The effects of the National Agricultural Input Voucher Scheme (NAIVS) on sustainable intensification of maize production in Tanzania

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Selected Poster prepared for presentation at the 2019 Agricultural & Applied Economics Association Annual Meeting, Atlanta, GA, July 21- 23

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1. Introduction & Main Contributions

- **Raising agricultural productivity is critical for meeting rising food demand in sub-Saharan Africa (SSA)**

- **Conventional agricultural intensification** via high-yielding crop varieties and inorganic fertilizer may be **insufficient to sustainably intensify agricultural production** (Petersen and Snapp, 2015)
- **Sustainable intensification (SI)** could be a possible solution. *SI = raising agricultural productivity from the same area of land over the long-term, while preserving or improving the natural resource base* (Pretty et al., 2011).
- But many SSA governments' **policies have focused on conventional intensification** – e.g., **via large scale input subsidy programs (ISPs)**
- **Yet the production and welfare effects of ISPs have been smaller** than expected due in part to **low crop yield response to inorganic fertilizer caused by poor soil quality** (Jayne et al., 2018; Burke et al., 2017)
- Joint use of inorganic fertilizer with other soil fertility management (SFM) practices (e.g., organic fertilizer and maize-legume intercropping) can help

➔ **Research question**: do **ISPs encourage or discourage such joint use?**

- **Main contributions:**
  - ✓ Previous studies (e.g., Holden and Lunduka, 2012; Koppmair et al., 2017; and Morgan et al., 2019) have focused on ISP impacts on SFM practices but not the key question of ***joint* use with inorganic fertilizer**
  - ✓ We focus on **Tanzania** (previous studies focus on Malawi & Zambia)

2. NAIVS

- Implemented by the Tanzanian government with financial support from the World Bank from 2008/09-2013/14
- A key example of a **"smart" subsidy program that used vouchers redeemable at private agro-dealers' shops**
- **Each beneficiary to receive 3 vouchers for 3 years:** (1) 50-kg bag of urea, (2) 50-kg bag of DAP or two 50-kg bags of Minjingu Rock Phosphate with N supplement, & (3) 10 kg of hybrid or OPV maize seed or 16 kg of rice seed
- **Many beneficiaries received less than the full suite** of vouchers **but most beneficiaries redeemed the vouchers** they received (Table 1)

Table 1. Voucher receipt & redemption by sample HHs

Voucher(s)	% of beneficiaries receiving	% of recipients redeeming vouchers
Inorganic fertilizer only	66%	89%
Improved maize seed only	11%	83%
Both	23%	84%

Note: See Data section for details on data source and analytical sample.

3. Data and Methodology

- **Data**
  - ✓ Main data source: **2008/09 and 2012/13 waves of the Tanzania National Panel Survey (TNPS)**, a nationally-representative survey
    - ❖ Don't use 2010/11 wave due to inconsistency in NAIVS questions
  - ✓ Other important data sources:
    - ❖ Rainfall and soils data from NOAA and FAO
    - ❖ Constituency-level data from 2005 and 2010 presidential elections
- **Analytical sample**
  - ✓ **2,559 maize plots** cultivated by the balanced panel of maize-growing rural HHs interviewed in TNPS 2008/09 and 2012/13 (812 HHs/round)

- **Focus on 3 maize-related SFM practices important in Tanzania:** (a) **inorganic fertilizer**, (b) **organic fertilizer**, and (c) **maize-legume intercropping**
  - ✓ Group into 4 "SI categories" based on their potential to contribute to SI in maize-based systems: **None, Intensification, Sustainable, and SI**

Table 2. Maize SI categories and prevalence in Tanzania

Case	Inorganic fertilizer	Organic fertilizer	Maize-Legume Intercrop	# of maize plots	SI category	% of maize plots
1				1,159	**None**	45%
2	√			224	**Intensification**	9%
3		√		166	**Sustainable**	37%
4			√	699		
5		√	√	113		
6	√	√		50	**SI**	9%
7	√		√	147		
8	√	√	√	31		

- **Econometric approach**
  - ✓ **Multinomial logit (MNL) regression of plot-level SI category** on NAIVS voucher receipt (or redemption) & other explanatory variables
  - ✓ **Correlated random effects (CRE)** to control for time-constant unobserved heterogeneity
  - ✓ **Control function approach** using two IVs: electoral threat (Chang, 2005) and the number of fertilizer vouchers distributed to HH's region

4. Results

Table 3. APE of NAIVS voucher on use of each SI category (CRE-MNL)

Maize input voucher type	NAIVS voucher *receipt*				NAIVS voucher *redemption*			
	N	I	S	SI	N	I	S	SI
Panel A								
Any input	**-0.21***	**0.10***	0.02	**0.09***	**-0.21***	**0.10***	0.01	**0.10***
Panel B								
Inorganic fertilizer	**-0.25***	**0.10***	0.05	**0.10***	**-0.22***	**0.10***	0.02	**0.10***
Maize seed	-0.03	0.01	0.02	-0.00	-0.10	0.04	0.02	0.04

Notes: N, I, and S denote "None", "Intensification", and "Sustainable", respectively. * indicates that the APE is significant at the 1% level.

