Sustainable land management under rural transformation in Africa

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Rural Transformation in the 21st Century: The Challenges of Low-Income, Late-Transforming Countries

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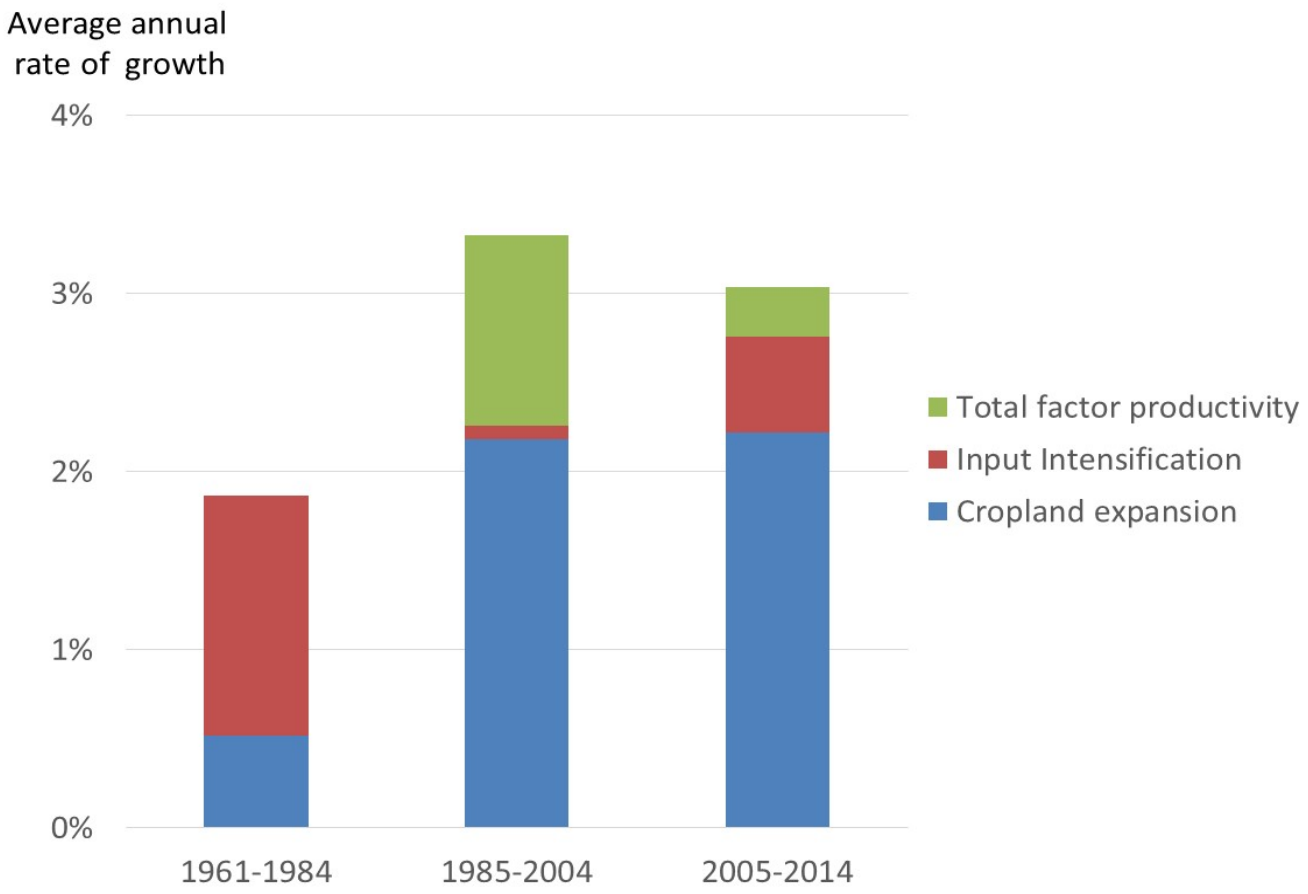
AFRICA'S AGRICULTURAL GROWTH STILL RELIES MAINLY ON CROPLAND EXPANSION, NOT ENOUGH ON PRODUCTIVITY GROWTH



Source: Economic Research Service, https://www.ers.usda.gov/data-products/international-agricultural-productivity/

Motivation

1. Land degradation a growing problem in Africa, and a drag on the region's development
2. Encouraging sustainable land management (SLM) crucial to rural development
3. Rural Africa undergoing rapid transformation – differently in different regions
4. The specific nature of rural transformation is affecting the viability of alternative SLM and entry points for promoting SLM

Objectives

1. To highlight salient changes underway in parts of rural Africa and consider how these transformations are influencing agricultural systems in the region
2. To partition rural Africa into four general categories and hypothesize how agricultural systems and incentives to adopt SLM are likely to evolve differently in each these four categories
3. To review recent literature to examine the extent to which these hypotheses are being borne out
4. To consider implications for policies and programs to promote SLM and sustainable agricultural intensification

