Productivity in Sub Saharan Africa

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Outline

- Agricultural productivity overview
  - Trends in spatial patterns in Labor and Land
  - Trends in Total Factor Productivity
- Key constraints
  - R&D
  - Input markets
  - Infrastructure
- Results and implications

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Measures of Productivity

- Partial factor productivity (land and labor)

- Total factor productivity and decomposition
  - ***efficiency*** **arising from reallocation of productive factors**
  - ***technical change*** **arising from things that do not directly relate to the factors of production or the productivity of the factors**

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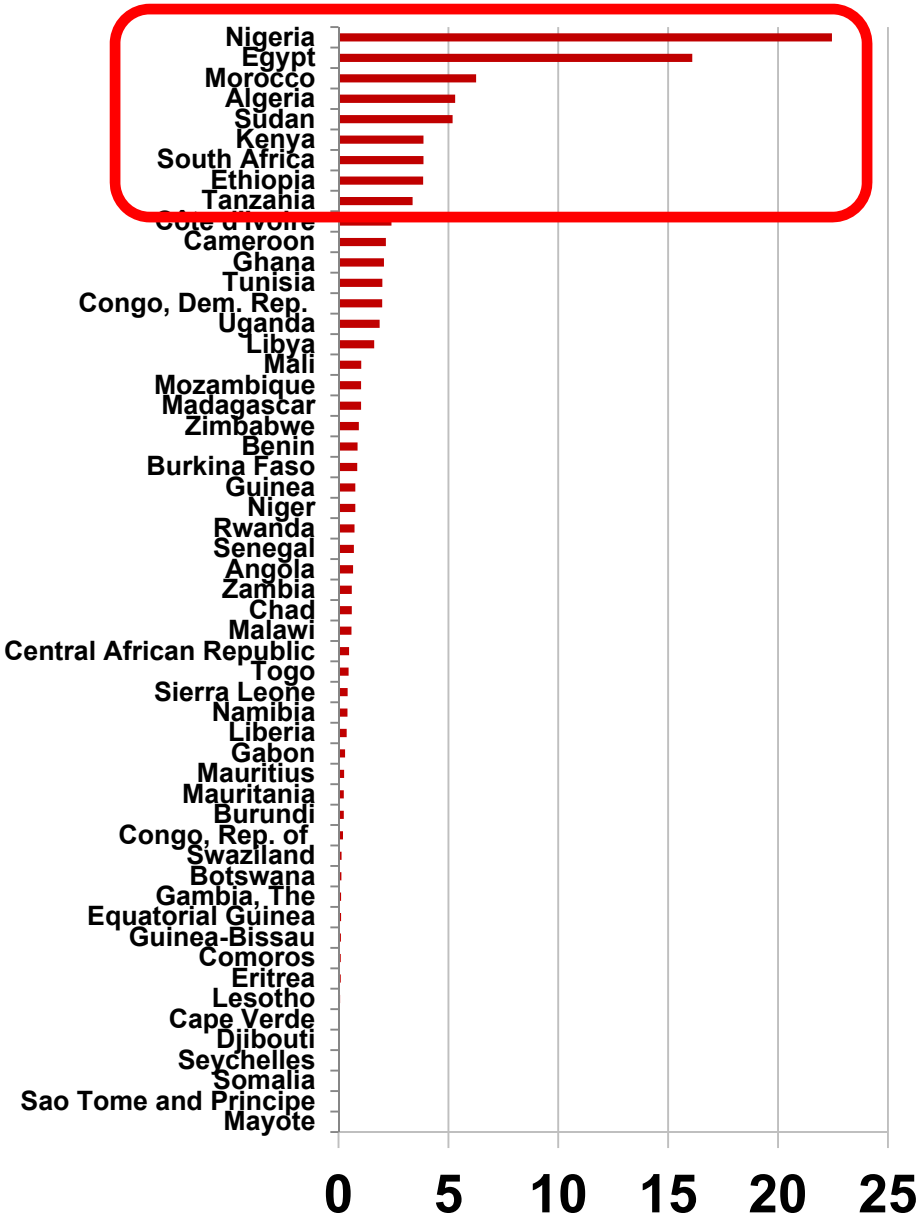
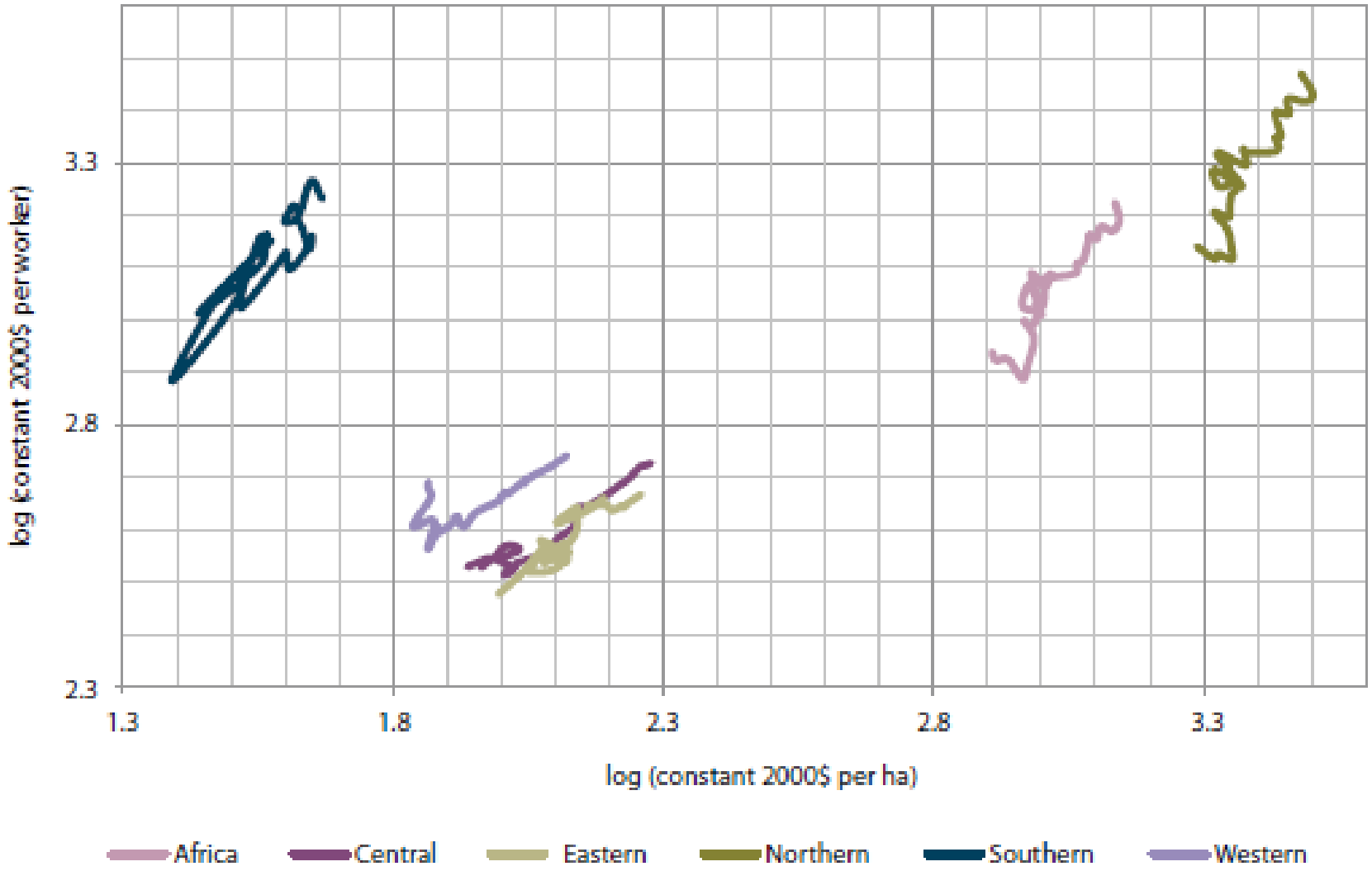
Share (%) in Africa's total AgGDP (annual average 2003-2010)



- Drivers of trends at Africa-wide level (top 9)
  - Nigeria
  - Egypt
  - Morocco
  - Algeria
  - Sudan*
  - Kenya
  - South Africa
  - Ethiopia
  - Tanzania

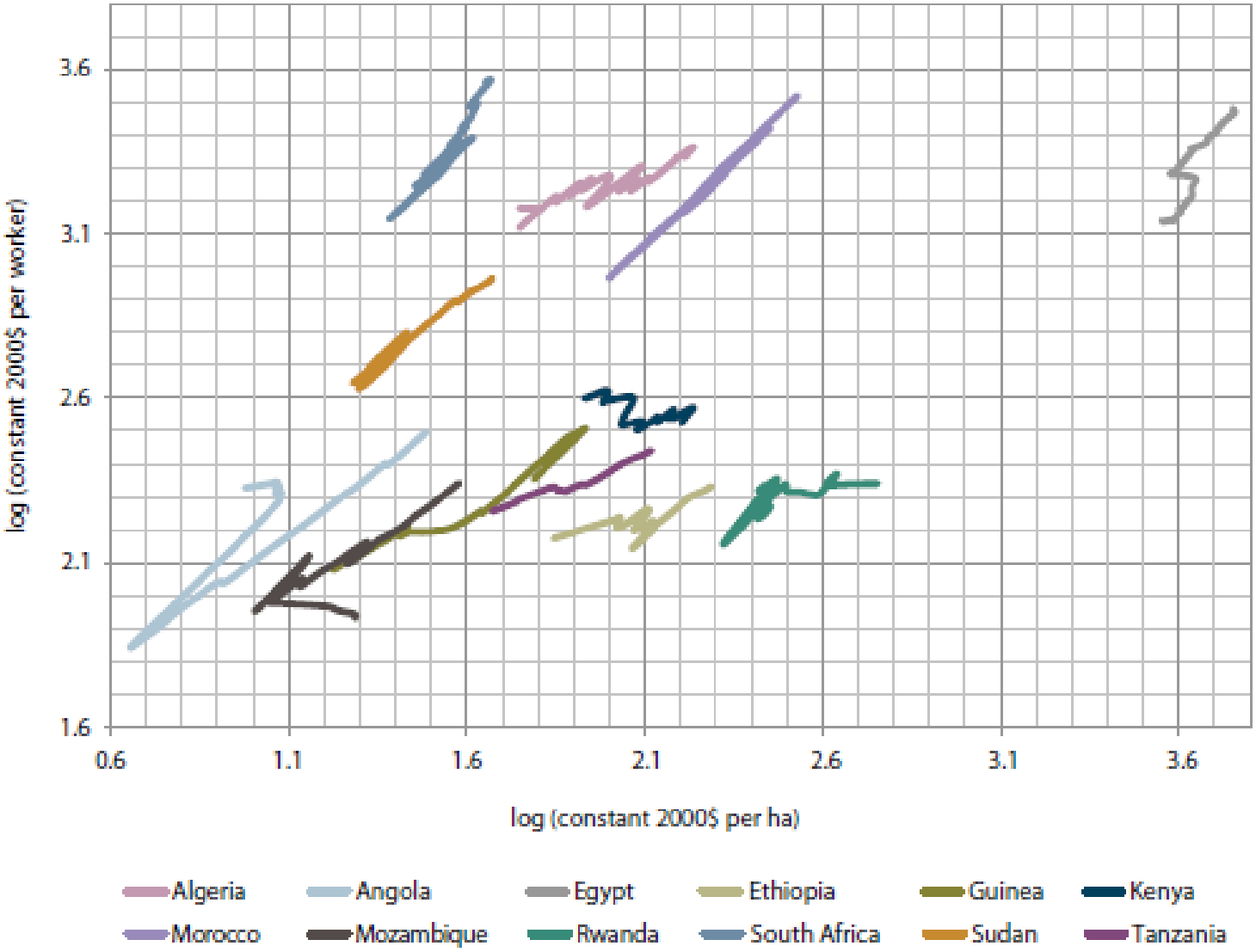
Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

