Heterogeneous Constraints and Incentives and the Uptake of Agricultural Innovations by Smallholder Farmers

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Poor but efficient revisited

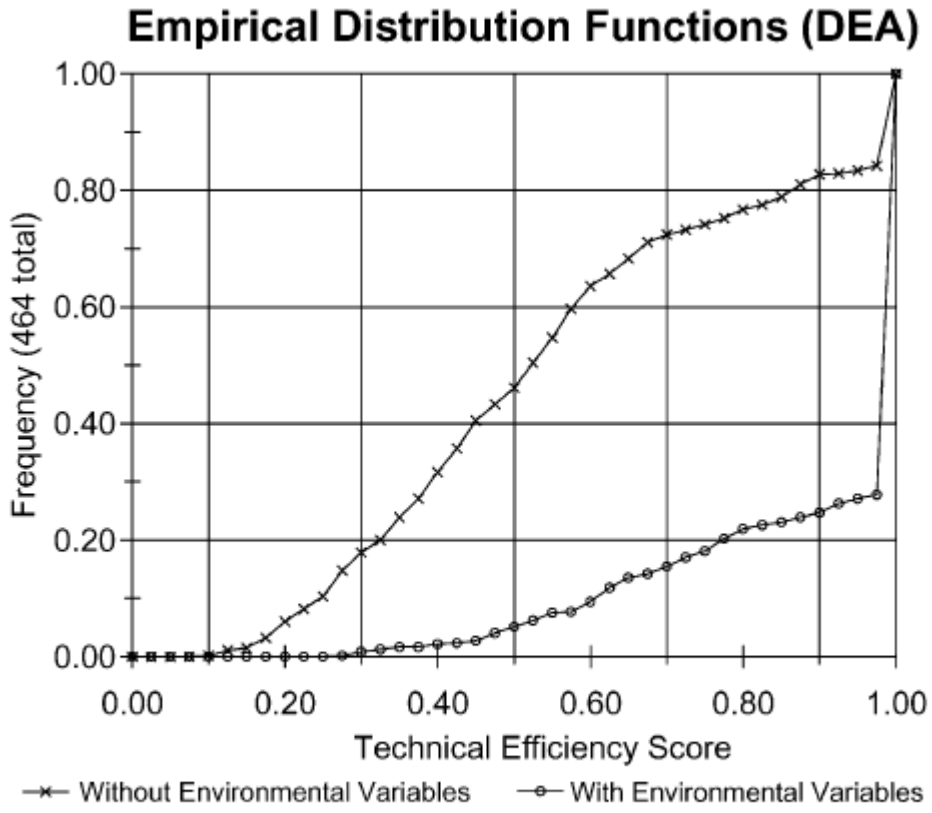

Fig. 2. Distribution functions for estimated plot-specific technical efficiencies.

Observations of smallholder inefficiency often reflect failure to control for nature.

Ex: Ivorien rice farmers – median is at the production frontier w/ control for soils, rain, pests, etc. vs. 52% w/o

(Sherlund, Barrett & Adesina *JDE* 2002)

So perhaps non-uptake is optimal as well??

