Agricultural R&D investment in Africa: Indicators that matter

Presentation to AU-SAFGRAD in preparation for submission of final report "Boosting Investment in Agricultural Research in Africa", 17 May 2021

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Objectives

- Assessment of long-term R&D investment in Africa
- Questioning the current BR process on R&D performance
- Analysis of the quality of research spending and an optimal future spending model
- Address AU comments and concerns on draft report

ASTI collects institutional, investment, human resource, and research output data from agricultural R&D agencies in low- and middle-income countries

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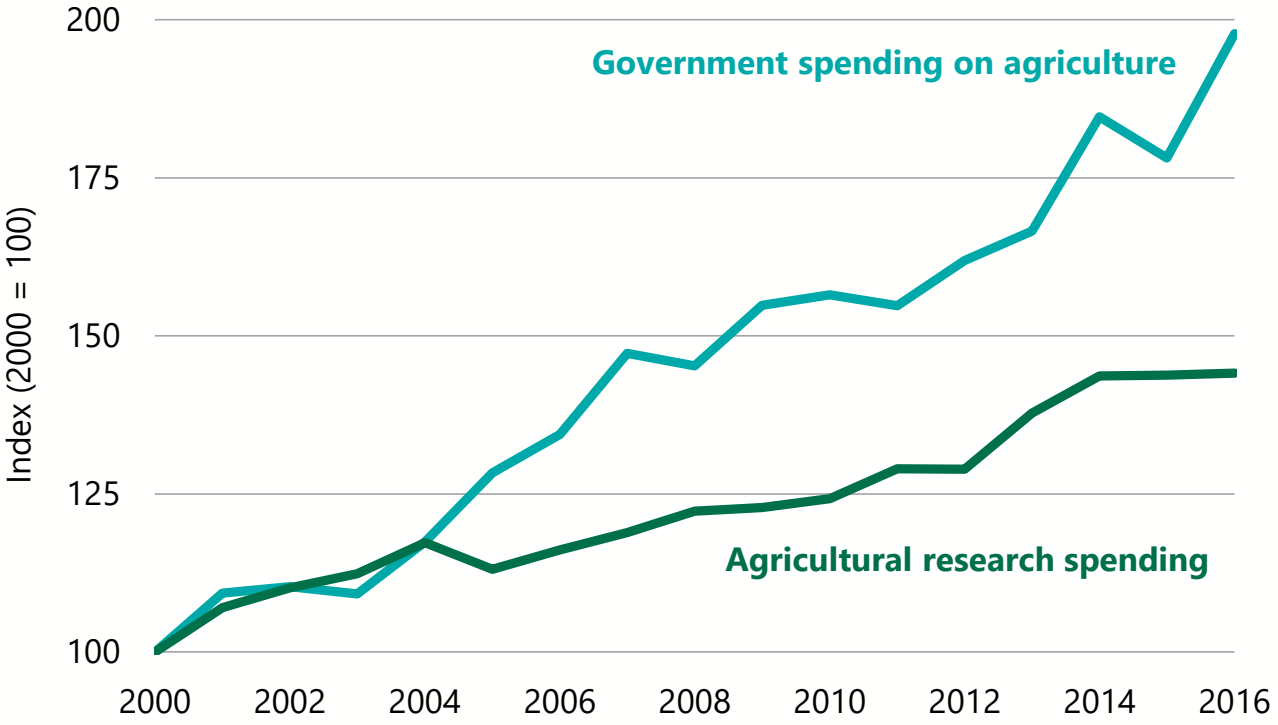
KEY INVESTMENT TRENDS IN AFRICA

- Agriculture sector spending nearly doubled during 2000-2016.
- Agricultural research spending lagged behind.

Agricultural sector and agricultural R&D spending compared



Sources: Data on agricultural spending are from ReSAKSS (2021); data on agricultural research spending are from ASTI (various years).
Notes: Agricultural research spending covers all (salaries, operating, capital) expenditures incurred by government, higher education, and nonprofit agencies involved in agricultural R&D. It excludes private-sector expenditures.