Land and labor productivity in SSA and sub-regions (1961-2009)



Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

Land and labor productivity in selected countries (1961-2009)

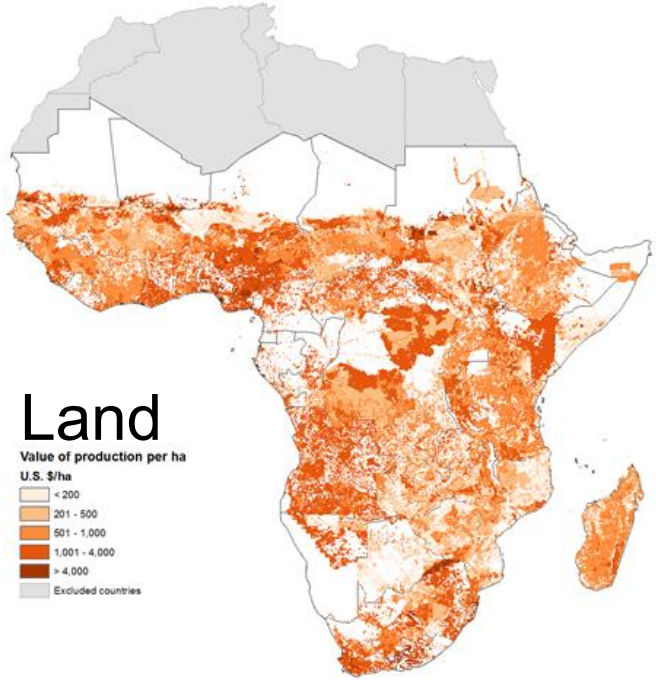


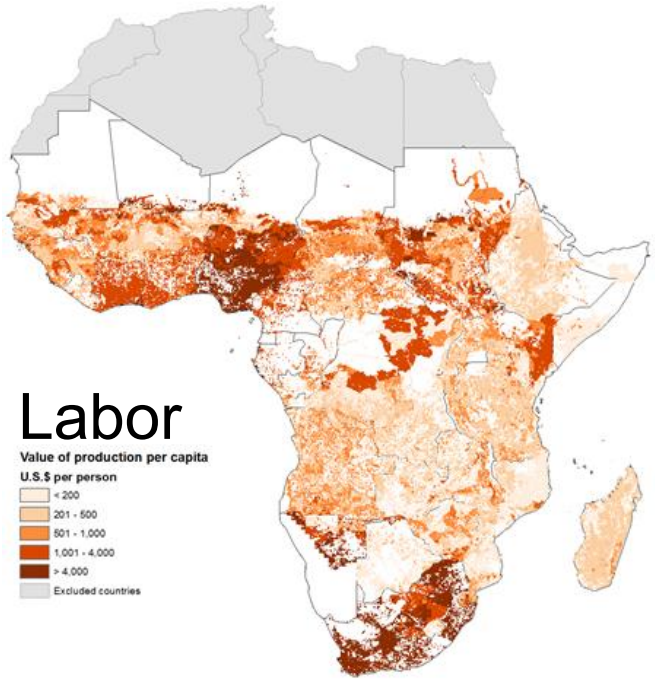
Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

Summary of Trends

- Labor productivity has risen much faster than land productivity in Africa as a whole
  - **particularly in the northern region a trend that is driven by Egypt**
- In SSA and many other countries, land productivity has risen much faster than labor productivity
- In the southern Africa and in Morocco both measures have risen at about the same rate
- General slowdown in the increase in both land and labor productivity in the 1990s than in preceding or subsequent sub-periods.

Spatial Patterns (annual avg. 2005-07)





- **Land productivity**
  - Closer for ECA ($690/ha) and SA ($756/ha); significantly higher in WA ($1300/ha)
  - In WA, rising from semi-arid Agro-Pastoral systems of the Sahel ($700/ha), through the higher rainfall Cereal-Root Crop system ($1293/ha) and Root Crop system ($2129/ha), to the sub-humid and humid Coastal Artisanal Fishing system ($2143/ha)

Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

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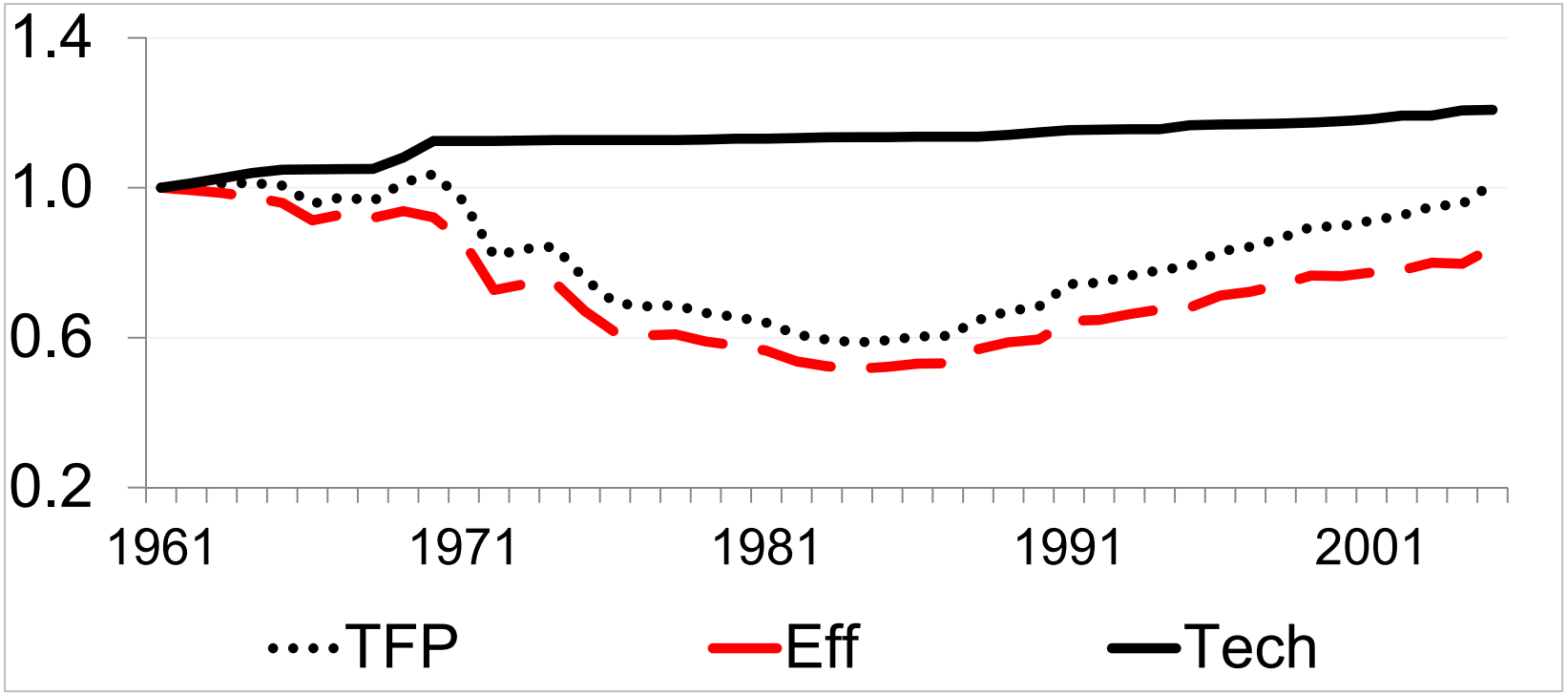
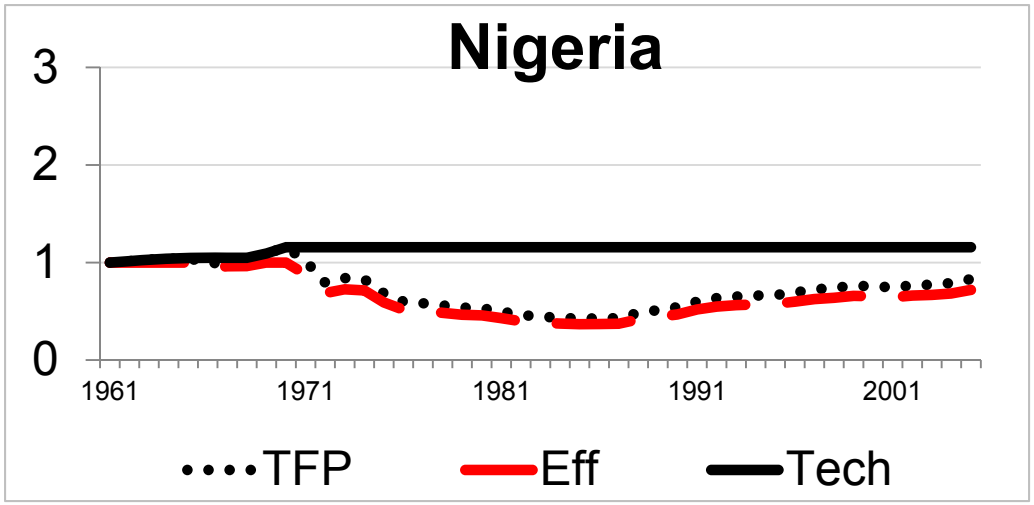
TFP in SSA (1961=1)