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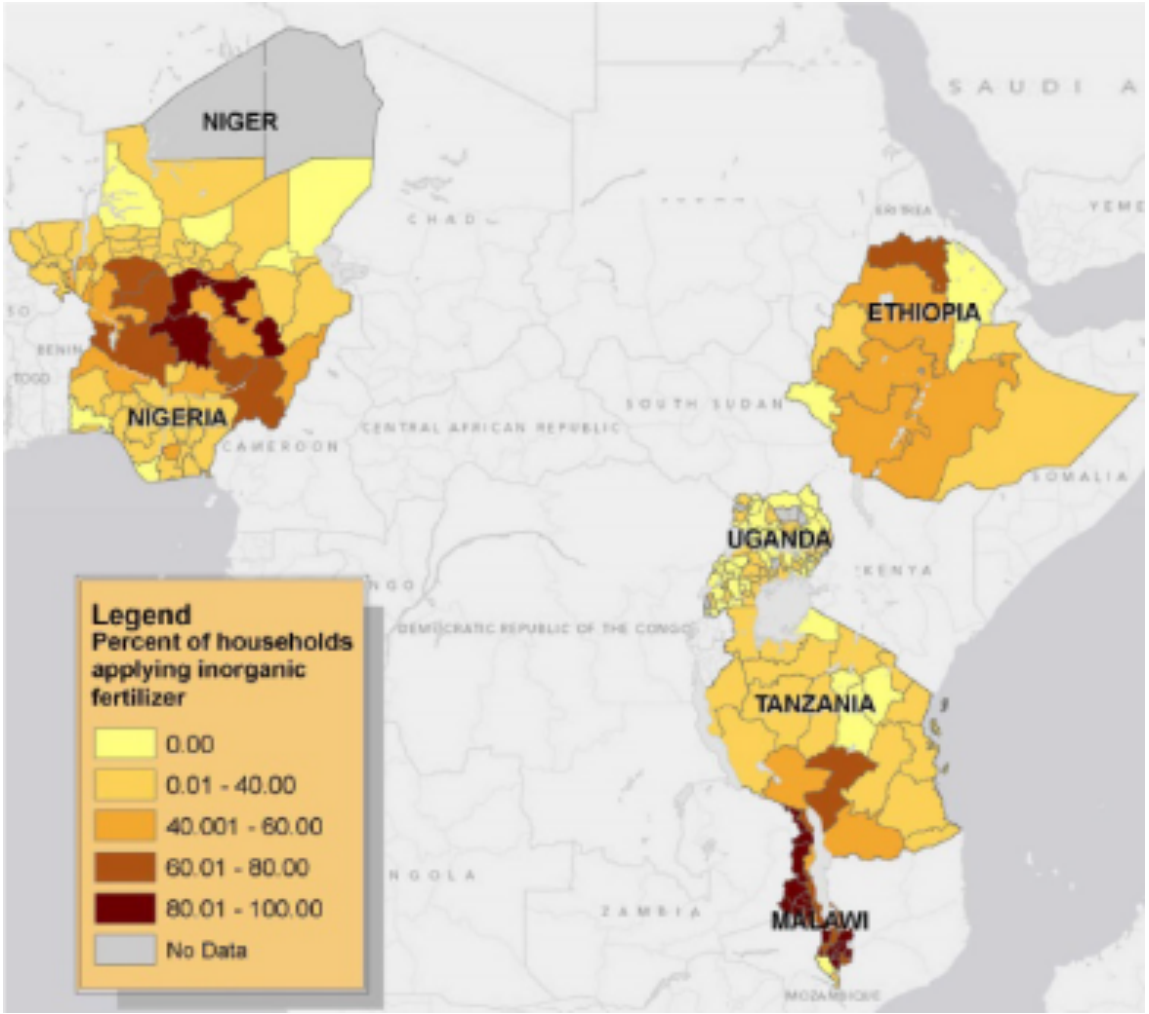
Heterogeneous uptake of innovations



LSMS-ISA data show that uptake of modern ag inputs varies markedly.

Within-country variation

(Sheahan & Barrett, *FP* in press)

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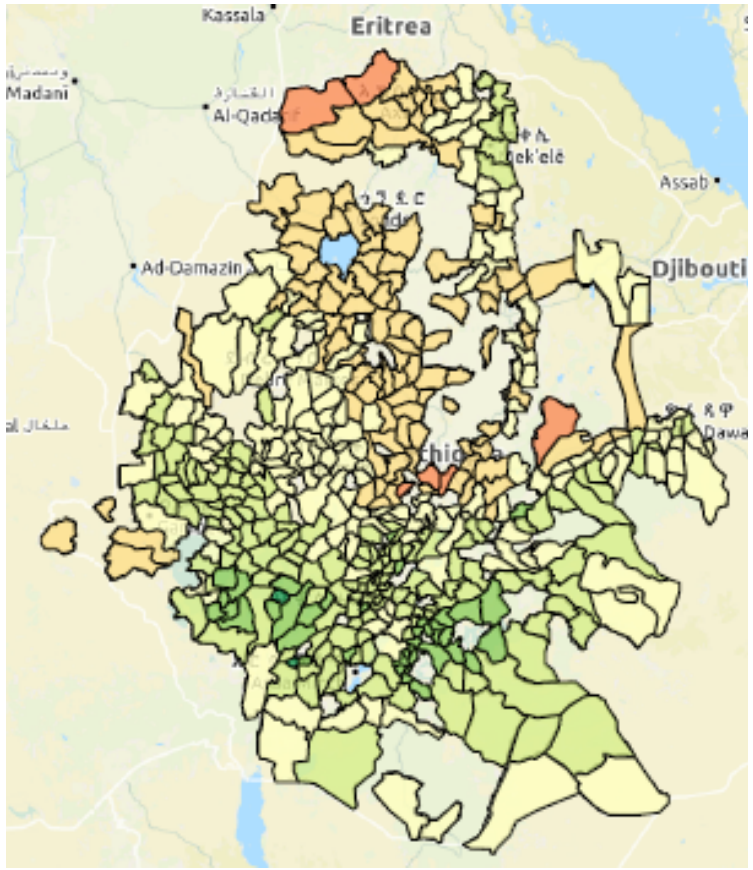
Likely reflects heterogeneous returns