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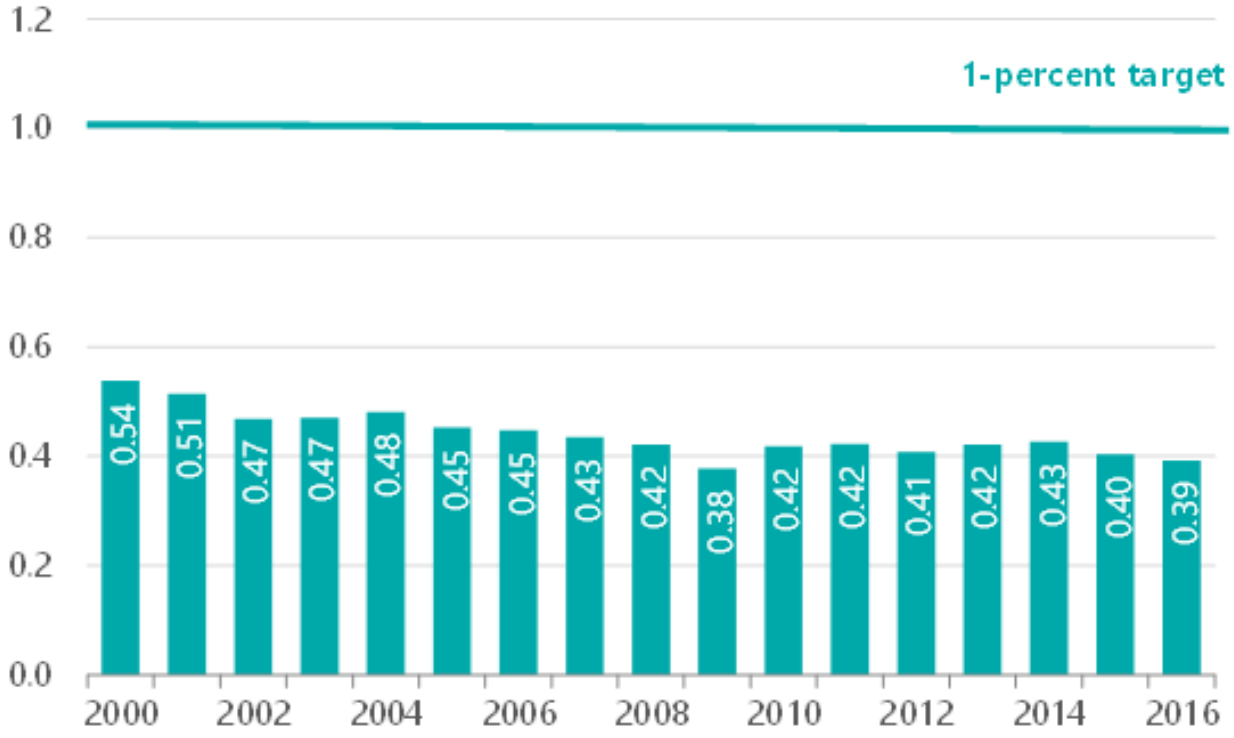
AGRICULTURAL RESEARCH INTENSITY

- Growth in spending on agricultural R&D has also been slower than growth in agricultural output over time.
- Agricultural research spending as a percentage of AgGDP dropped from 0.54 percent in 2000 to 0.39 percent in 2016.

Agricultural R&D spending as a % of agricultural GDP



Sources: data on agricultural R&D spending from ASTI (various years); data on AgGDP from World Bank (2021).