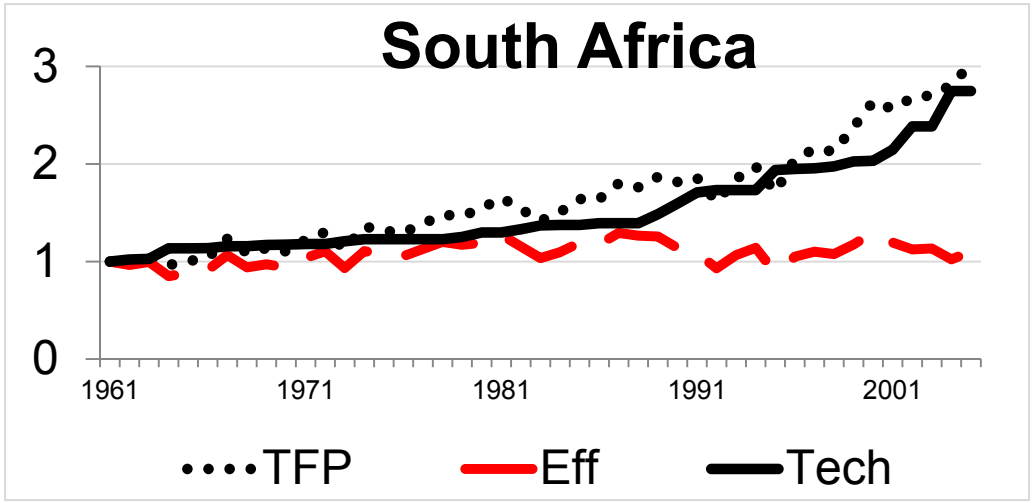


- Slight improvement in 1960s followed by a rapid deterioration in TFP and efficiency till mid-1980s and then recovery starting in 1984-1985
- Very little technical change

Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

Major Drivers of the trends in SSA: Nigeria and South Africa

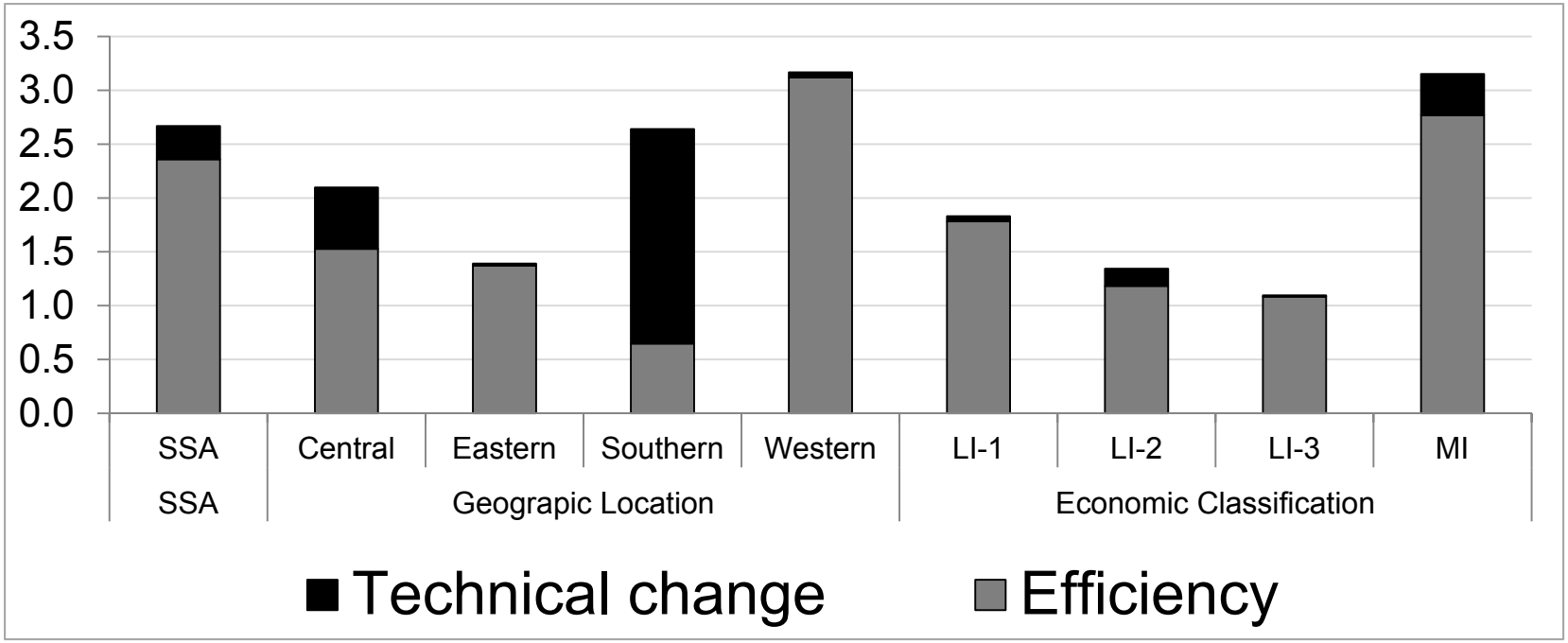




- Nigeria exerts downward pressure
- South Africa exerts upward pressure

Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

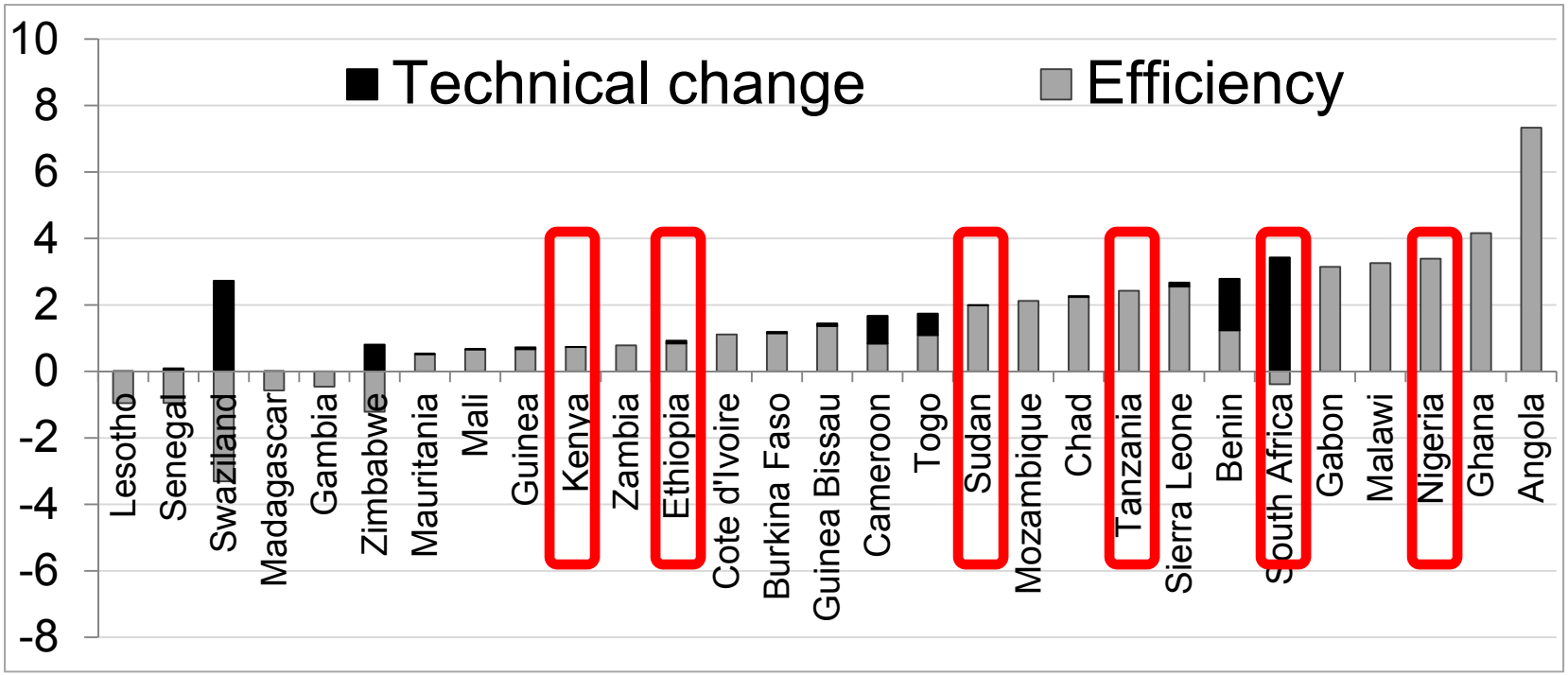
Annual Average Growth Rate in TFP by Region (%, 1985-2005)



- High TFP growth in western, but little technical change
- Southern Africa outperforms in technical change
- Technical change in the central region was also high

Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

Annual Average Growth Rate in TFP by country (%, 1985-2005)



- Except South Africa, average or below average performance for Big 9 agricultural economies

Source: Benin, et.al (2011). Trends and Spatial Patterns in Agricultural Productivity in Africa 1961-2010, ReSAKSS.