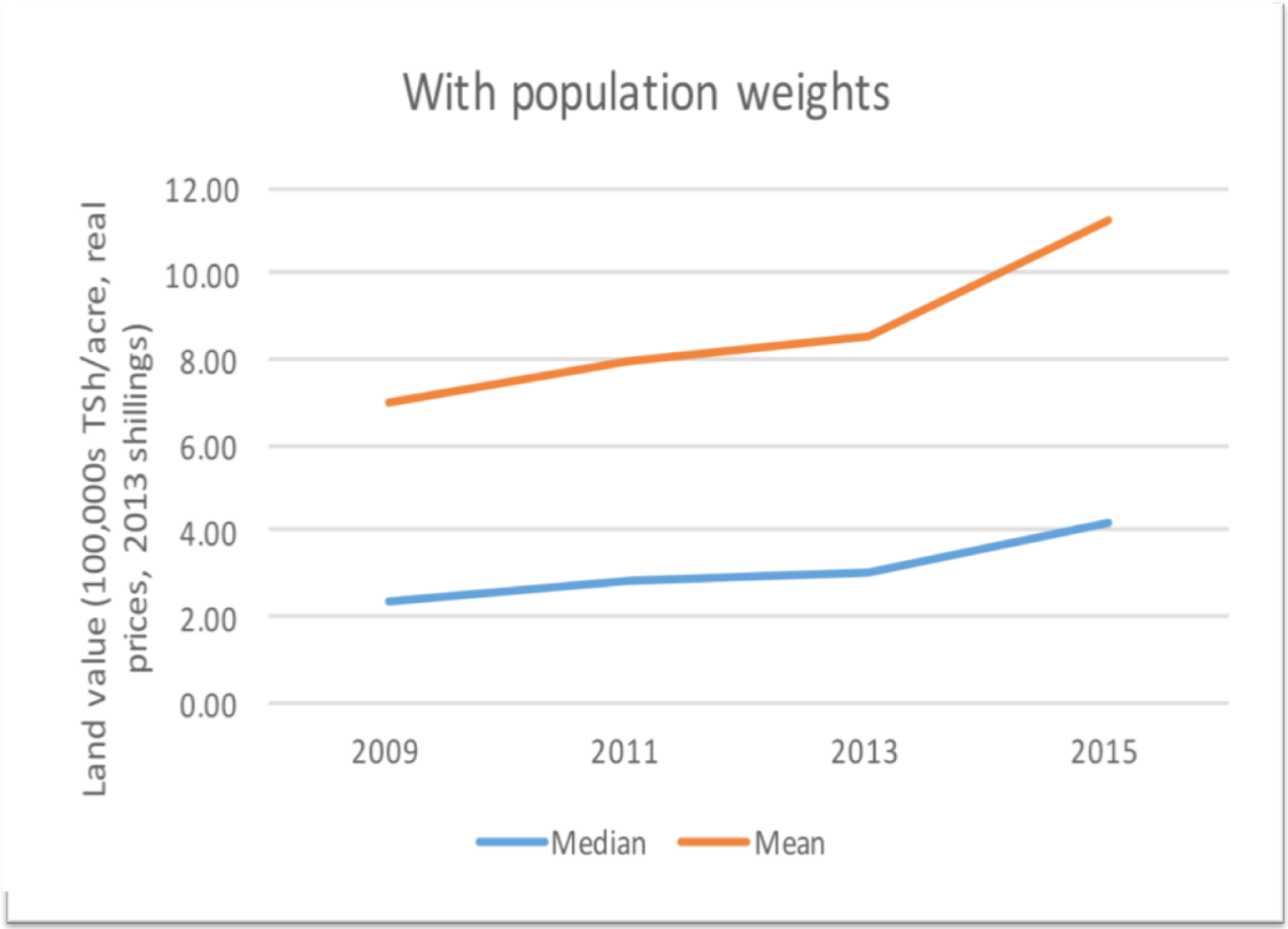
SIX UNMISTAKABLE SIGNS OF RURAL TRANSFORMATION IN SSA

1. Major growth in per capita incomes (Barrett et al., 2017)

   — greater ability to afford cash inputs

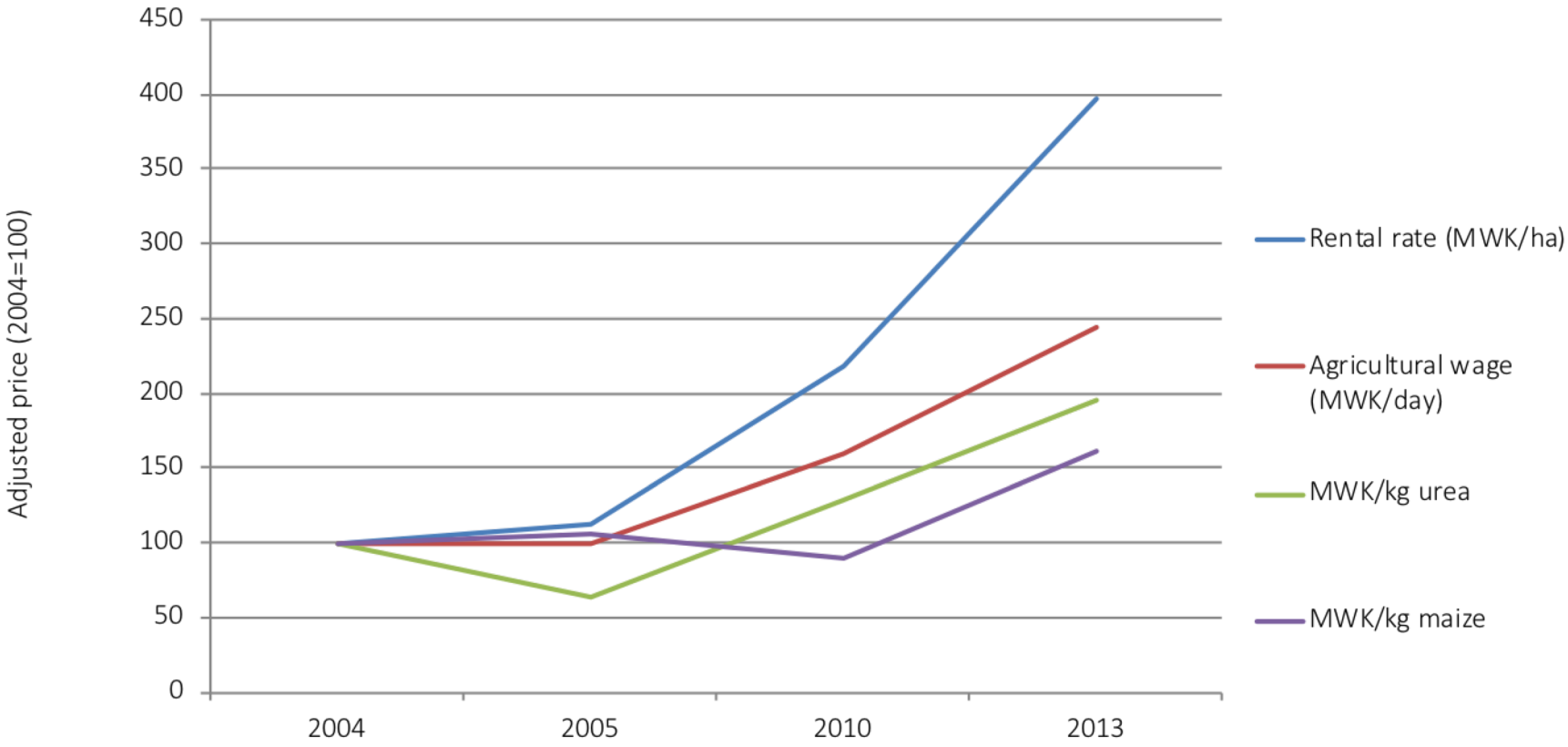
2. Rising land scarcity in many rural areas (Jayne, Chamberlin, Headey, 2014)