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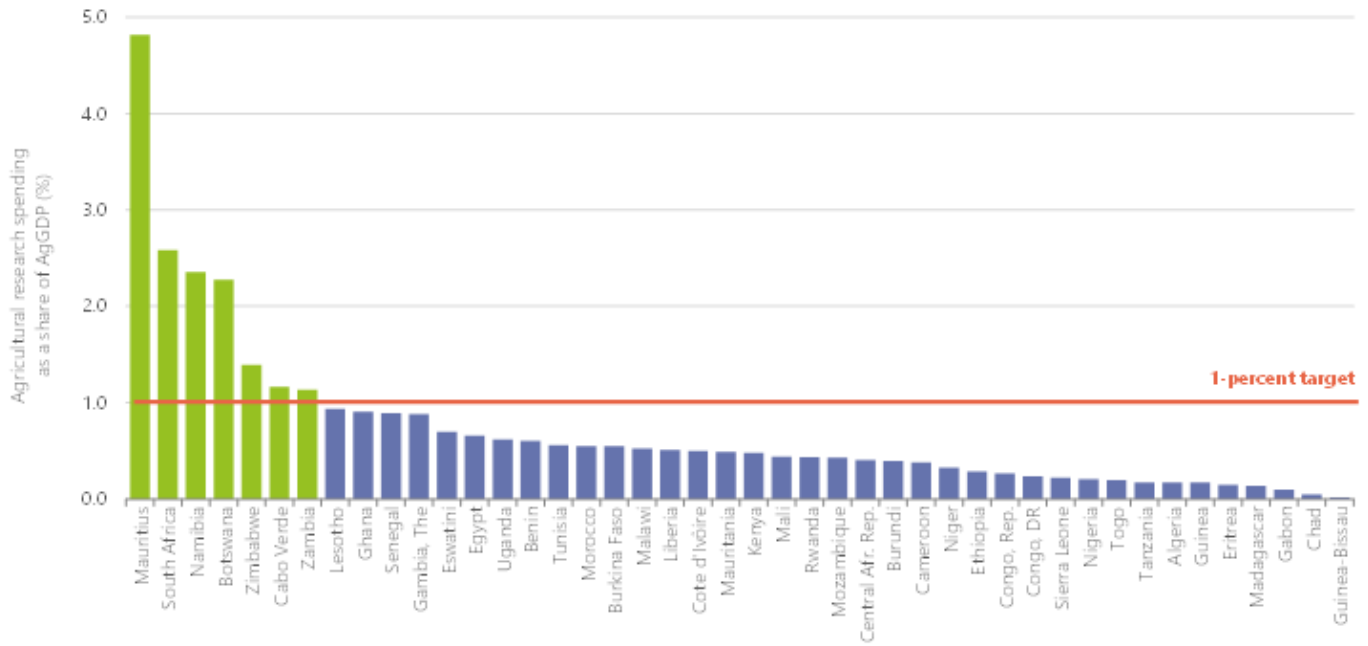
RESEARCH INTENSITY BY COUNTRY

- In 2016, 37 of the 44 African countries for which data were available invested less than 1 percent of their AgGDP in agricultural research.

Agricultural R&D spending as a % of agricultural GDP



Brazil	1.9%
China	0.6%
India	0.3%

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SHORTFALLS OF R&D INTENSITY RATIOS

Intensity ratios fail to consider:

- policy and institutional environment within which agricultural research occurs
- the broader size and structure of a country's agricultural sector and economy
- qualitative differences in research performance across countries.

A one-size-fits-all investment target for Africa is not desirable given that structural economic differences call for different investment strategies.

ASTI developed various alternatives to assess the overall performance of NARS and the level of underinvestment.