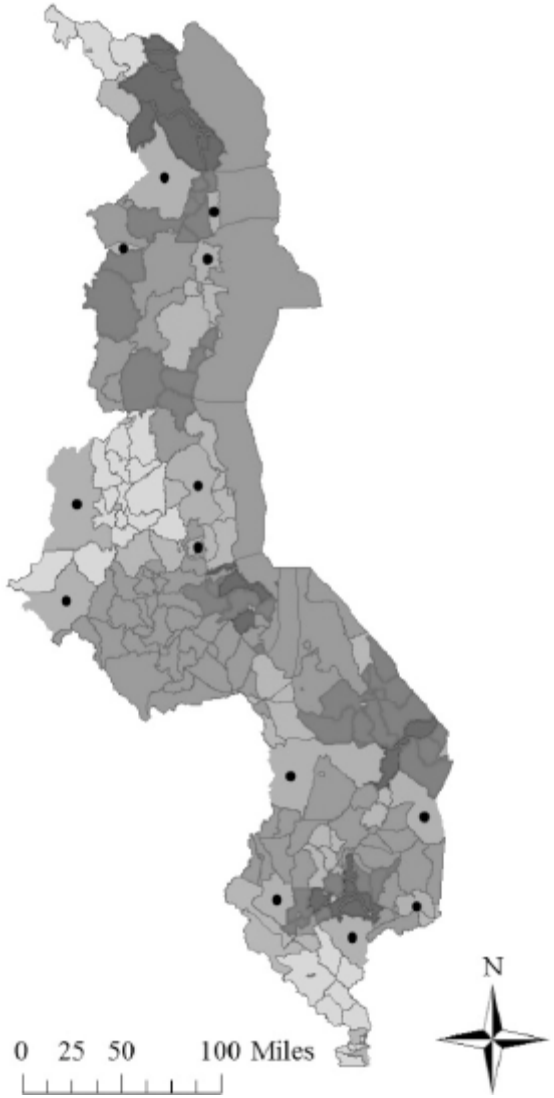


Suri (EMTRA 2011) –
Kenya hybrid maize seed

McCullough et al. (2016 WP) -
Ethiopia fertilizer

Harou et al. (JAfrEcon in press) -
Malawi fertilizer

etc.