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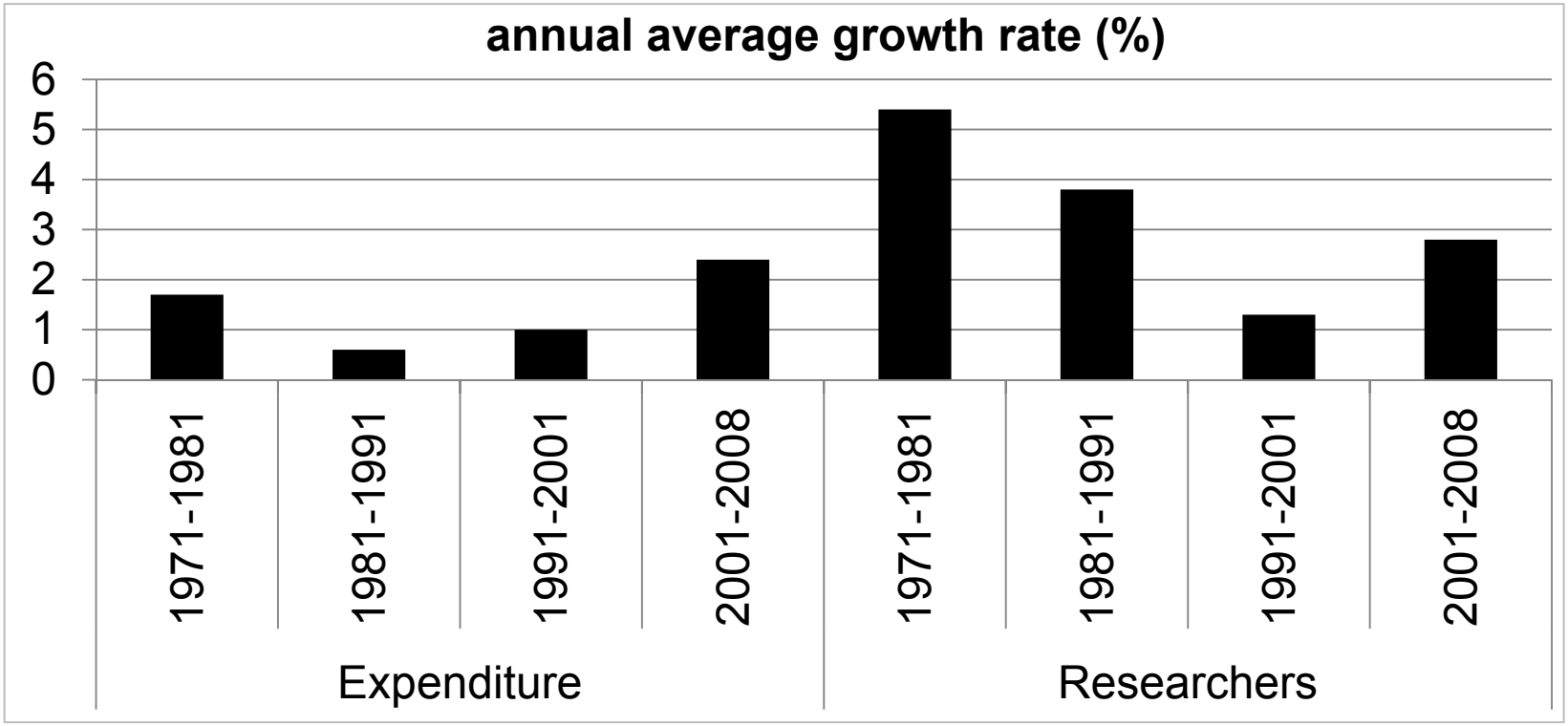
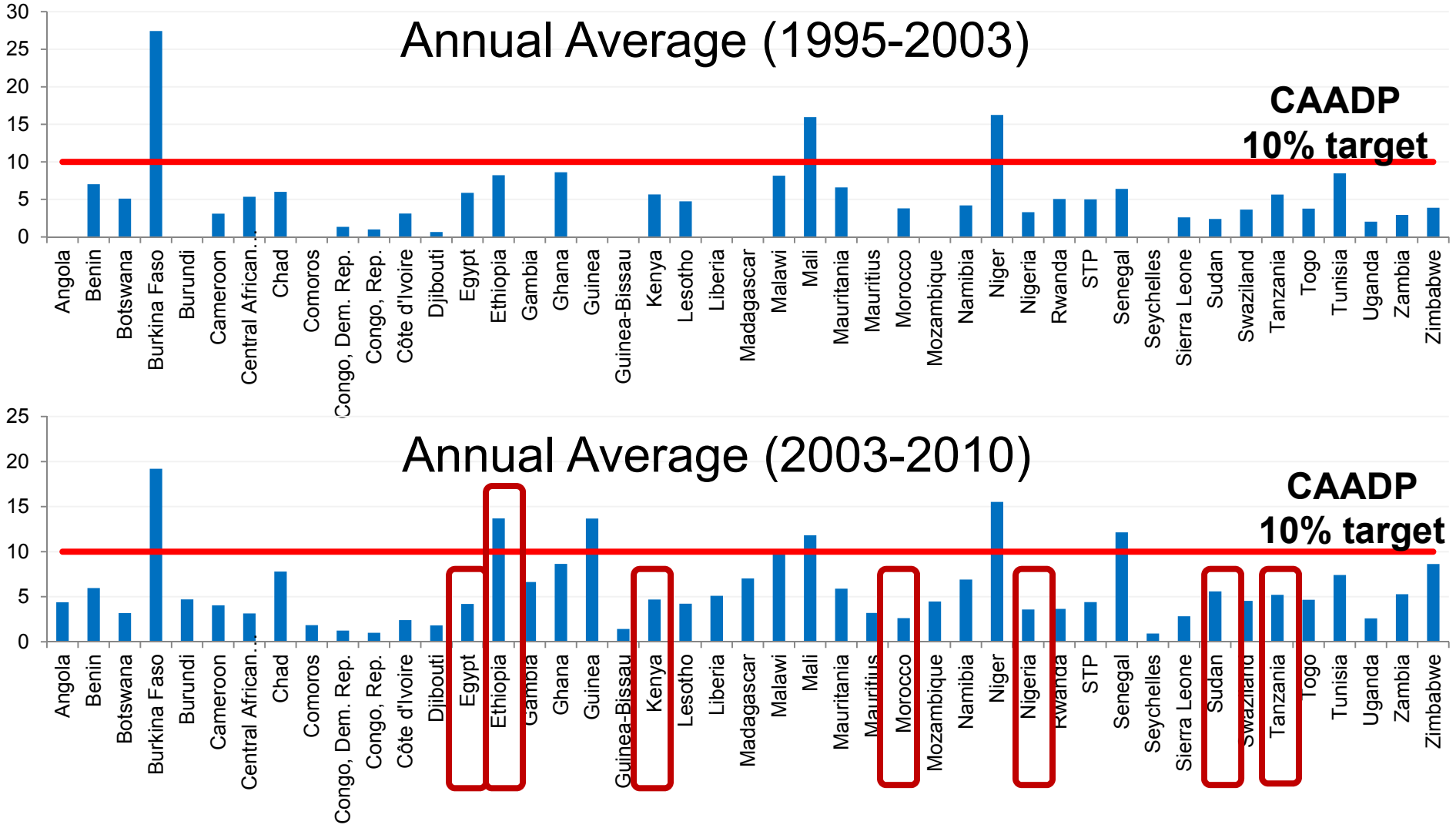
- AgR&D infrastructure and capacities have eroded over time through years of neglect, primarily from lack of public funding for agR&D.
- Growth in spending on agR&D and number of researchers have only recently picked up; reflects the trends in agricultural productivity growth



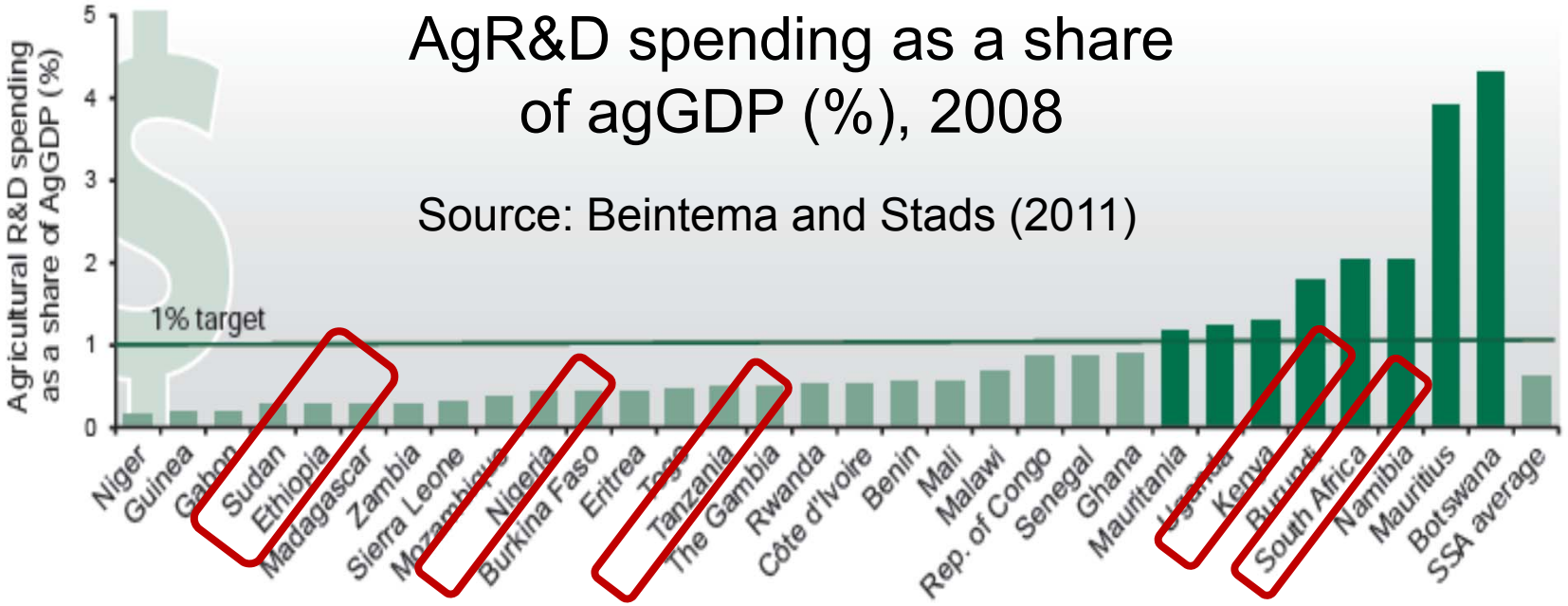
Source: Beintema and Stads (2011)

Meeting the Maputo 10% target



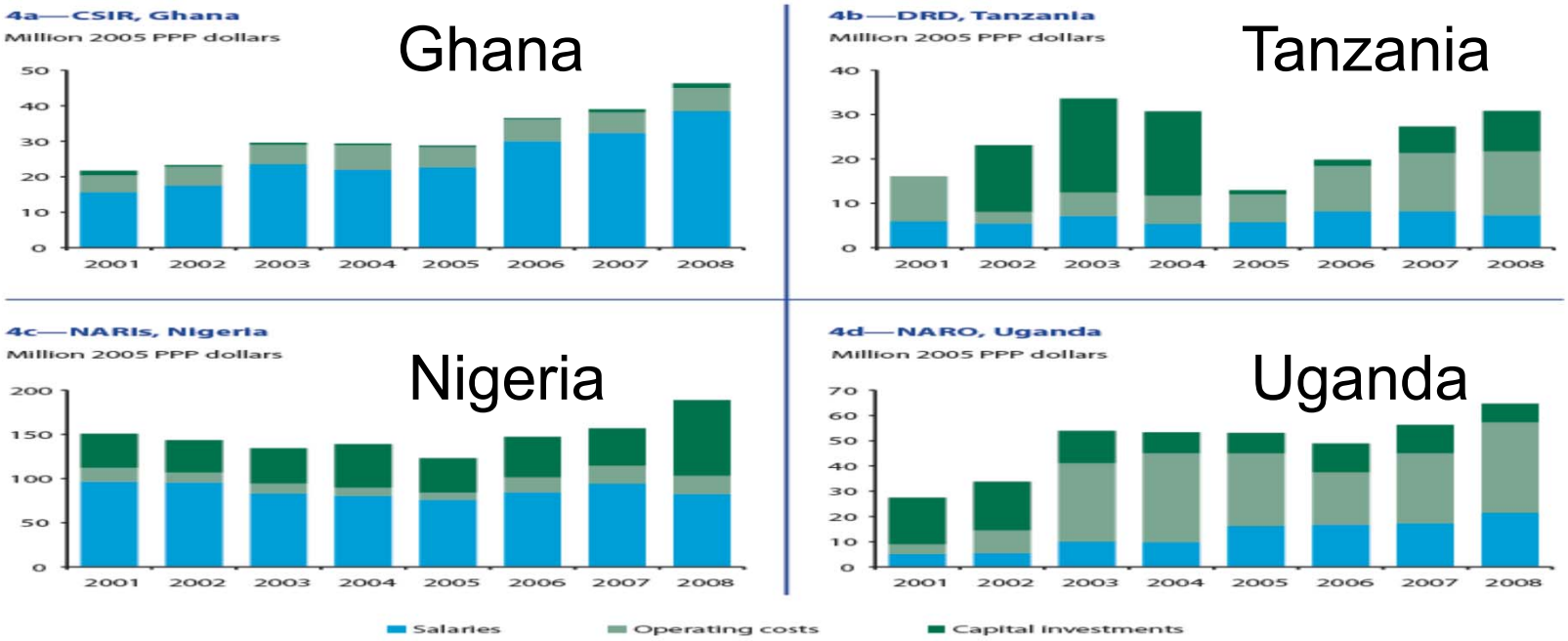
Except Ethiopia, none of Big 9 has achieved target

How much is spent on agR&D?