MEAN LAND PRICES IN RURAL TANZANIA : +53.9% IN REAL TERMS IN 6 YEARS



Source: LSMS 2009, 2011, 2013, 2015

OUTPUT AND FACTOR PRICE INDICES, RURAL MALAWI, 2004-2013

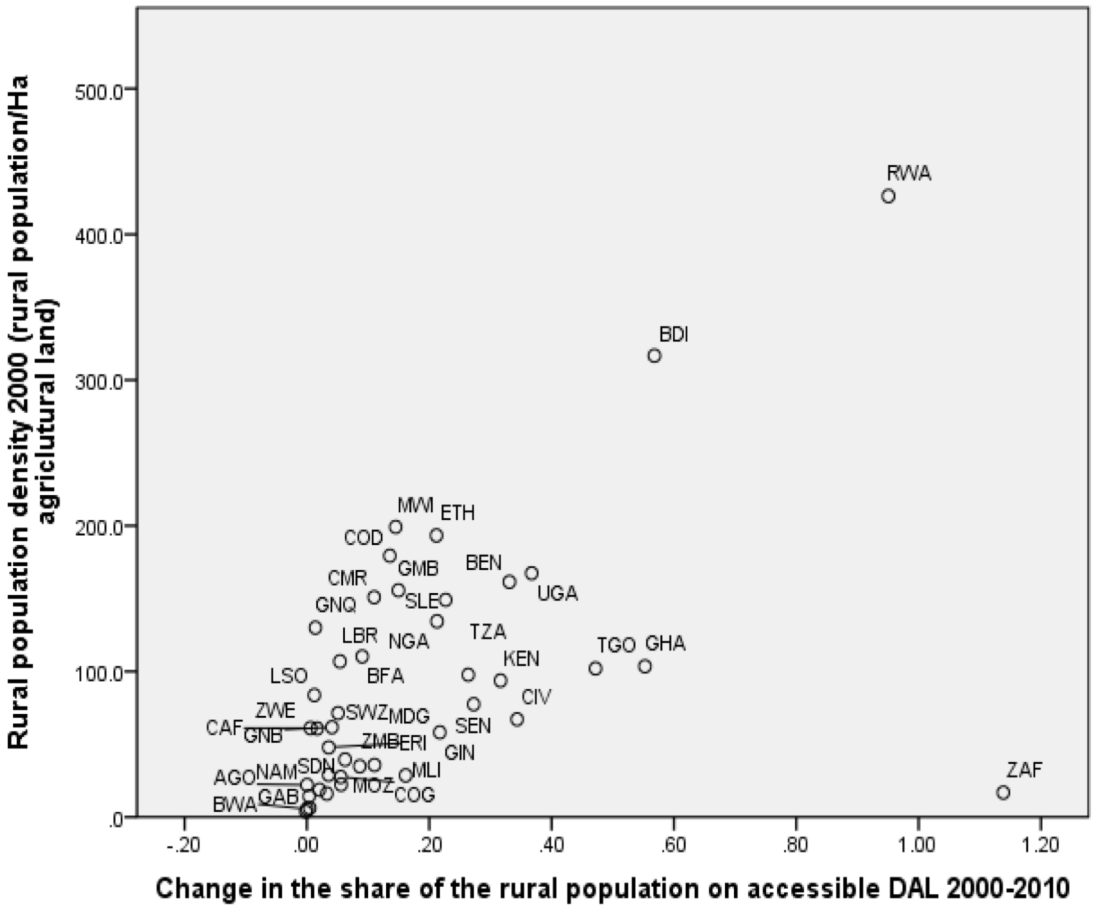


Sources: LSMS-ISA and IHS for land and wages; FEWSNET for urea and maize

SIX UNMISTAKABLE SIGNS OF RURAL TRANSFORMATION IN SSA

1. Major growth in per capita incomes – greater ability to afford cash inputs