https://www.ag-analytics.org/AgRiskManagement/EthiopiaGeoApp

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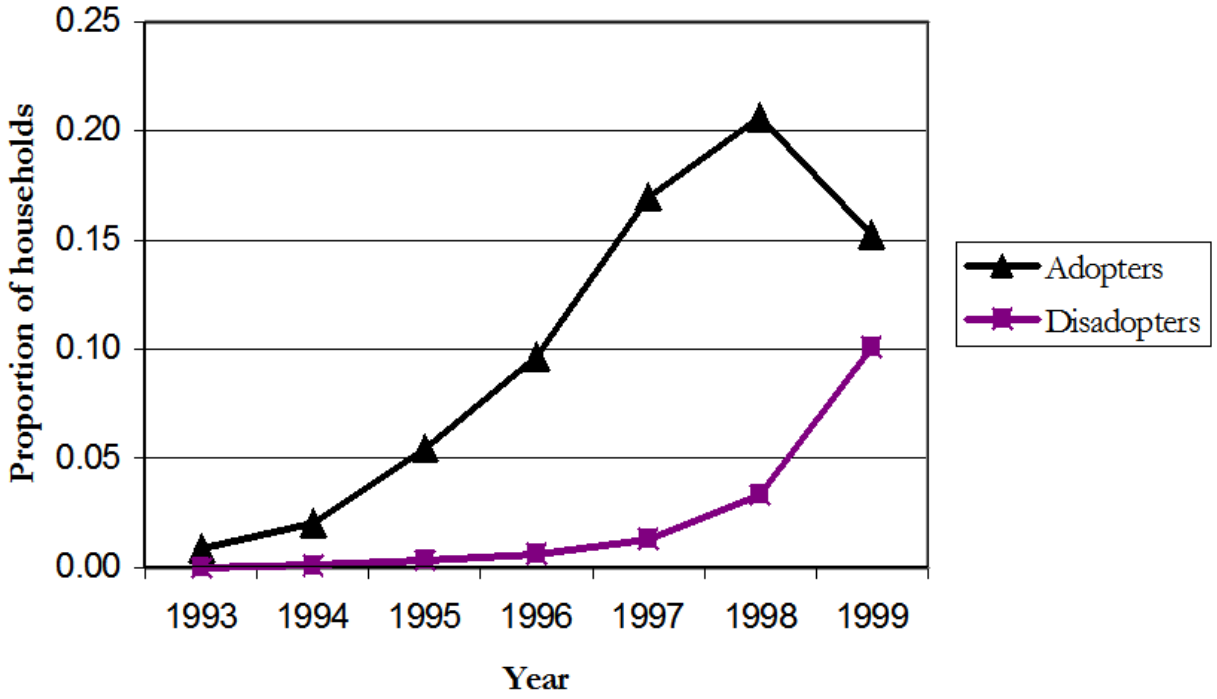
And disadoption rates often high

Example:

SRI in spite of 60-80% yield gains

- Haiti (Turiansky WP 2016)
- Indonesia (Takahashi & Barrett *AJAE* 2014)
- Madagascar (Moser & Barrett *AgEcon* 2006)

SRI adoption-disadoption in Madagascar



Moser & Barrett *AgEcon* 2006

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WHY? 1. Nature's complementary inputs

The profitability of modern ag inputs commonly depends on natural endowments:

- Soil quality
  - Soil organic carbon, other nutrients, Ph (Marenya & Barrett *AJAE*/*AgEcon* 2009, Suri *EMTRA* 2011, Harou et al. *Ag Econ* in press, Burke et al. Ag Econ 2016, Harou et al. *JAfrEcon* in press)
  - Within-village variability in soil quality also impedes learning (Tjernstrom WP 2015)
  - VCR in Ethiopia (McCullough et al. WP 2016)
- Water (irrigation, rainfall, soil water retention capacity, evapotranspiration)
- Temperature, altitude and growing season length
- Biotic and abiotic stresses (e.g., aluminum, iron, salt, striga)