- Only 8 of the 31 countries studied met the NEPAD 1% target
- Except Kenya and South Africa, the other big agricultural economies spent less than 0.5 percent
- The other high performers (Botswana, Burundi, Mauritania, Mauritius, Namibia, and Uganda) together account for only 3.2 percent of Africa's total agGDP; little impact on the performance for Africa/SSA as a whole

How has the increase in agR&D expenditure been allocated?



Source: Beintema and Stads (2011)

- **Ghana**: mostly salaries
- **Tanzania**: capital investments in 2002-2004 and operating costs in following years
- **Uganda**: operating costs

What types of investment are needed?

- Those that deliver location-specific technologies and account for diversity of potentials in and constraints faced by farmers
  - But many small economies and limited capacities and resources for developing effective agR&D systems
  - Regional agricultural R&D strategy can help fill these gaps and facilitate scale economies.
  - African centers of excellence initiatives are laudable
  - Need complementary polices and extension systems that enhances and maximizes the technology spillovers from centers to all places

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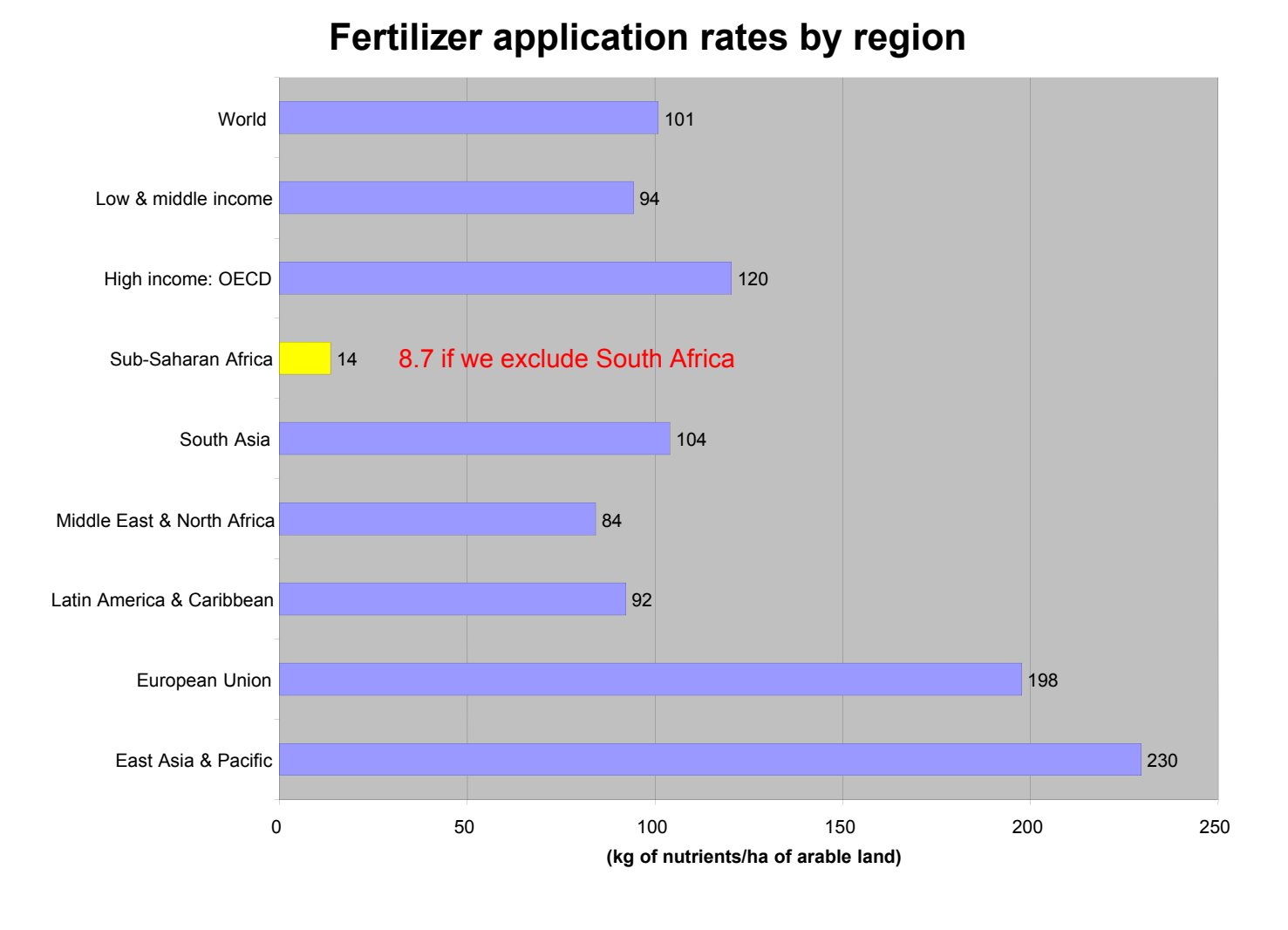
Missing input markets: fertilizers



Source: Minot and Benson (2008). “Fertilizers subsidy in Sub-Saharan Africa, New Wine or just New Bottles”

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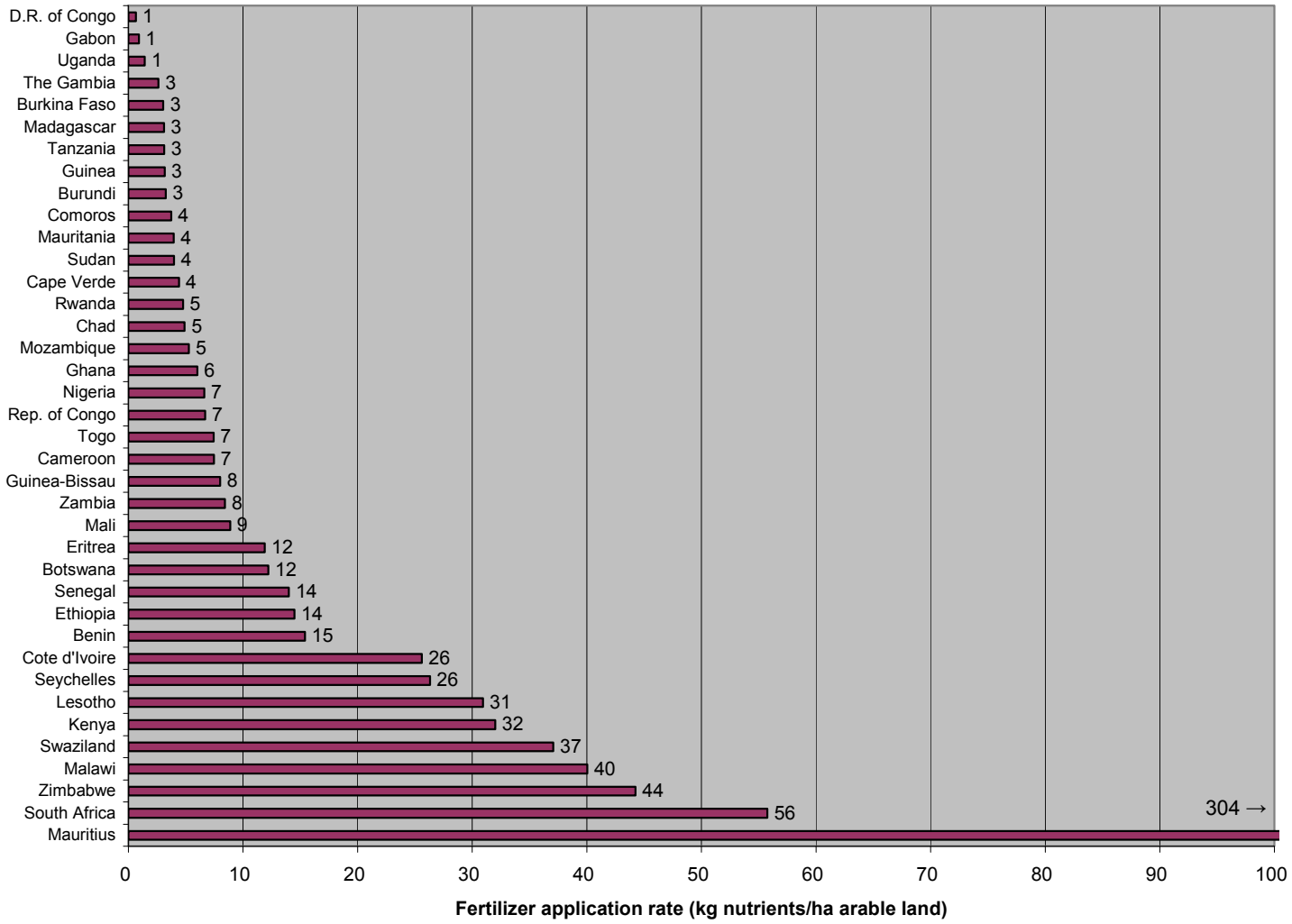