Table 4. APE of NAIVS voucher on use of inorganic fertilizer with maize-legume intercropping (Panel A) vs. organic fertilizer (Panel B)

Maize input voucher type	NAIVS voucher *receipt*				NAIVS voucher *redemption*			
Panel A	**None**	**Inorganic fertilizer**	**Mz-Leg IC**	**Both**	**None**	**Inorganic fertilizer**	**Mz-Leg IC**	**Both**
Inorganic fertilizer	**-0.19***	**0.12***	-0.01	**0.08***	**-0.19***	**0.12***	-0.01	**0.08***
Panel B	**None**	**Inorganic fertilizer**	**Organic fertilizer**	**Both**	**None**	**Inorganic fertilizer**	**Organic fertilizer**	**Both**
Inorganic fertilizer	**-0.22***	**0.16***	0.03	**0.03***	**-0.21***	**0.16***	0.01	**0.04***

Note: * indicates that the APE is significant at the 1% level.

5. Key Findings & Policy Implications

- Table 3: Participation in NAIVS, particularly receipt/redemption of a **NAIVS fertilizer voucher**, appears to encourage farmers' sole use of inorganic fertilizer **("Intensification")** as expected **but also joint use of inorganic fertilizer with other SFM practices ("SI") on a given maize plot**
- Table 4: Receipt/redemption of a **NAIVS fertilizer voucher** has a **positive effect on joint use of inorganic fertilizer with each "Sustainable" SFM practice: maize-legume intercropping** (Panel A) **& organic fertilizer** (Panel B)

➔ **Positive signs for the longer-term impacts of NAIVS on soil health**

- **Inorganic fertilizer use much less prevalent in Tanzania** than in Malawi or Zambia before each country implemented "second generation" ISPs in the 2000s. Prior to NAIVS, **Tanzanian farmers** relied mainly on organic sources of soil fertility → **may view inorganic fertilizer (incl. from NAIVS) as a complement to,** rather than a substitute for, **these practices**.
- Further research is needed on **changes that could be made to NAIVS-like ISPs to further incentivize SI**

Acknowledgements: This study was made possible by the generous support of the American People provided to the Feed the Future Innovation Lab for Sustainable Intensification [grant number AID-OAA-L-14-00006] and the Feed the Future Innovation Lab for Food Security Policy [grant number AID-OAA-L-13-00001] through the United States Agency for International Development (USAID). This work was also supported by the US Department of Agriculture (USDA) National Institute of Food and Agriculture and Michigan AgBioResearch [project number MICL02501].

References

- Burke, W.J., Jayne, T.S., and Black, J.R. 2017. Factors explaining the low and variable profitability of fertilizer application to maize in Zambia. *Agricultural Economics* 48(1):115-126.
- Chang, E. 2005. Electoral incentives for political corruption under open-list proportional systems. *The Journal of Politics* 67(3):716-730.
- Holden, S., and Lunduka, R. 2012. Do fertilizer subsidies crowd out organic manure? The case of Malawi. *Agricultural Economics* 43(3):303-314.
- Jayne, T.S., Mason, N.M., Burke, W.J., and Ariga, J. 2018. Review: Taking stock of Africa's second-generation agricultural input subsidy programs. *Food Policy* 75:1-14.
- Koppmair, S., Kassie, M., and Qaim, M. 2017. The influence of farm input subsidies on the adoption of natural resource management technologies. *Australian Journal of Agricultural and Resource Economics* 61(4):539-556.
- Morgan, S., Mason, N.M., Levine, N.K., and Mbata-Zulu, O. 2019. Dis-incentivizing sustainable intensification? The case of Zambia's maize-fertilizer subsidy program. *World Development* 122: 54-69.
- Petersen, B., and Snapp, S. 2015. What is sustainable intensification? Views from expert. *Land Use Policy* 46:1-10.
- Pretty, J., Toulmin, C. and Williams, S. 2011. Sustainable intensification in African agriculture. *International journal of agricultural sustainability* 9(1): 5-24.