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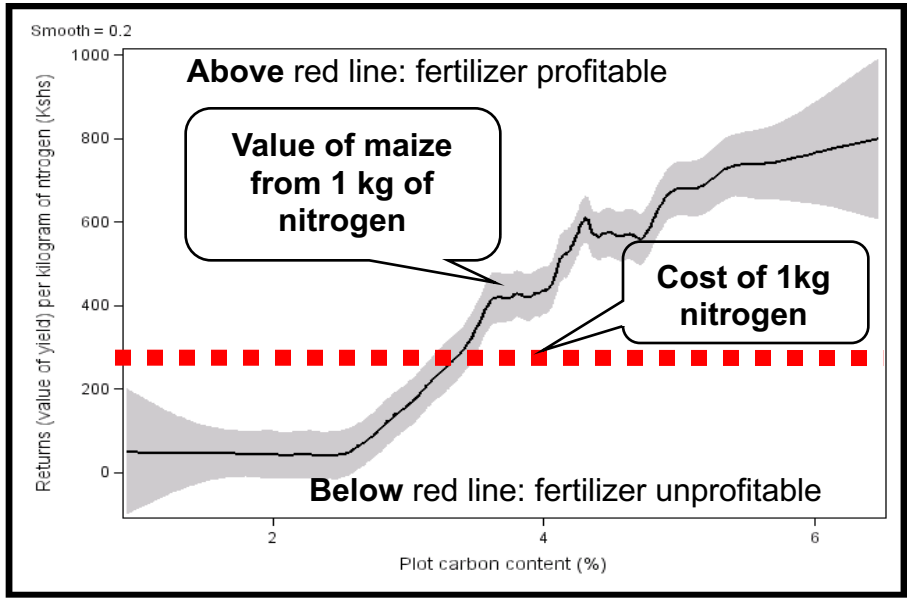
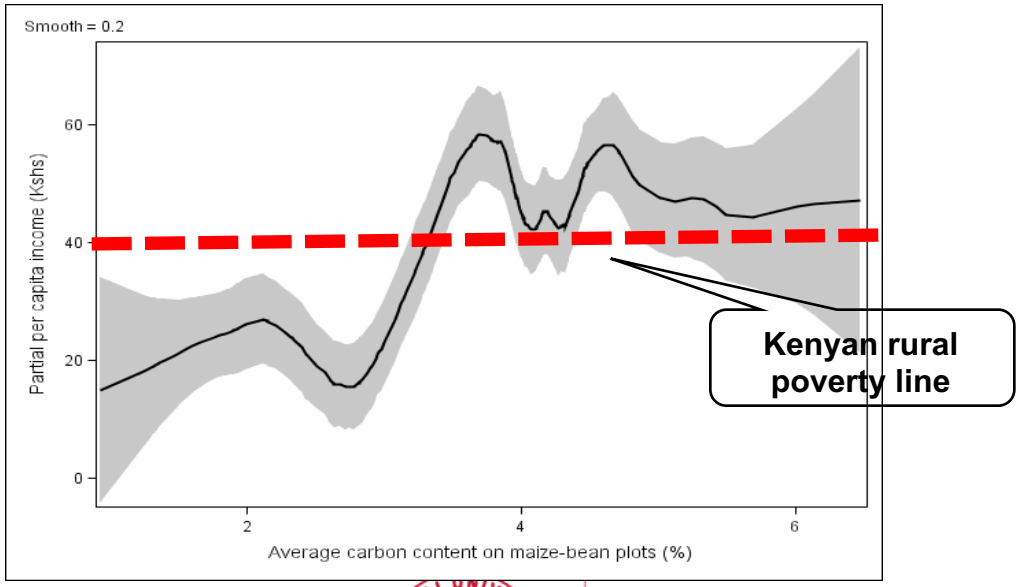
1. Nature's complementary inputs

The profitability of modern ag inputs commonly depends on natural endowments:

Example: Soil degradation in Kenya Marginal returns to fertilizer application low on degraded soils; and poorest farmers are on the most degraded soils. Soil degradation also feeds a striga weed problem that discourages uptake ($7bn/yr in crop losses).