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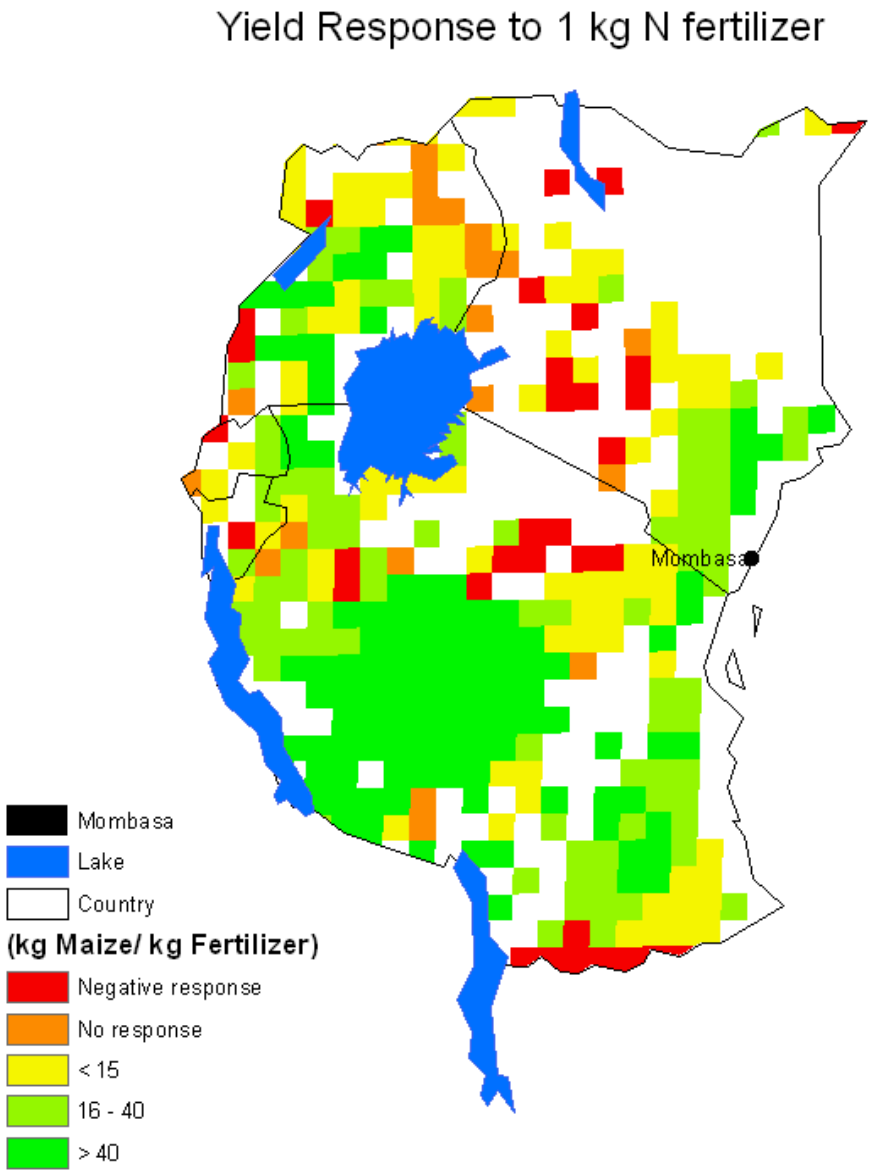
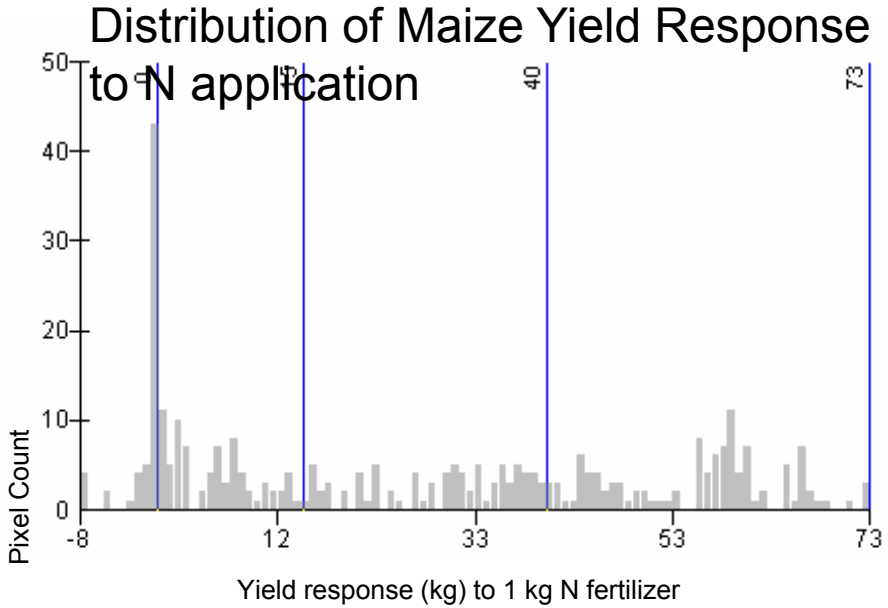
Maize Yield Response to Fertilizer





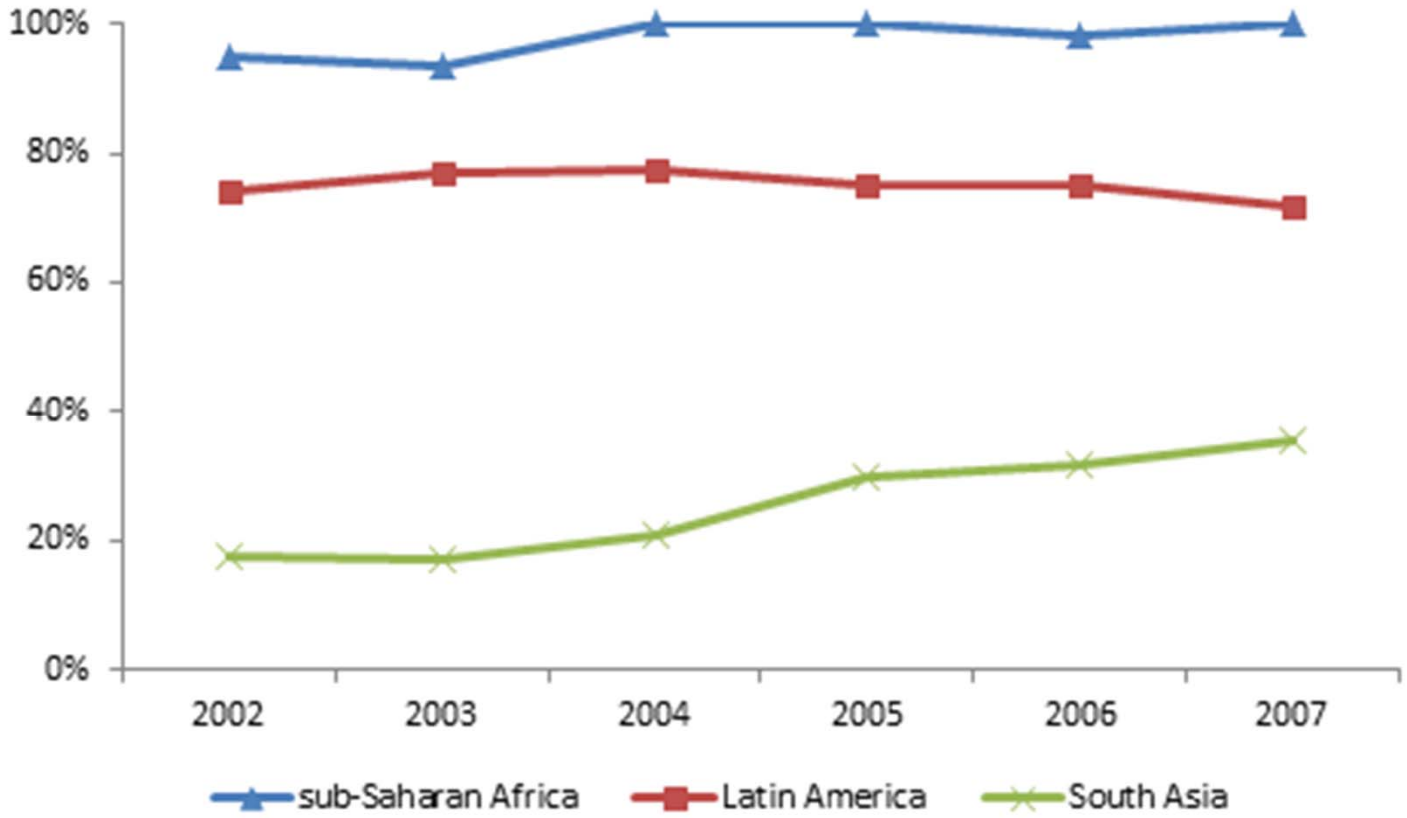
Increased fertilizer use can significantly raise productivity growth in smallholder agriculture

Source: Harvest Choice, IFPRI.

Input markets – Fertilizers: Global patterns

high dependence of SSA on imported fertilizer

Imports of fertilizer as a percentage of consumption in sub-Saharan Africa, Latin America and South Asia, 2002-2007

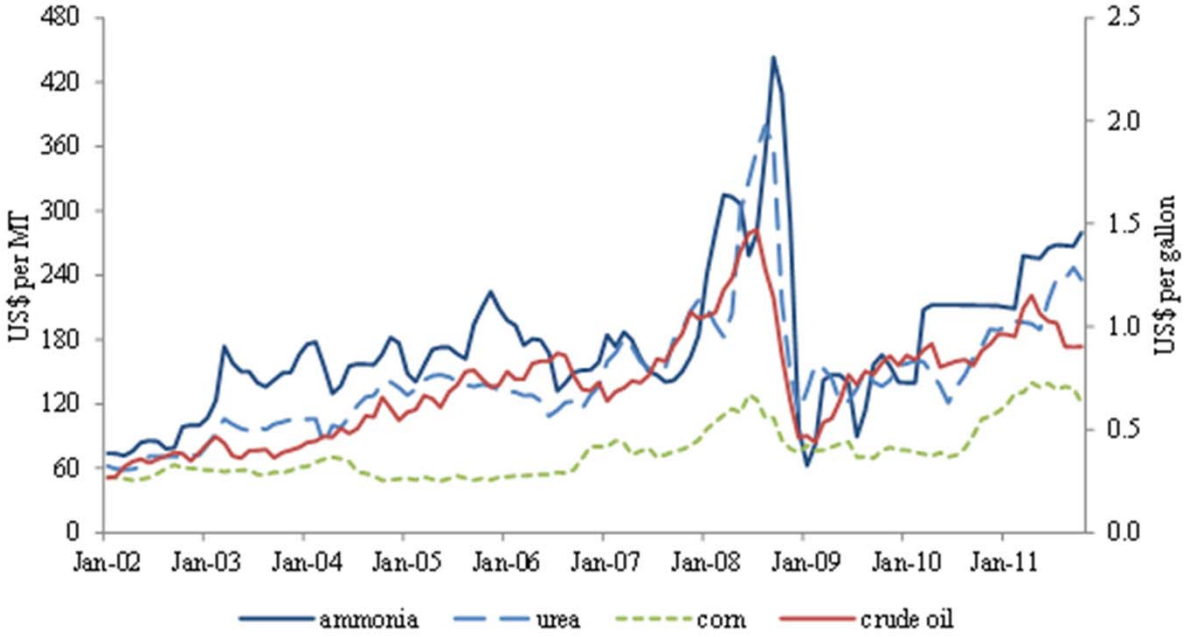


Note: Data on fertilizer nutrient consumption and imports obtained from the FAOSTAT Online database.