2. Rising land scarcity in many rural areas
3. Land degradation – correlated with rural population density

Relationship between % of rural population on degrading agricultural land and pop density



- % of rural population in SSA living on degrading agricultural land has risen from 19% in 2000 to 28% in 2010.

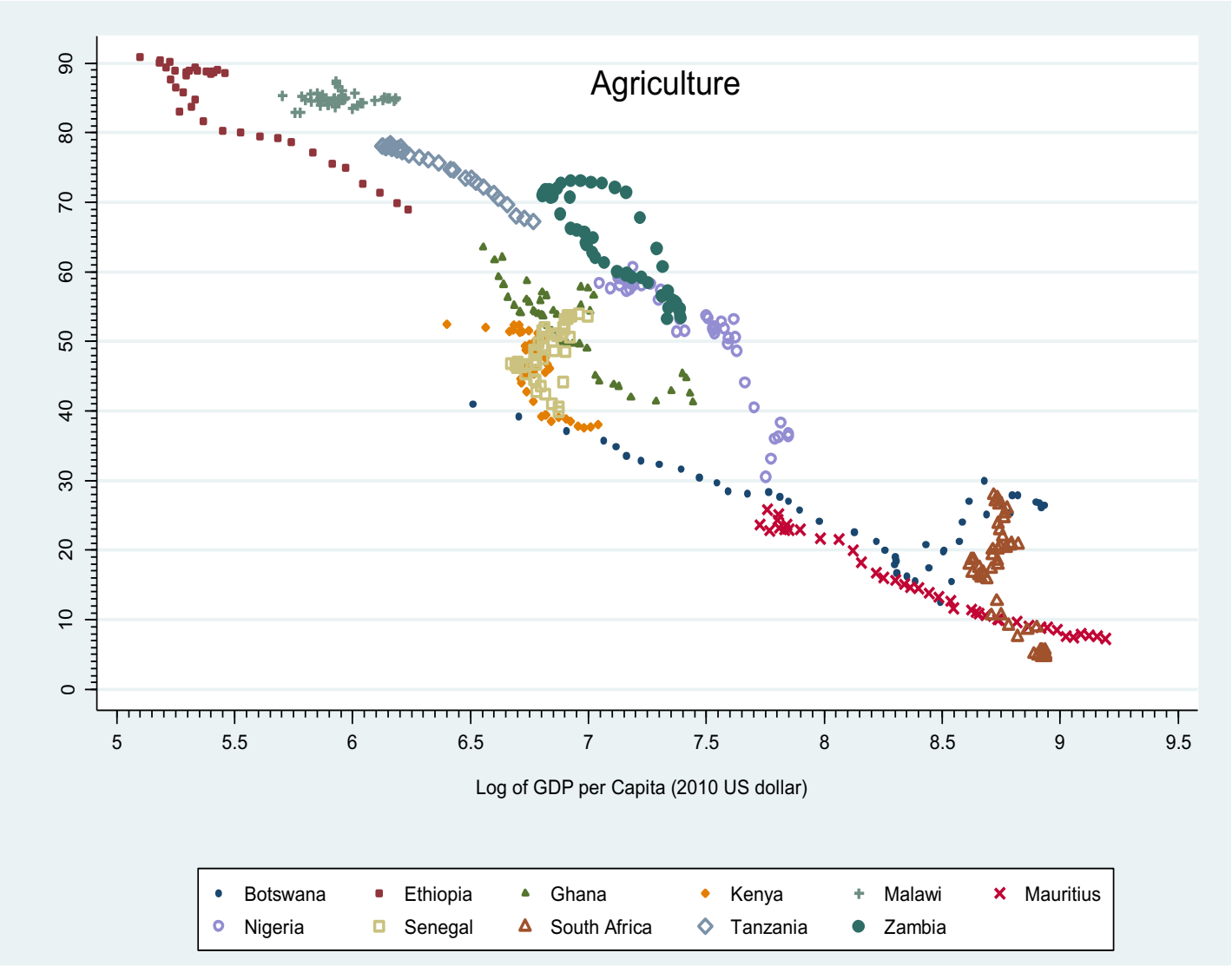
Review of maize-fertilizer response rates on farmer-managed fields