Marenya & Barrett *AJAE* 2009

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2. Labor availability

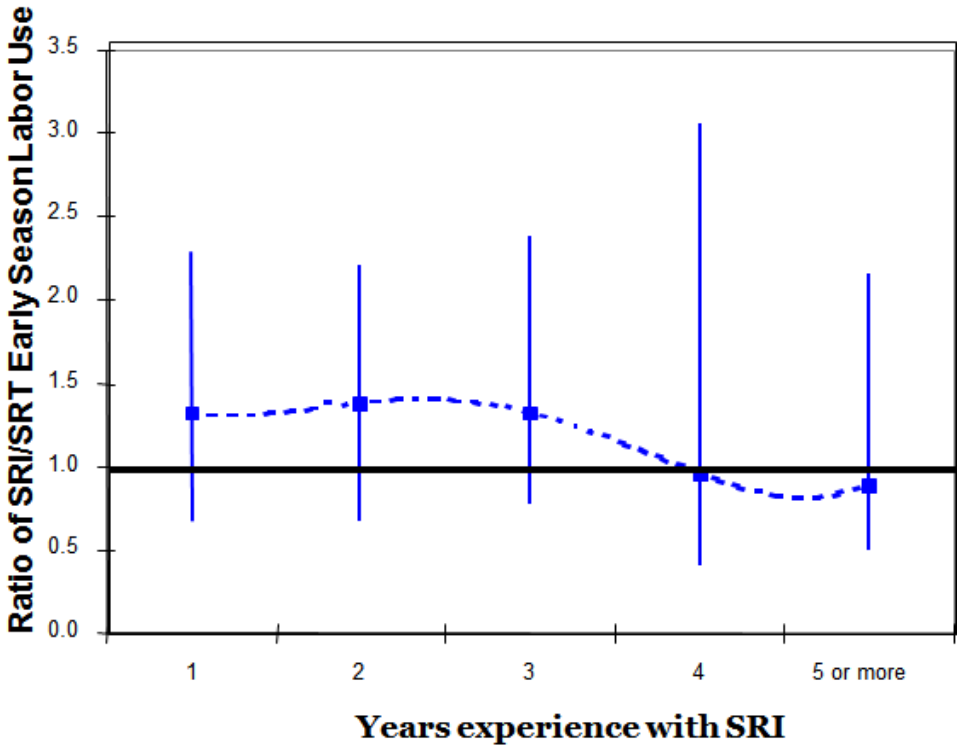
Many agricultural innovations also require labor availability (hh or hired).

Examples:

SRI (Haiti, Madagascar, Indonesia, Timor Leste – Moser & Barrett *Ag Econ* 2006; Notlze et al. *AgSys* 2012; Takahashi & Barrett *AJAE* 2014, Turiansky WP 2016)

Mucuna (Honduras, Neill & Lee *EDCC* 2001)

Herd splitting (Toth *AJAE* 2014)



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3. Gender

Male-run plots more likely to use modern inputs (Sheahan & Barrett *FP* in press).

Returns to inputs appear lower for female farmers (due to social norms on labor and market access, etc.)

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4. Market access and prices

Market access:

Transport costs and reliable access to intermediaries drive input/output prices

Omamo (AJAE 1996)

Fuel prices have a big impact on food prices (Dillon & Barrett *AJAE* 2016)

Burkina Faso school feeding program and cowpeas (Harou et al. *WD* 2013) – trader seasonality, market access and bulking