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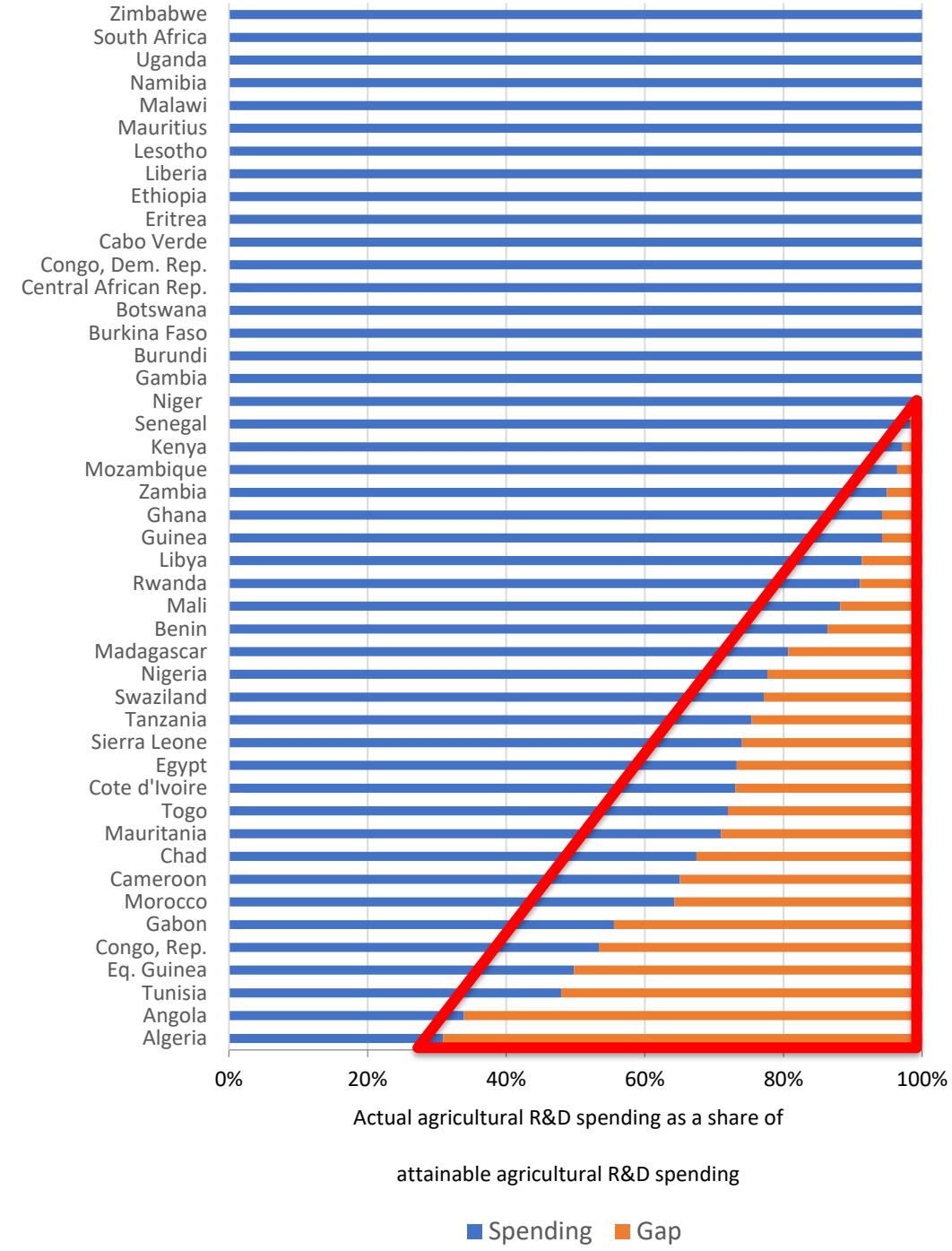
ALTERNATIVE INTENSITY INDICATOR

- ASTI's "attainable level" of R&D investment is based on five variables: 1) the size of a country's economy, 2) size of its agricultural sector 3) its income level, 4) the level of diversification of its agricultural production, and 5) the availability of relevant technology spillovers.
- Africa's R&D investment gap was assessed at roughly $1 billion in 2016.



Underinvestment

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RESEARCH PERFORMANCE INDICATORS

- R&D investment, funding, human capital, and output indicators are combined to assess overall NARS performance of different countries.
- This provides a more balanced view of NARS than investment targets alone.
- Performance differences can be explained predominantly by:
  - The size of research system, which in turn affects quality of human capital and the R&D cost structure
  - Differences in human capital, which directly affect productivity of researchers
  - Budget constraints and lack of resources, which are correlated with donor dependency and volatility of R&D funding

Comparison between best and worst performing countries

	Indicator	Best	Worst	
Size	Average R&D spending	158	14	***
	Number of researchers (FTEs)	1,361	189	-
Human capital, costs and efficiency	Spending per published article ($million/article)	5.03	24.39	***
	Ratio PhD/MSc	1.24	0.42	**
	Spending per researcher ($million/FTE)	0.22	0.09	***
	Salaries per researcher (million $ 2011 per FTE)	0.13	0.04	***
Funding	Volatility	0.12	0.21	***
	Share of R&D funded by donors	0.06	0.26	***