Study	country	Agronomic response rate (kgs maize per kg N)
Morris et al (2007)	W/E/S Africa	10-14
Sheahan et al (2013)	Kenya	14-21
Marenya and Barrett (2009)	Kenya	17.6
Liverpool-Tasie (2015)	Nigeria	8.0
Burke (2012)	Zambia	9.6
Snapp et al (2013)	Malawi	7.1 to 11.0
Holden and Lunduka (2011)	Malawi	11.3
Minten et al (2013)	Ethiopia	11.7
Pan and Christiaensen (2012)	Tanzania	11.8
Mather et al (2015)	Tanzania	5.7 to 7.8

SIX UNMISTAKABLE SIGNS OF RURAL TRANSFORMATION IN SSA

1. Major growth in per capita incomes – greater ability to afford cash inputs
2. Rising land scarcity in many rural areas
3. Land degradation
4. Diversification of the labor force into off-farm activities

Share of labor force in farming declining



- Uptake of labor-saving technologies:
  - herbicides / pesticides (Grabowski et al., 2015; Haggblade et al., 2017)
  - Mechanization (Vanderwesthuisen, Daum, Takashima, Diao)
  - Fertilizers (Sheahan and Barrett, 2017)

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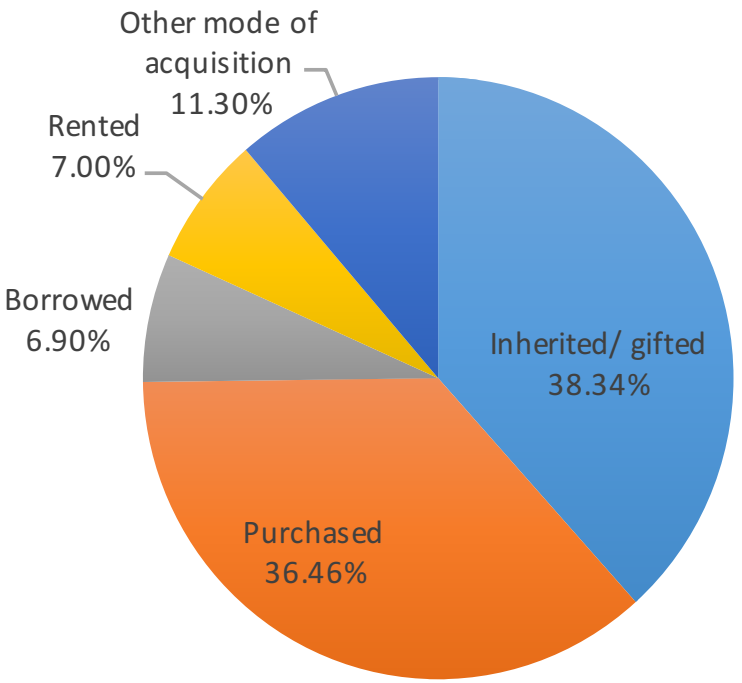
4. Diversification of the labor force into off-farm activities
5. Greater vibrancy of agricultural factor markets
6. Improving market access conditions for African farmers

