Adoption of maize technology bundles: Implications on productivity and food Security

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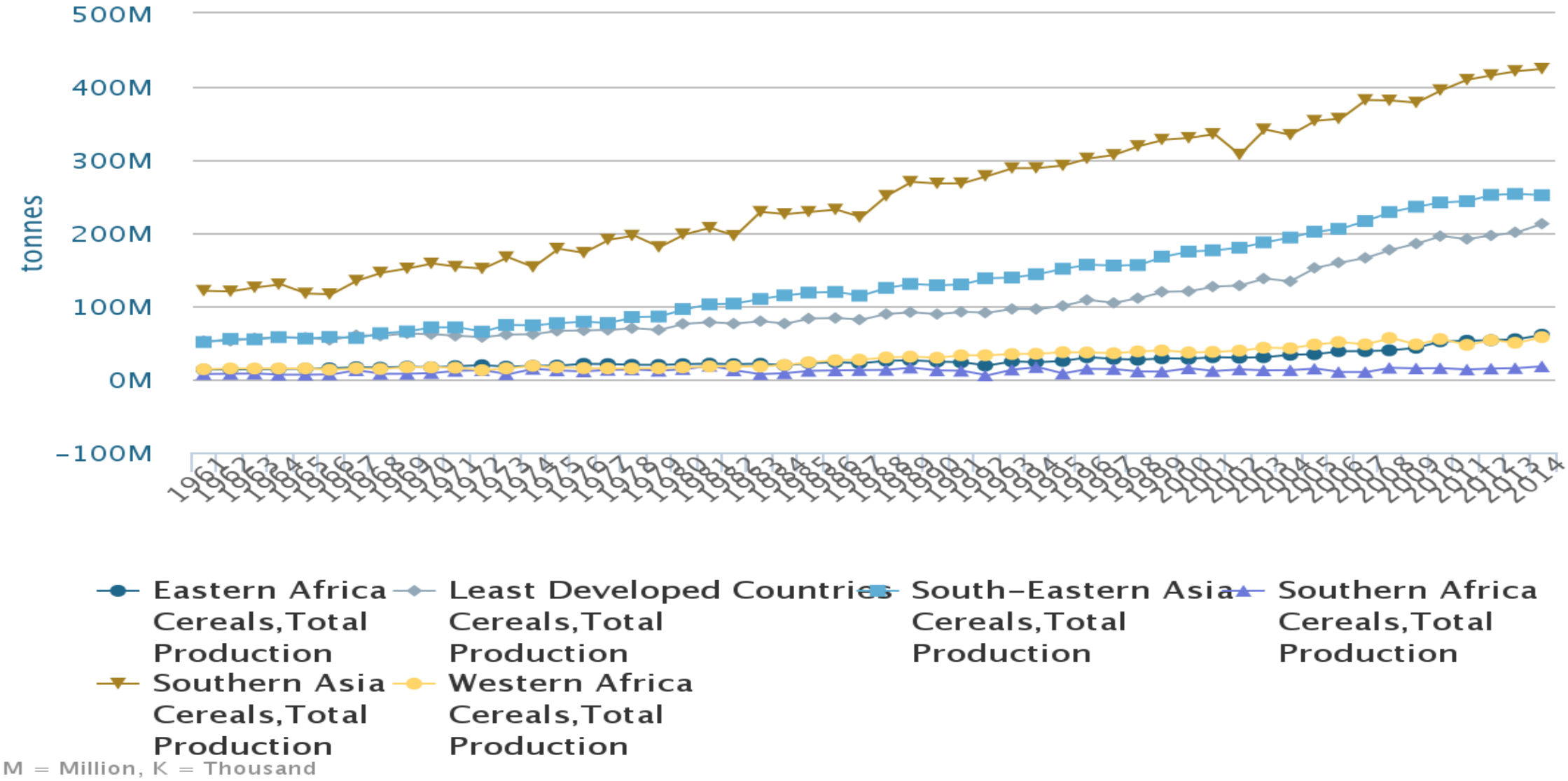
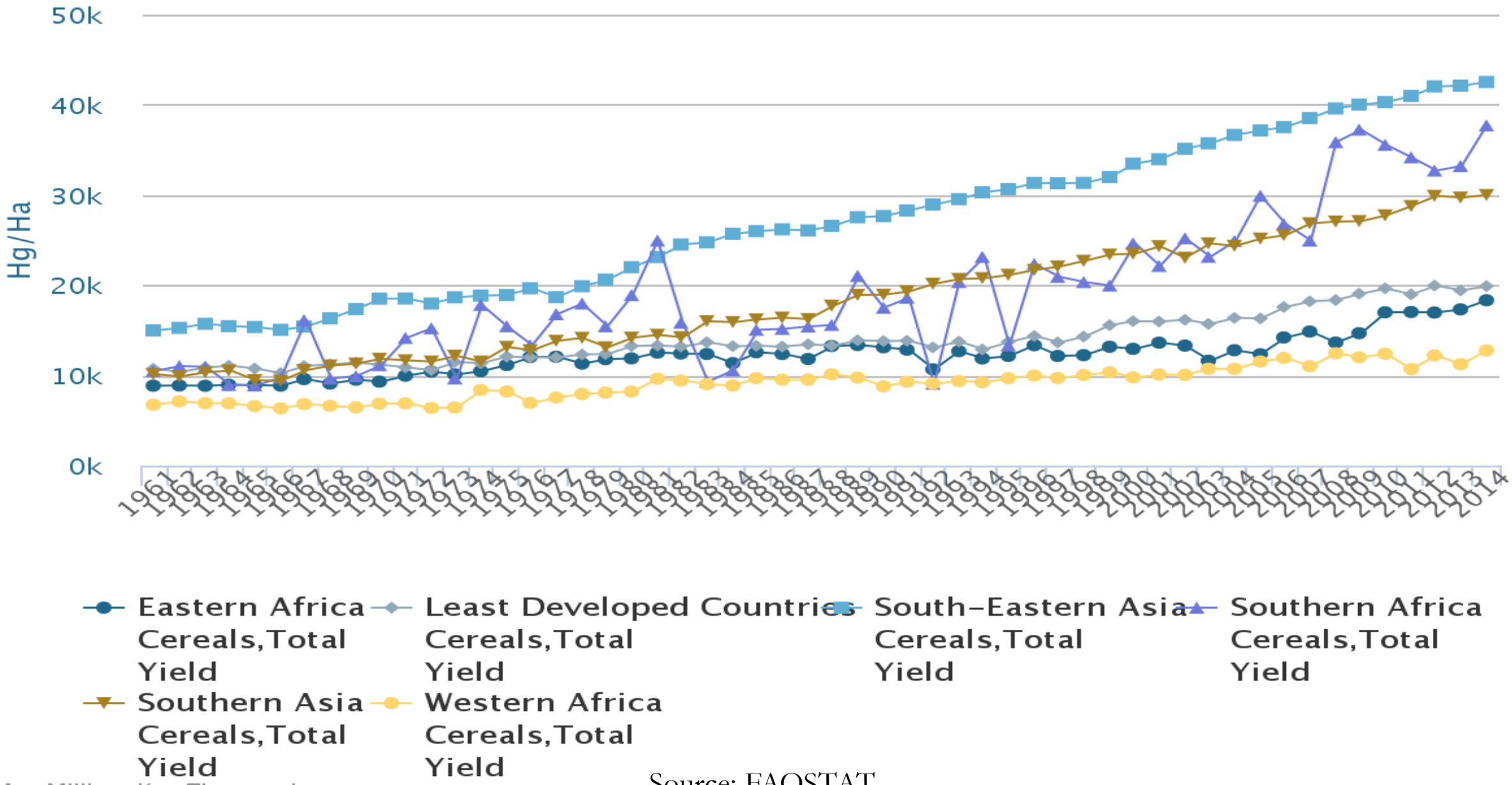
Introduction