Fertilizer prices

- During the food price crisis of 2007-2008, fertilizer prices exhibited higher spikes than oil and agricultural prices.

Real monthly ammonia, urea, corn and crude oil prices, 2002-2011



Note: Prices deflated by CPI, 1982-84=100. The prices correspond to Ammonia US Gulf barge and Urea US Gulf prill import from Geen Markets, No. 2 yellow corn FOB US Gulf from FAOSTAT Online database, and Oklahoma crude oil FOB spot price from the Energy Information Administration.

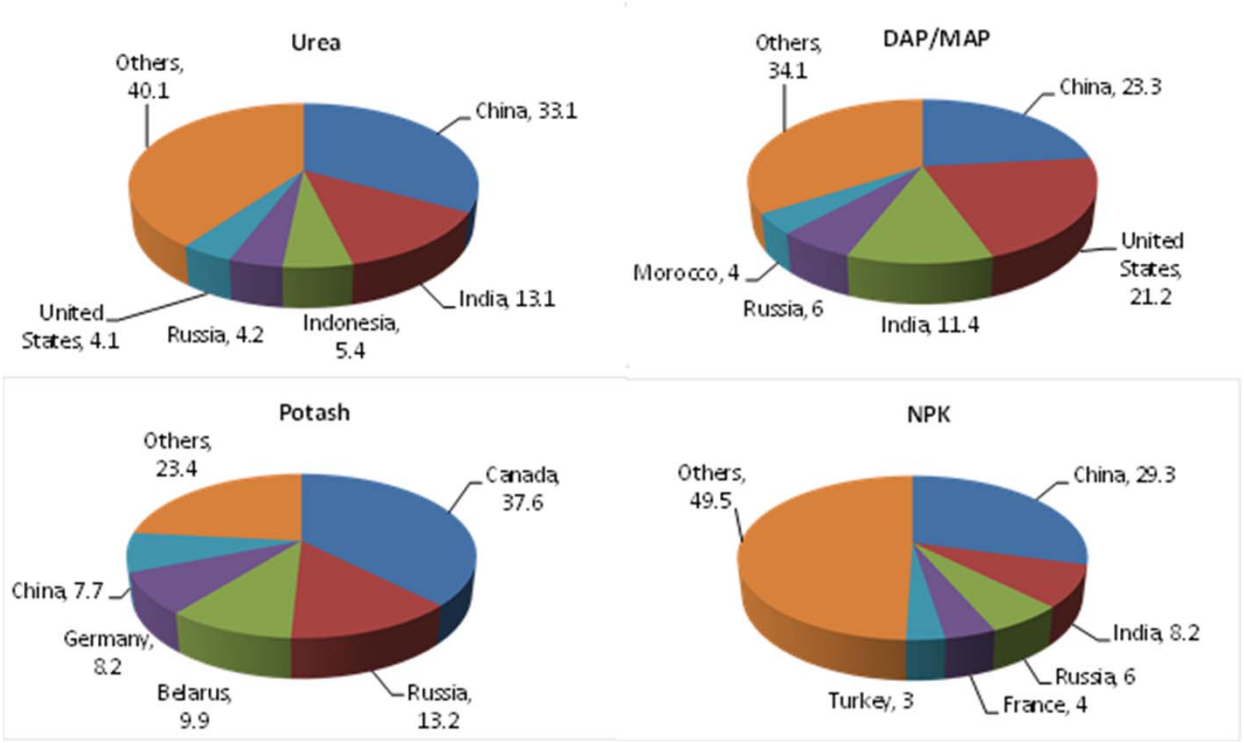
- Industry reports indicate that leading fertilizer producers achieved record profits in recent years (e.g., Potash Corp reported a gross margin of US$ 4.86 billion in 2008 versus US$ 474 million in 2000).

Global patterns

Top-5 countries control more than 50% of the global production capacity

- Canada & Russia alone explain more than half of potash global capacity.
- Basically the same countries (China, US, India & Russia) control most of the production capacity of urea and DAP/MAP.

Distribution of world fertilizer production capacity by country, 2008-09



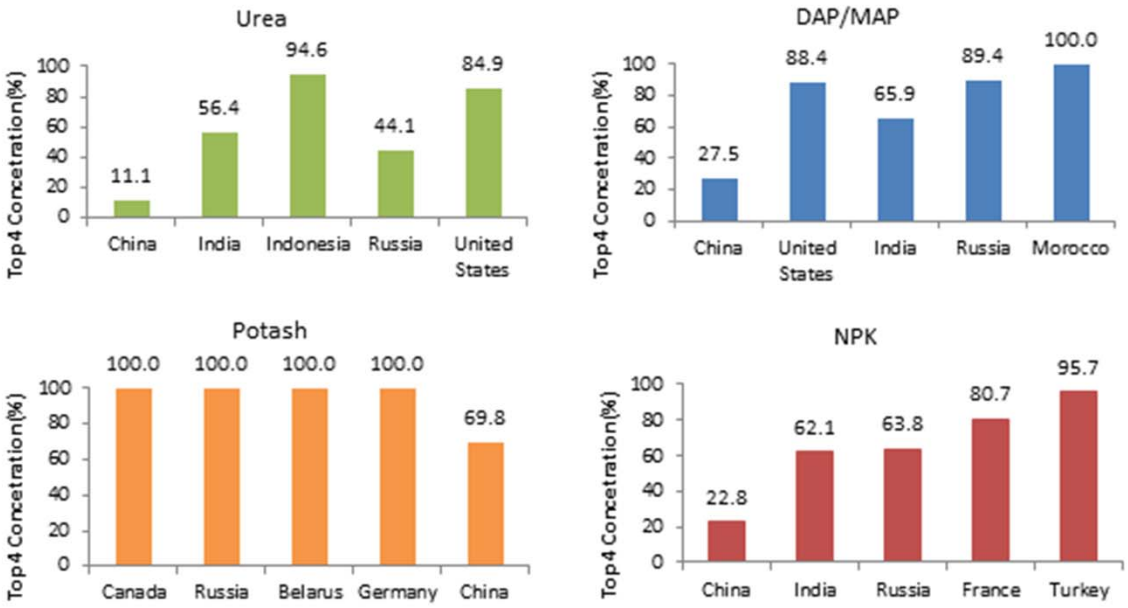
Note: Based on capacity of operative plants in 2008-09 according to IFDC Worldwide Fertilizer Capacity Listings by Plant.

Global patterns

Top-4 FIRMS generally control more than half of EACH Major COUNTRY production capacity

- In some cases, only one company operates in the country (e.g., in Belarus and Germany for potash and in Morocco for DAP/MAP).
- Figures do not include associations/partnerships between firms.

Concentration of fertilizer production capacity in main producing countries, 2008-09



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Empirical model

- We estimate the following dynamic price model.

$$\ln p_{ijt} = \alpha \ln p_{ijt-1} + \beta mktstructure_{ijt} + X_{ijt}\delta + \varepsilon_{ijt}$$

$$\varepsilon_{ijt} = c_i + u_{ijt}$$

where p_{ijt} is the price of urea in country *i* from region *j* at year *t*; $mktstructure_{ijt}$ is a measure of market concentration; X_{ijt} is a vector of controls; c_i is a country specific effect and u_{ijt} is an idiosyncratic shock.

- We use annual data on urea for 38 countries during1970-2002.
- The panel nature of our data permits us to exploit differences in market structure across countries and time.

- Estimate model following Arellano & Bond (1991) GMM procedure to account for the potential correlation of c_i with some of the X_{ijt}, and the potential endogeneity of market structure and the lag of price.

RESULTS

effect of market concentration on urea prices

- Positive correlation between concentration and prices (when significant).
- Elasticities range between 0.82 and 1.65.

Concentration measure	Arellano-Bond difference GMM	
	Model 1	Model 2
Top-4 ratio on production capacity		
Measure 1	0.032	0.316
Measure 2	0.718	0.817*
Top-4 ratio on number of plants		
Measure 1	-1.013	-0.858
Measure 2	0.976**	1.155**
HHI on production capacity		
Measure 1	0.979	1.058
Measure 2	0.672	0.558
HHI on number of plants		
Measure 1	1.642*	1.654*
Measure 2	0.998**	0.921**
Main producer & share imports/consumption	Yes	No
Among top-4 producers & share imports/consumption	No	Yes
Regional fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Measure 1 corresponds to the weighted average of the measure of market concentration at the country and regional levels; Measure 2 is the measure of market concentration at either the country or regional level, depending on whether most of the urea consumed is from local production or imports.

SIMULATION ANALYSIS

increasing competition

- It is worth further evaluating the potential impact that increased competition in the industry could have on low-income countries.

- We conduct a basic simulation analysis.