MODE OF ACQUISITION OF ALL FARM PLOTS IN TANZANIA

PERCENT OF PLOTS

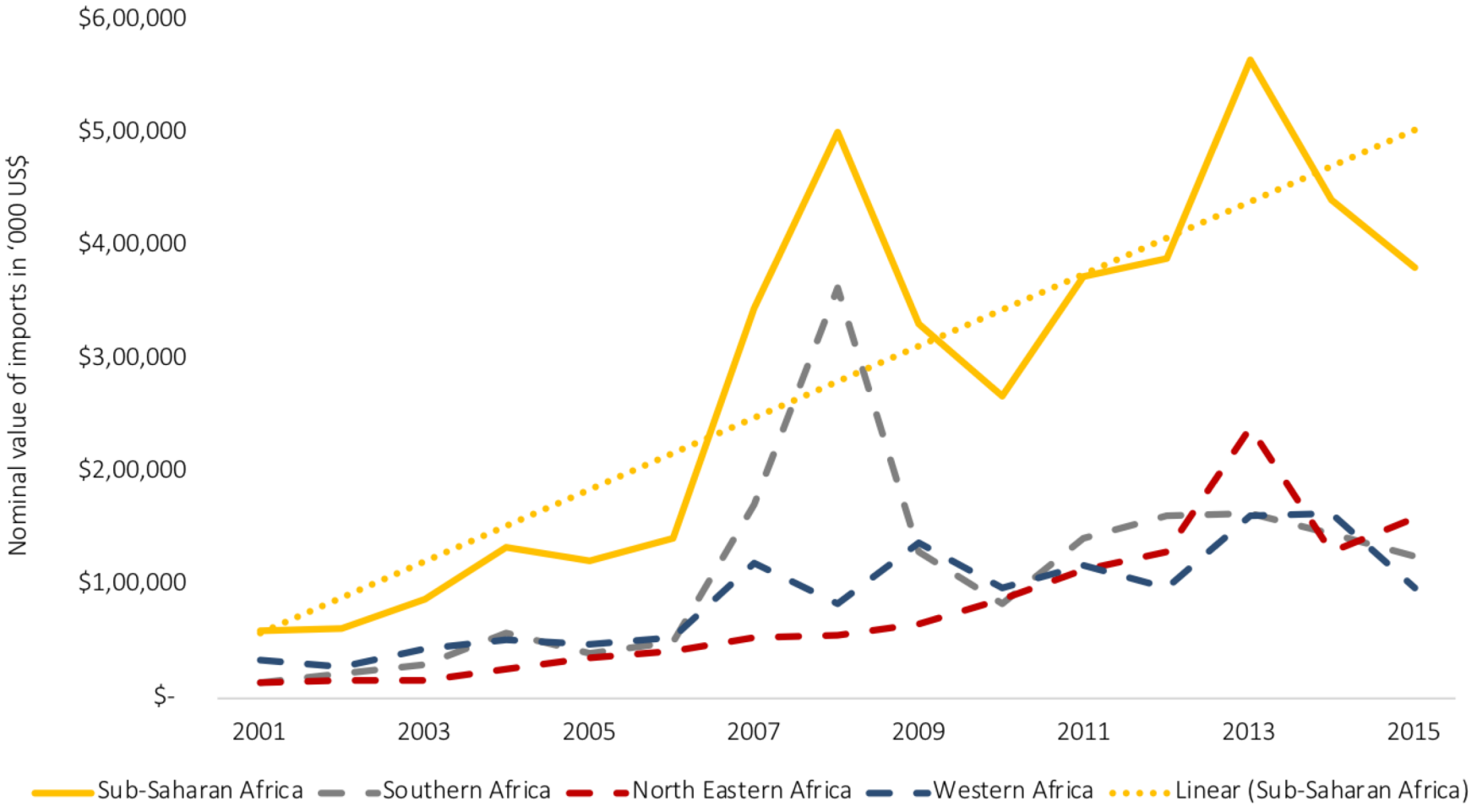
Inherited	33.17%
Gifted	10.33%
Purchased	29.63%
Borrowed	11.09%
Rented	9.63%
Other (squatting / cleared land/ allocated)	6.16%
Observations	4,291