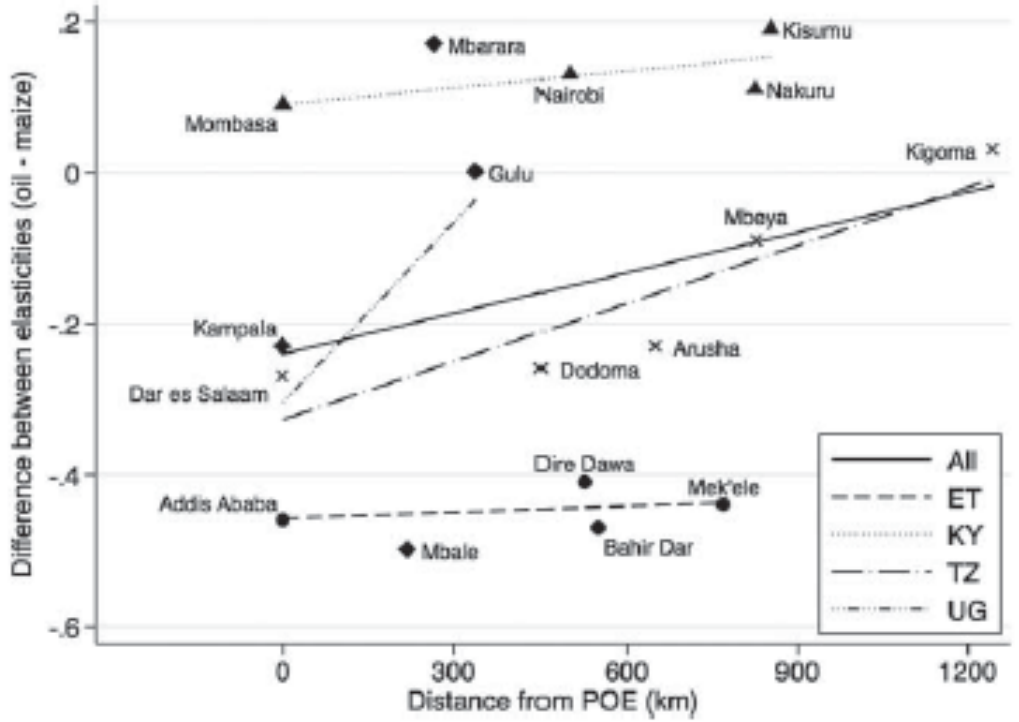

Figure 4. (Elasticity of local maize to global oil) – (Elasticity of local maize to global maize) plotted against distance from POE

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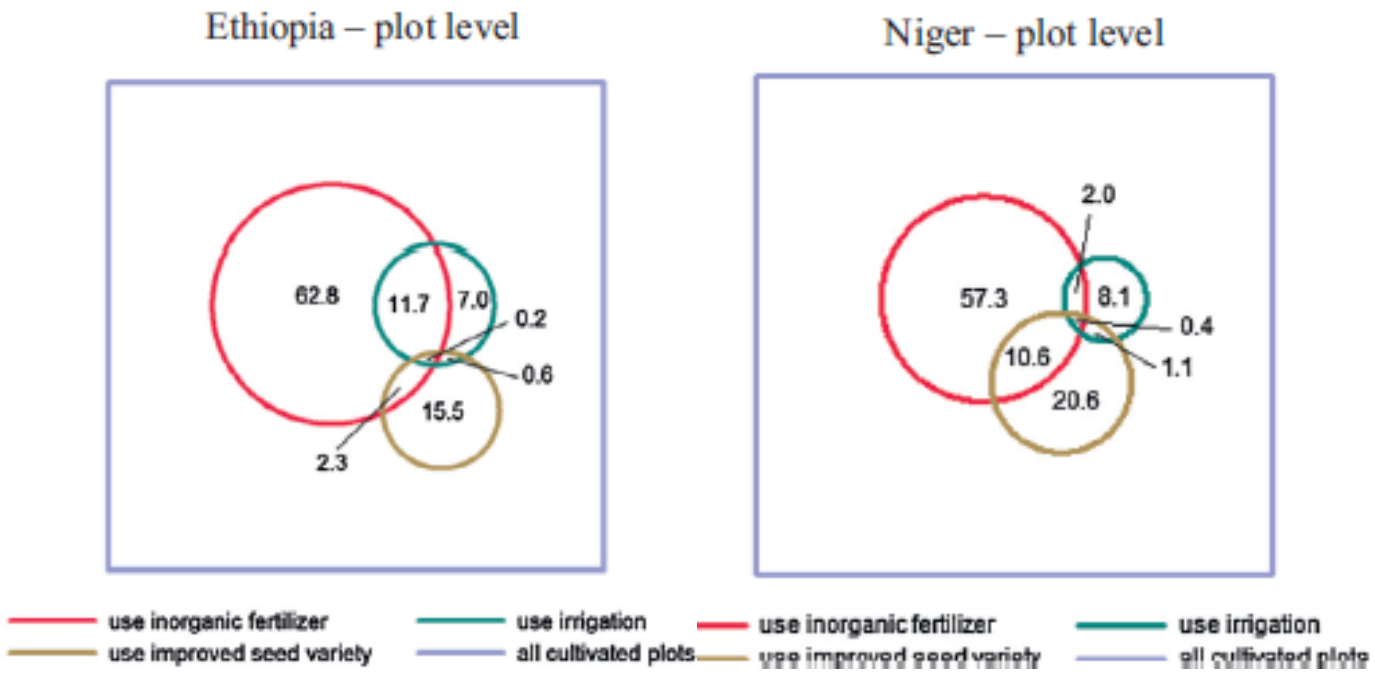
Two puzzles: Uneven adoption within hhs
1 - Limited joint input application

LSMS-ISA data show little joint uptake of modern ag inputs despite agronomic synergies and contrary to ISFM principles.