- First simulate the general impact of increased competition on prices, fertilizer intake, crop production and rural income.
  (use elasticities derived above and from other related studies)

- Then perform a cost-benefit analysis for selected countries.
  (Ghana, Kenya, Senegal and Tanzania in SSA; Bangladesh and India in SA)

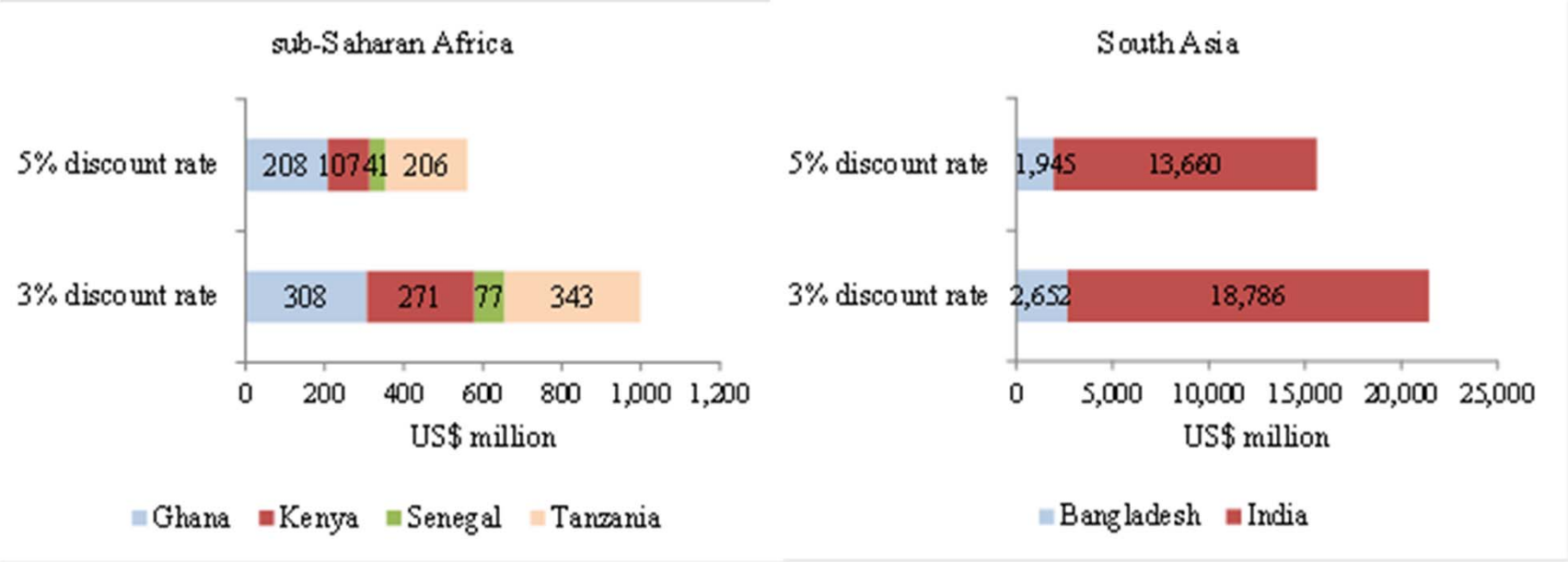
- Based on the top-4 concentration ratio results, a10% increase in competition leads to:

- Conservative scenario: 8.2% decrease in prices.
- Optimistic scenario: 11.6% decrease in prices.

SIMULATION ANALYSIS (3)

increasing competition

Net present value of simulated policy in selected countries in sub-Saharan Africa and South Asia (time horizon of 40 years)



- NPV in 4 countries in SSA: US$1 billion (3% discount rate); US$561 million (5% discount rate).
- NPV in 2 countries in SA: US$21.4 billion (3% discount rate); US$15.6 billion (5% discount rate).

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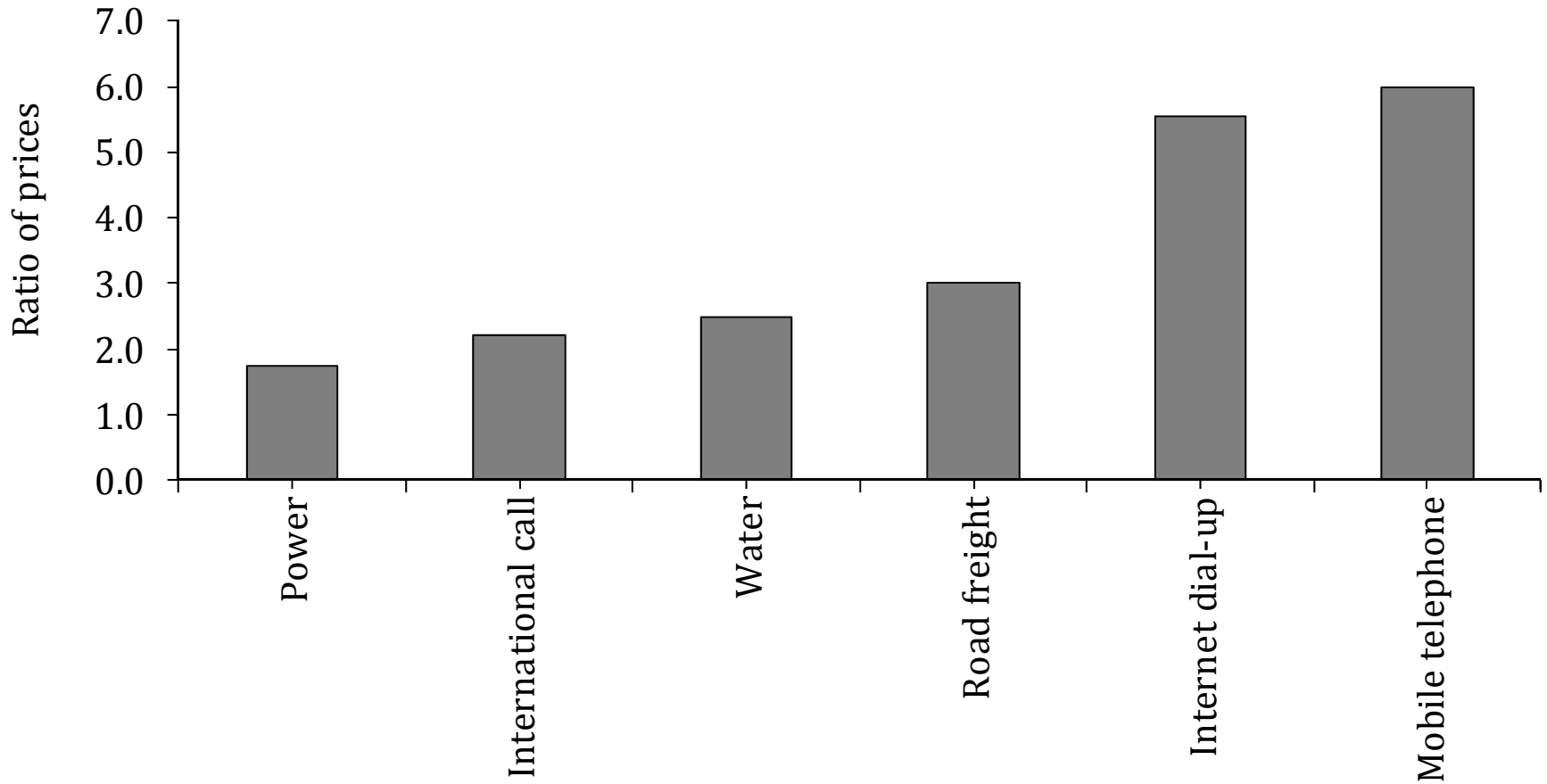
Africa's infrastructure services several times more expensive than elsewhere



Infrastructure will require an additional US$31 billion a year and huge efficiency gains

All figures in US$ billion a year

Source: World Bank

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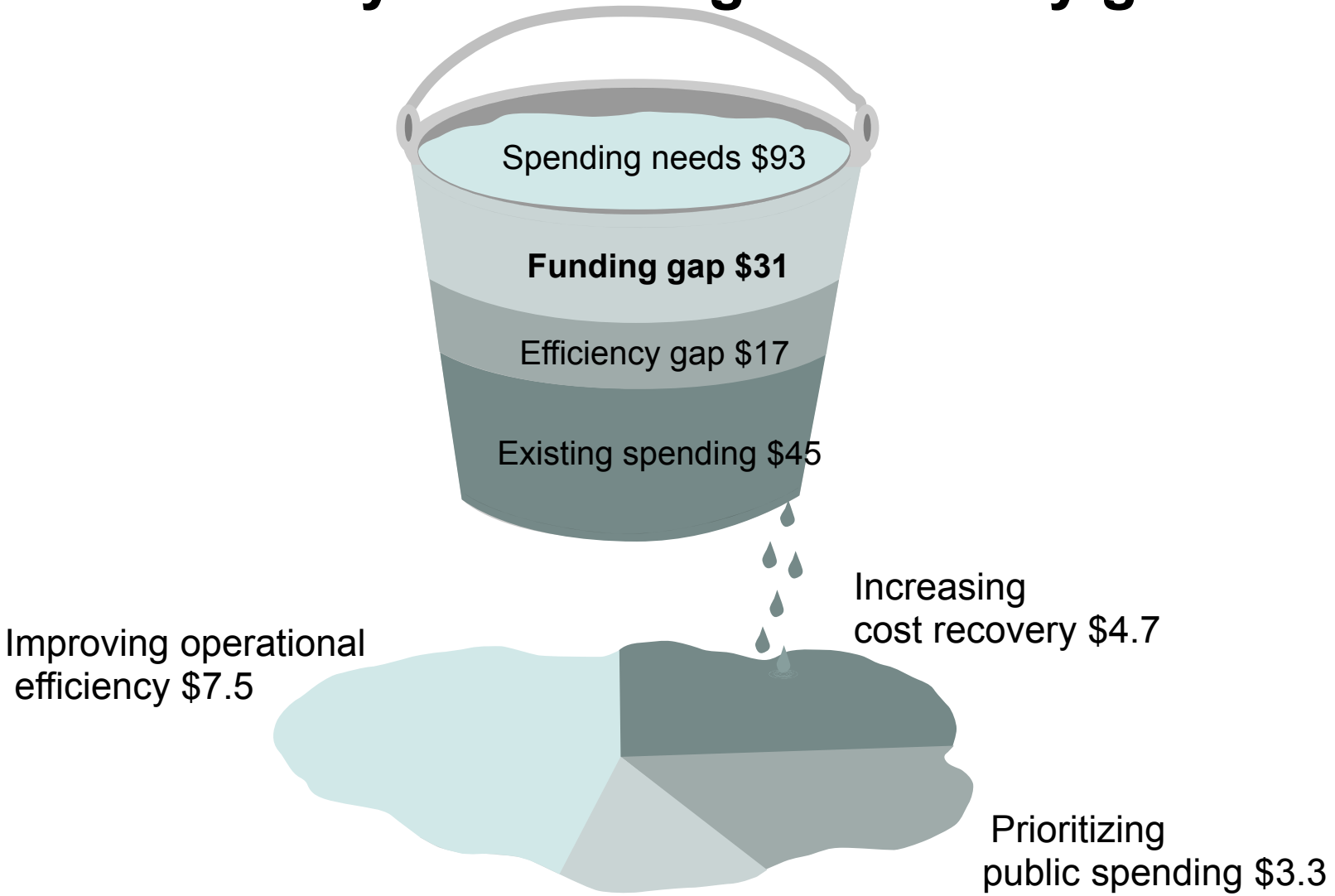

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Results and Implications

- Agricultural productivity growth in Africa, and particularly in SSA, has been impressive since the mid-1980s
- But the performance represents a mere catching up with the levels achieved in the early 1960s, and there has been very little technical change
- Sustaining growth in labor productivity faces challenge of population growth and slowdown in land availability
- To allow this growth to continue there is a need for:
  - Policy improvements and significant investments in agricultural R&D
  - Reduction of the infrastructure gap
  - Increase competition and dependability on access to fertilizers and seeds