PERCENT OF TOTAL FARMLAND AREA



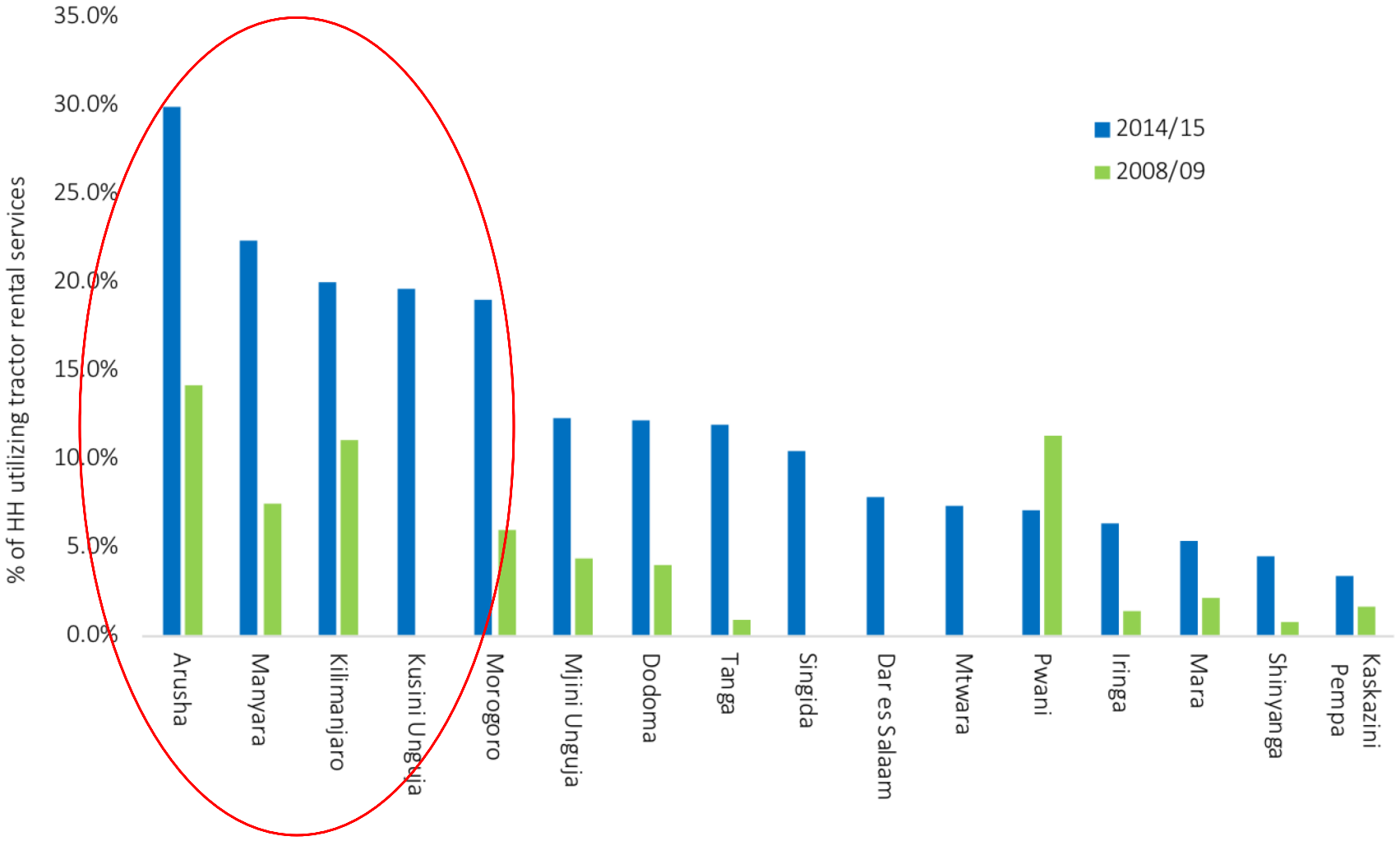
Source: LSMS/National Panel Survey 2014/15

NOMINAL VALUE OF TRACTOR IMPORTS TO SUB-SAHARAN AFRICA (EXCL. SOUTH AFRICA), 2001-2015



Source: Van der Westhuisen et al, 2018, based on Trade Map database

% OF FARM HOUSEHOLDS RENTING TRACTOR SERVICES IN TANZANIA, 2009 VS 2015



Source: Van der Westhuisen, 2018, based on LSMS/NPS surveys

Major Beneficial SLM Practices

Major Resource	Practice	Description
Soil	Organic amendments	Manure, plant material, compost
	Soil conservation	Ridging, terracing, vegetation cover
	Conservation agriculture	Minimum tillage, ground cover, crop rotation
Water	On farm capture and distribution	Rainwater harvesting, water ponds, micro catchments
	Off farm sourcing of water	Channels for water flow, pumps and other equipment
Vegetation	Inter-cropping	Legume intercrops and inoculant
	Rotations	Legume rotations
	Agroforestry	Intercrops, fallows
	Biodiversity	Pest barriers, pollinator habitats

Major Beneficial SLM Practices

General Factor Intensities

Major Resource	Practice	Description
Soil	Organic amendments	Crop res, manure, plant material, compost
	Soil conservation	Ridging, terracing, vegetation cover
Labor using	Conservation agriculture	Minimum tillage, ground cover, crop rotation
Water	On farm capture and distribution	Rainwater harvesting, water ponds, micro catchments
Capital using	Off farm sourcing of water	Channels for water flow, pumps and other equipment
Vegetation	Inter-cropping	Legume intercrops and inoculant
	Rotations	Legume rotations
Land using	Agroforestry	Intercrops, fallows
	Biodiversity	Pest barriers, pollinator habitats

Findings: How well are the hypotheses supported by empirical studies?