Note: ** and *** mean that the difference is significantly different from 0 at the 5% and 1% levels, respectively

NARS size differences impact performance and efficiency

Indicator	Large	Small	
Number of countries	15	24	***
Total R&D spending (million $ 2011, total all countries)	2,583	422	
Average R&D spending	172	18	***
Number of researchers (FTEs)	1,412	170	**
Spending per published article ($million/article)	4.6	16.2	***
Spending per researcher ($million/FTE)	0.19	0.12	**
Ratio PhD/MSc	1.33	0.57	**
Volatility of R&D spending	0.13	0.20	***

Note: Small systems are in countries spending less than 40 million $ of 2011

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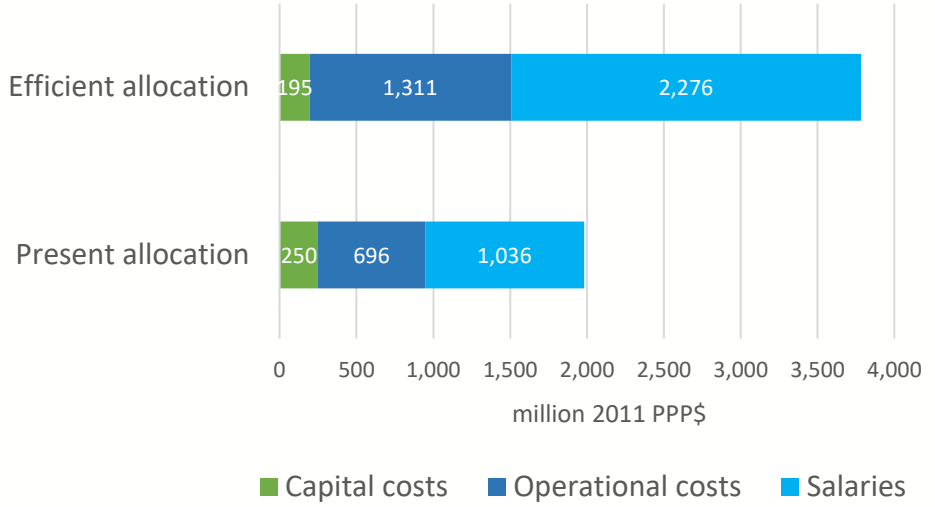
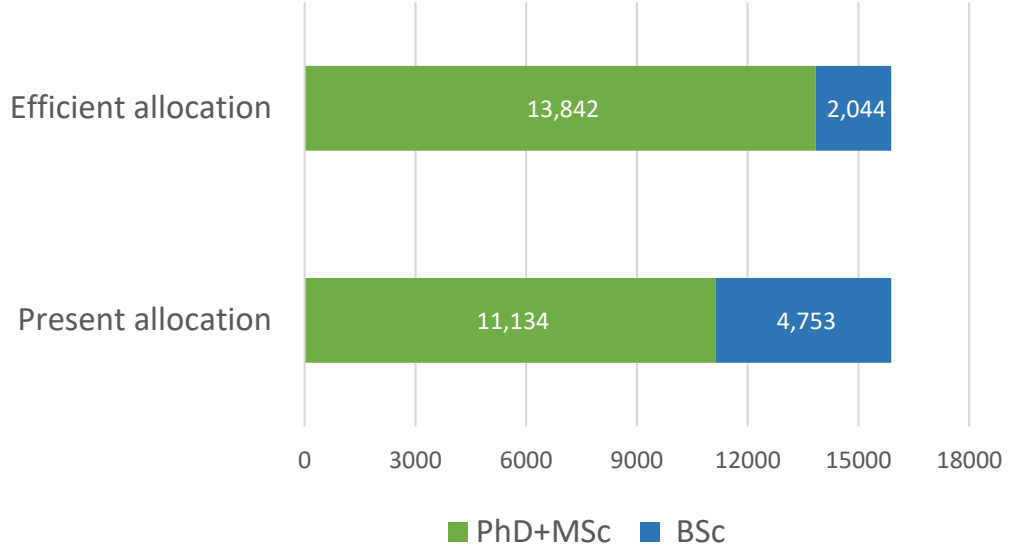
MORE EFFICIENT RESOURCE ALLOCATION

- Egypt, South Africa, and Kenya have the top three research systems in Africa.
- Increase spending in the rest of Africa to match the cost structure and human capital composition of these 3 countries (keeping the number of researchers constant).
- Result: Africa needs to double R&D spending (and spending in salaries and operational costs), and increase the number of PhD- and MSc-qualified researchers by a quarter.