Source: FAOSTAT

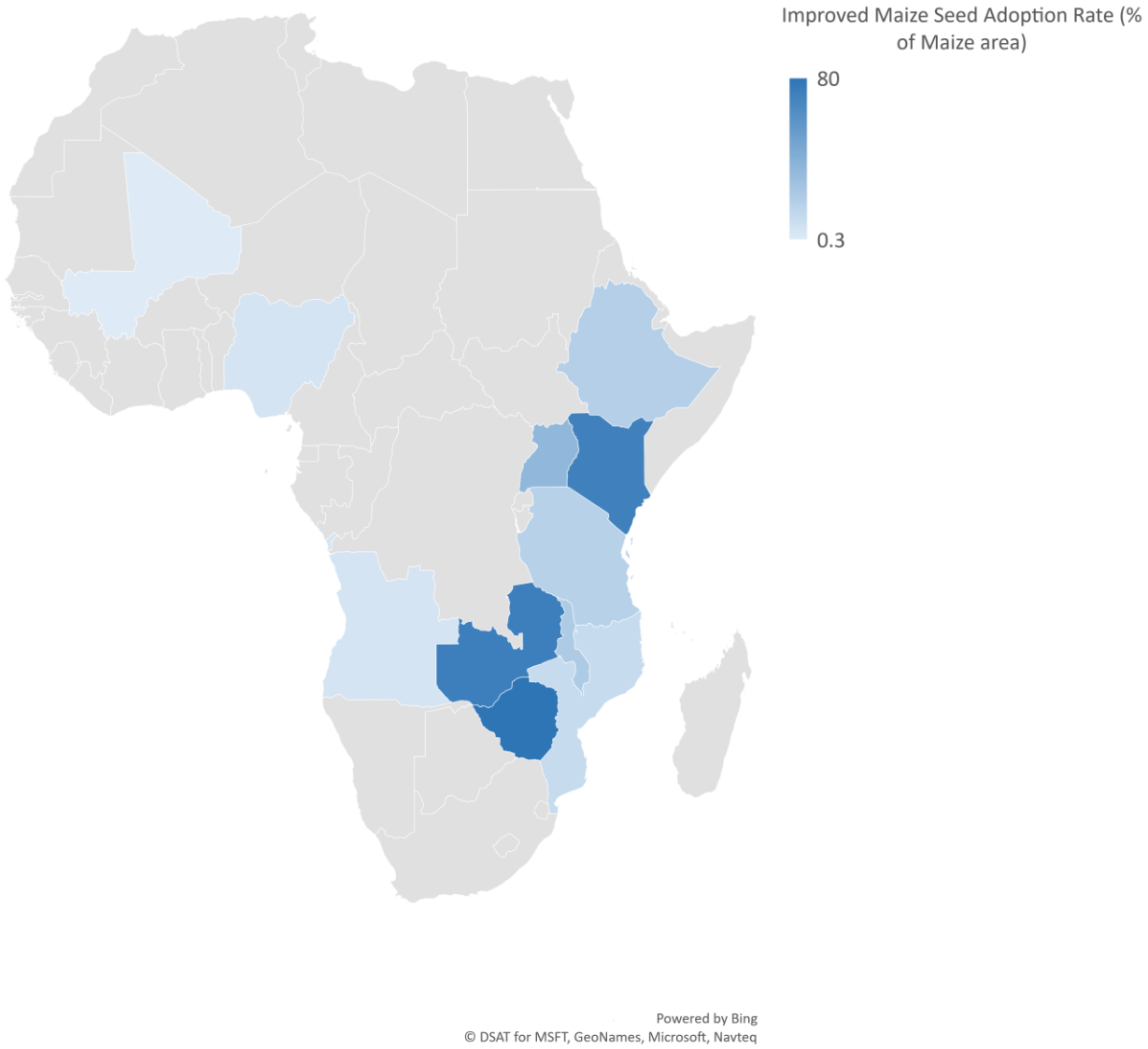
Introduction



Source: FAOSTAT

Adoption of Improved Maize Seed in SSA

	Average Area (million ha) 1990-2007	Improved Maize Seed Adoption Rate (% of Maize area)
Eastern Africa	6.6	33
Southern Africa	5.4	38



Source: Langyintuo et al (2010)

Motivation

- Recent studies show positive impact of technology adoption on income, poverty & food security (Asfaw et al, 2012; Magrini & Vigani, 2014; Mathenge et al., 2014; Khonje et al., 2015)
- However, this studies have looked at technology adoption singly e.g. adoption of improved seed or fertilizer
- Most of these studies have looked at impacts on production & income with the exception of Magrini & Vigani (2014)

Motivation

- In practice, these technologies are used jointly/package (Byerlee and Hesse, 1982)
- There exists systematic or stochastic interdependence for adoption for various choices (Smale and Heisey, 1993)

- Important to consider other indicators of household welfare
  - Food security and nutrition indicators
- This study introduces technology bundles
  - How different technologies interact and complement each other

