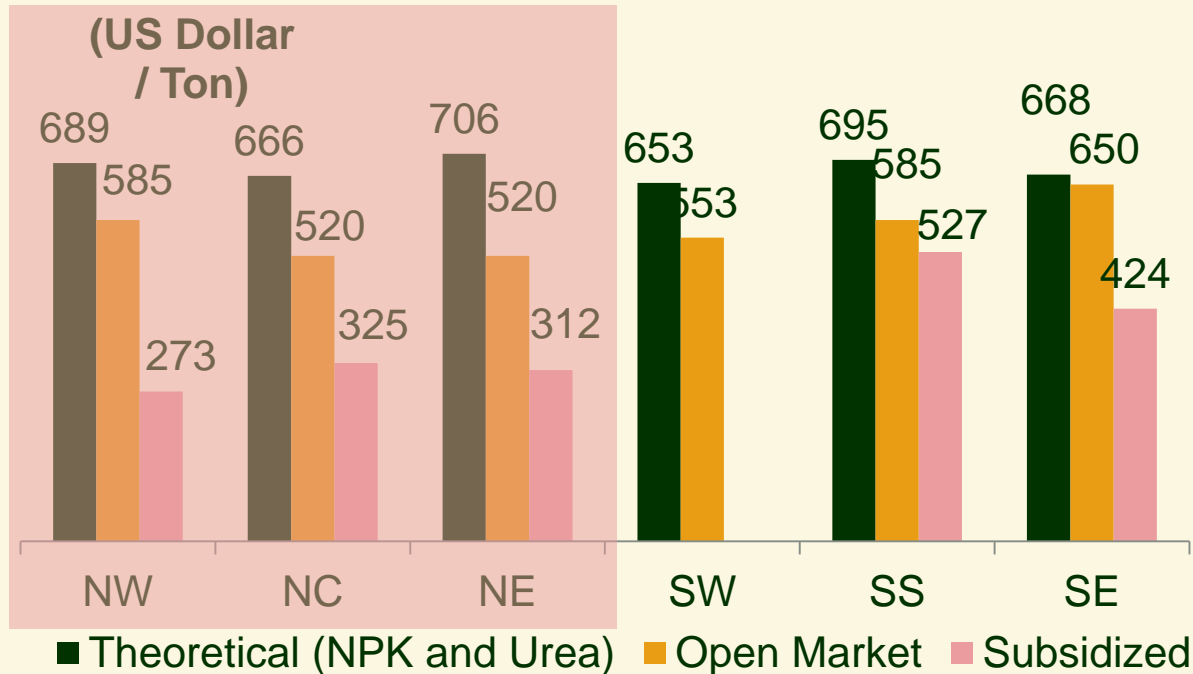
Data: National Household Surveys

- National Survey on Agricultural Export Commodities (NSAEC) (2003, 2006, 2007) – pseudo-panel
- LSMS:ISA data (2010) – cross section

Methods

- Similar to Xu et al. (2009), Ricker-Gilbert et al. (2011) except:
 - Endogenous commercial fertilizer price \leq affected by subsidy

Subsidy depressed commercial price



Lagos (entry port)

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

$$(\Pi_C, \Pi_G) = f(x) \quad \Rightarrow \text{Obtain } \lambda \text{ (inverse mills ratio)}$$

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

$$T^* = f(x_G, x_C, \delta)$$

δ : 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:

$$\widehat{gr}_i = -\hat{\tau} 1[QFert_{si} = 0] \lambda(-Z_i \hat{\gamma}) + 1[QFert_{si} > 0] (QFert_{si} - Z_i \hat{\gamma})$$

Where $\hat{\tau}$ and $\hat{\gamma}$ are the Tobit MLEs and λ 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

	Old	New
Price discount mechanism	Fertilizer sold by public institutions at discounted price	Voucher given to targeted recipients
Subsidized quantity	Rationed at aggregate level	Quota at beneficiary level
Maximum subsidized quantity	About 0.5 million ton	About 0.5 million ton (5 million farmers * 100 kg)
Subsidy rate	25% Federal + 0 ~ 50% State subsidy rates	Similar to old scheme
Fertilizer distribution	Subsidized - Government Un-subsidized – Private sector	Private sector

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