Introduction:

- There are almost no longitudinal studies of SLM adoption to compare against studies of transformation
- Cross sectional studies are varied in geographical and SLM scope and are often from non-representative samples
- Focus is thus on more general findings on direct effects of labor/wages and land size and acquisition on adoption of SLM practices
- Indirect effects – among SLM practices and with other input factors and SLM – are included in some studies

Findings: How well are the hypotheses supported by empirical studies?

Hypothesis	Evidence
Land-using SLM disfavored on smaller farms	**Across 70+ country-SLM combinations, farm size was positively associated with adoption in 17 cases, negatively associated in 10 with the remaining being insignificant.** In Tanzania, Kassie et al (2015) and Haile et al (2017) both find no correlation for 8 different SLM practices altogether. But other studies find a positive effect on legume rotation (Kassie et al 2013) and conservation agriculture (Corbeels et al 2014)) Farmsize was positively related to SLM in less densely populated Niger and Nigeria and negatively related to SLM in more densely populated Kenya and Uganda (Pender et al 2010) **No clear pattern between land using SLM and other SLM.**

Findings: How well are the hypotheses supported by empirical studies?

Hypothesis	Evidence
Medium to long term SLM disfavored on rented land	**Across 41 country-SLM combinations, there was lower SLM adoption on rented land in 23 cases and higher SLM adoption in 0 cases, with the remaining 18 being insignificant.** Sheahan and Barrett (2014) found significantly higher percent of owned plots using organic nutrients compared to rented plots in Ethiopia, Malawi, Nigeria, Tanzania and Uganda. Kassie et al (2015) found lower adoption of manure on rented land in all four study countries (Ethiopia, Kenya, Malawi, Tanzania) Laboratory measured soil fertility found to be lower on rented land in Kenya (Yamano et al 2009)

Findings: How well are the hypotheses supported by empirical studies?

Hypothesis	Evidence
SLM with less labor requirement are favored	**Across 80+ country/SLM combinations, labor or household size is positively associated with adoption in 28 cases, negatively associated in 4 cases (and the remaining were non-significant).** Tree canopy cover in African agricultural land held steady over the 2000-2010 period (Zomer et al 2014) despite rural rising population density. No effect on 5 SLM practices in Tanzania (Haile et al 2017l) or on conservation agriculture in Madagascar, Kenya and Tanzania (Corbeels et al. 2014) Soil and water conservation affected by labor in Kenya and manure in Malawi and Tanzania, but 6 other SLM/country combinations in those countries were unrelated to hh labor (Kassie et al. 2015) Female and male hh labor have differential effects on SLM in Kenya, but not Uganda (Pender et al. 2010)

Findings: How well are the hypotheses supported by empirical studies?

Hypothesis	Evidence
Increase of capital-using inputs will have effects on SLM	Herbicide use is increasing rapidly in several countries, and responding to higher wages, e.g. covering over 25% of cereal area in Ethiopia (Tamru et al 2017; Haggblade et al 2017). Herbicide access increased adoption of minimum tillage in Zambia (Grabowski 2014) but its use is negatively correlated with several SLM practices in Tanzania (Kassie et al 2013) Development of inoculant markets is increasing adoption of legumes in several countries (N2Africa.org) Fertilizer use generally does not have a strong affect on pattern of SLM (across 15 studies)

Findings: How well are the hypotheses supported by empirical studies?

Hypothesis	Evidence
Mechanization will increase and affect choice of SLM	The use of mechanization responds to higher wages in Ethiopia (Berhane et al 2016). Tractor users in Ghana bought more fertilizer and herbicides and had lower use of organic nutrients (Cossar 2016).

Hypotheses about trajectory of agricultural systems under different states of nature

	Economic dynamism	Slow economic development
Favorable areas	(Southern Ghana, parts of Tanzania, highland Kenya, Ethiopia) Hypotheses: • Strong intensification • Factor market participation rises • Labor and land saving and capital using technologies (mechanization, fertilizers, herbicides, pesticides) • Strong potential for SLM	(Zambia, Malawi) Hypotheses: • Moderate intensification and extensification, mainly near urban areas. • Little use of SLM
Less favorable areas	(Northern Ghana) Hypotheses: • Strong extensification • Labor saving / Land and capital using • Larger farm investment (mechanization, lower-valued crops) • Potential for SLM	(southern Zimbabwe, lowland Kenya, Niger) Hypotheses: • Limited ext or int. • Little use of SLM

Elements of a holistic strategy:

1. National ag research systems and development orgs to collaborate in identifying and promoting SLM practices for different typologies of regions
2. Soil testing programs and appropriate fertilizer use recommendations
3. Reducing costs in input supply chains
4. Programs to help farmers restore soil quality
5. Supply chains for organic matter or legume seeds and inoculants
6. Physical infrastructure – roads, electrification, communication, irrigation, etc.

Thank you