Motivation

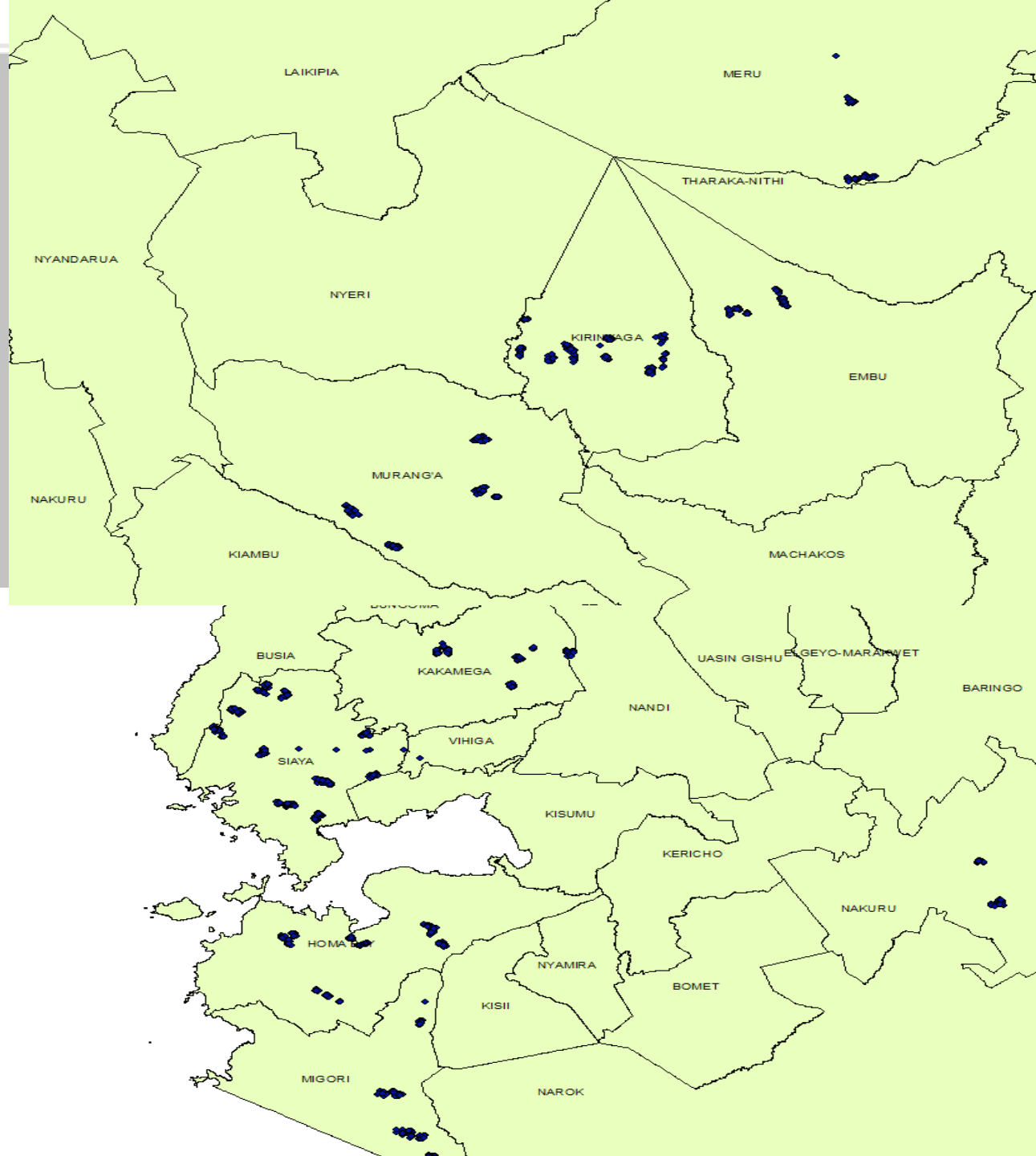
- How different technologies interact and complement each other
  - Combination of improved seed & fertilizer

Key questions:

- What are the drivers of different technology bundles?
- How do adoption of technology bundles impact productivity & food security?
- Use the case of maize farmers in Kenya

Data

- 1,800 maize growing HH
  - Study areas in Mid-altitude areas in Kenya
    - Western region
    - Central region
  - Three wave panel data (2013, 2015 and 2016)
  - Matched households (11% attrition)
  - Collected data
    - HH characteristics
    - Farm characteristics
    - Input use