(Sheahan & Barrett, *FP* in press)



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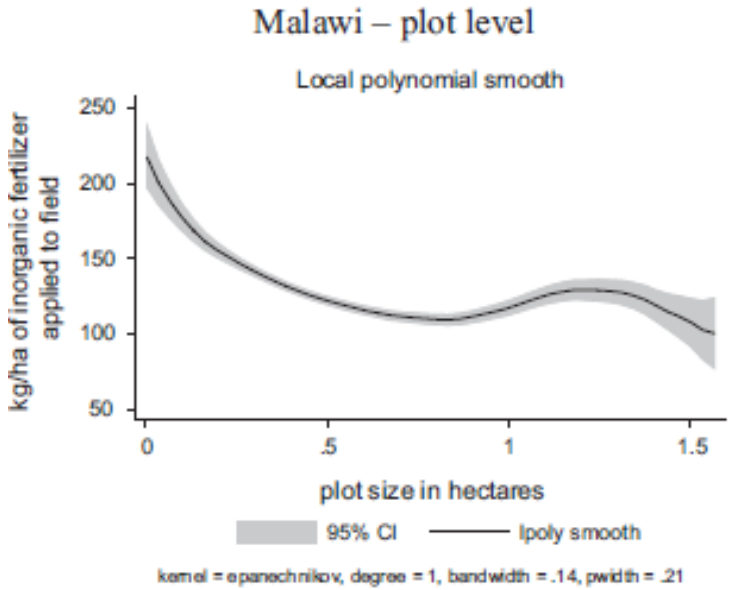
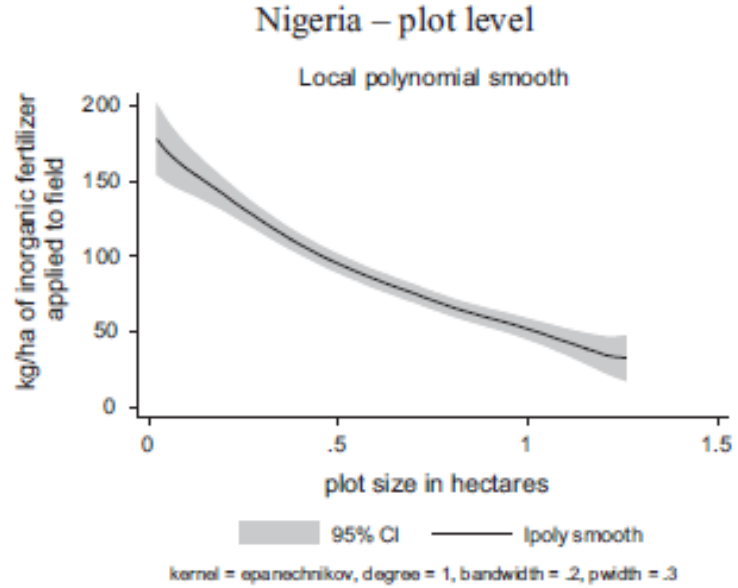
2 - Plot-level inverse size-productivity relation





Plot-level input application and productivity varies inversely w/plot size. True *within-hh* and w/controls for soil quality and actual size, so *not* due to ORV, measurement error, or heterogeneous shadow prices.

Adoption varies even w/n hh … why?

Edge effects hypothesis?

(Barrett, Bellemare & Hou *WD* 2010; Carletto, Savastano & Zezza *JDE* 2013; Sheahan & Barrett, *FP* in press; Bevis & Barrett, 2016 WP)

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Key implications

1. Context matters

- Best technologies vary among farmers … one size fits all rarely works
- Agroecological niches are extremely important
- Physical and institutional infrastructure likewise important
- Lots of focus on technological innovation … but adaption to agro-ecological niches is equally important
  - Requires adequate local applied scientific research capacity
  - Requires companies with incentive to invest in adaptive research

Key implications

2. Bundled approaches often needed

- Multiple constraints often bind (nested or simultaneously)
- Success of BRAC ultra-poor programs (Bandiera et al. WP 2016, Banerjee et al. *Science* 2015)
- Address market access and modern inputs simultaneously (e.g., sugar farms in Kenya; contract farming in many countries)

Thank you for your interest and comments!

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