Methods

- Estimate a choice model for adoption of technology bundles (MNL following Valletta, 1997)
  - Non Adopters (local varieties without inorganic fertilizer)
  - Fertilizer only (local varieties with inorganic fertilizer)
  - Improved seed only
  - Improved seed and inorganic fertilizer
- FE to estimate effect on key outcome variables
  - Productivity
  - Per capita output (food availability)
  - (FE Count regression) Dietary diversity (food intake)
  - Consumption coping strategy

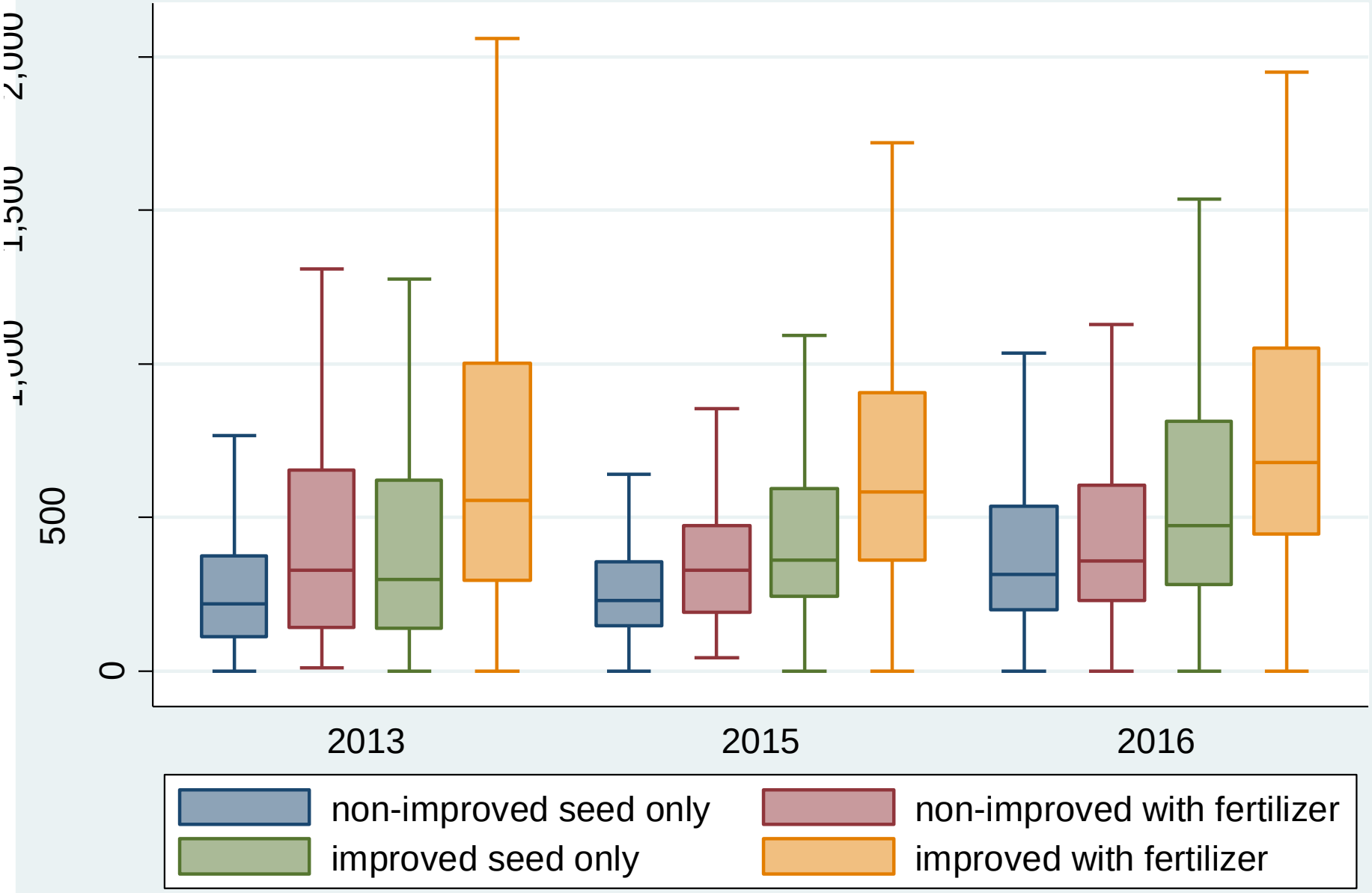
Farm Characteristics by year

Variables	2013	2015	2016
Total cultivated land (acres)	1.5	1.7	1.6
Proportion of land allocated to maize (%)	0.75	0.76	0.71
Proportion using Improved seed (%)	0.71	0.75	0.72
Seed use intensity (kgs/acre)	9.06	7.80	8.50
Proportion using inorganic fertilizers (%)	0.66	0.81	0.72
Fertilizer application rate (kg/acre)	32.0	34.5	33.2
Maize productivity (kgs/acre)	618	602	691

Characteristics by use of technology bundle -2016

Variable	Non-improved seed only	Non-improved + fertilizer	Improved seed only	Improved seed + fertilizer
Age of household head	56.9	54.5	53.1	52.3
Household size	5.3	5.8	5.9	5.5
Total cultivated land (acres)	1.5	1.5	1.6	1.7
Proportion of land allocated to maize (%)	0.8	0.8	0.7	0.7
Seed use intensity (Kg/acre)	9.9	10.0	8.0	7.9
Fertilizer application rate (Kg/acre)	-	22.8	-	34.7
Maize productivity (kgs/acre)	410	452	626	820
Crop Income (ksh/acre)	28,297	33,530	46,468	70,321

Yields by technology bundles across the years



Determinants of Choice of technology

Technology choices (non-improved seed used as base category)	Non-improved seed with fertilizer		Improved seed only		Improved seed with fertilizer	
Gender of head (1=male)	-0.49*	(-0.25)	-0.51	(-0.28)	-0.26	(-0.3)
Education level of head (base=no formal education)						
Primary education	0.11	(-0.3)	0.33	(-0.38)	0.5	(-0.4)
Secondary	0.3	(-0.38)	1.00*	(-0.47)	1.23*	(-0.49)
College and above	0.88	(-0.56)	1.76*	(-0.73)	2.33**	(-0.71)
Total arable land (acres)	0.1	(-0.08)	0.14	(-0.09)	0.30***	(-0.09)
Received credit dummy	0.12	(-0.19)	0.35	(-0.22)	0.56*	(-0.22)
Altitude (MASL)	0.01***	(0)	0.01***	(0)	0.01***	(0)
Visited demo plot dummy	0.49*	(-0.22)	0.38	(-0.25)	1.12***	(-0.24)
Geographical region (1=western)	-2.43***	(-0.41)	-2.82***	(-0.42)	-4.16***	(-0.44)
Time trend	1.18***	(-0.17)	0.52**	(-0.2)	1.64***	(-0.19)
Constant	-7.71***	(-1.86)	-6.50**	(-2.15)	-13.34***	(-2.08)

Effect on productivity

Technologies bundle	Yield (Agric. performance)	
	Coeff	Robust SE
Non-improved seed with fertilizer	42.16	(34.87)
Improved seed only	78.22	(49.31)
Improved seed with fertilizer	89.36**	(43.69)
Constant	-121.5	(433.6)

Effect on productivity & food security

Technologies bundle	Daily Per Capita Maize Output (Staple food availability)		Diet Diversity (Food intake)		Consumption Coping Strategy (Response to shock)	
	Coeff	Robust SE	Coeff	Robust SE	Coeff	Robust SE
Non-improved seed with fertilizer	27.07***	(8.061)	-0.003	(0.024)	-5.48*	(2.933)
Improved seed only	32.13***	(11.01)	-0.022	(0.023)	-1.67	(3.295)
Improved seed with fertilizer	35.27***	(9.545)	0.006	(-0.11)	-4.64	(2.975)
Constant	44.77	(79.08)			11.78	(22.76)

Conclusions & Implications

- Use of either improved seed or fertilizer can improve productivity & household food security
- Highest gains observed with improved seed & fertilizer bundle
  - Complementarity of technology
  - Use intensity of improved is okay but fertilizer is still low
- Constraints may exist
  - Knowledge
  - Finance
  - Gender
- Potentially affect how interventions aimed at improving productivity are structured
  - Bundling technologies has the greatest impact on productivity
  - Need also to consider constrains farmers face

Acknowledgement

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