Comparison between actual and efficient cost structure



Comparison between actual and efficient composition of human capital



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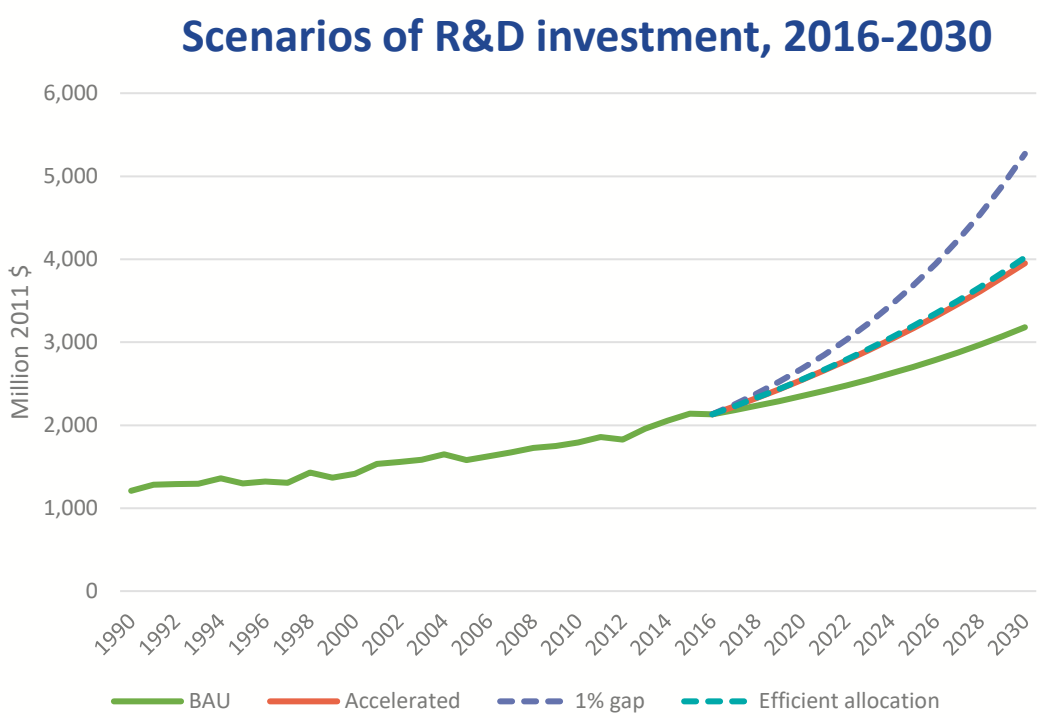
4 R&D INVESTMENT SCENARIOS

- *Closing-the-1%-gap* scenario requires the highest annual investment: $3.7 billion, compared to $2.8 billion under BAU.
- *Accelerated-R&D-investment* and *Efficient-allocation* scenarios need a similar amount ($3.2 billion).



- ***Business-as-usual* (BAU)** scenario: R&D investment growth continues the historical trajectory of 2000–2016, growing at an average annual rate of 2.4%.
- ***Accelerated-R&D-investment*** scenario: R&D investment growth is increased to the rate of agricultural sector spending between 2000 and 2016, i.e. 4.5% per year
- ***Closing-the-1%-gap*** scenario: R&D investment growth is increased to reach 1% of AgGDP investment by 2030; average annual spending growth rate of 6.7%.
- ***Efficient-allocation*** scenario: R&D investment growth is increased to match cost and human capital structure of efficient countries by 2030; average annual spending growth ate of 4.6%.

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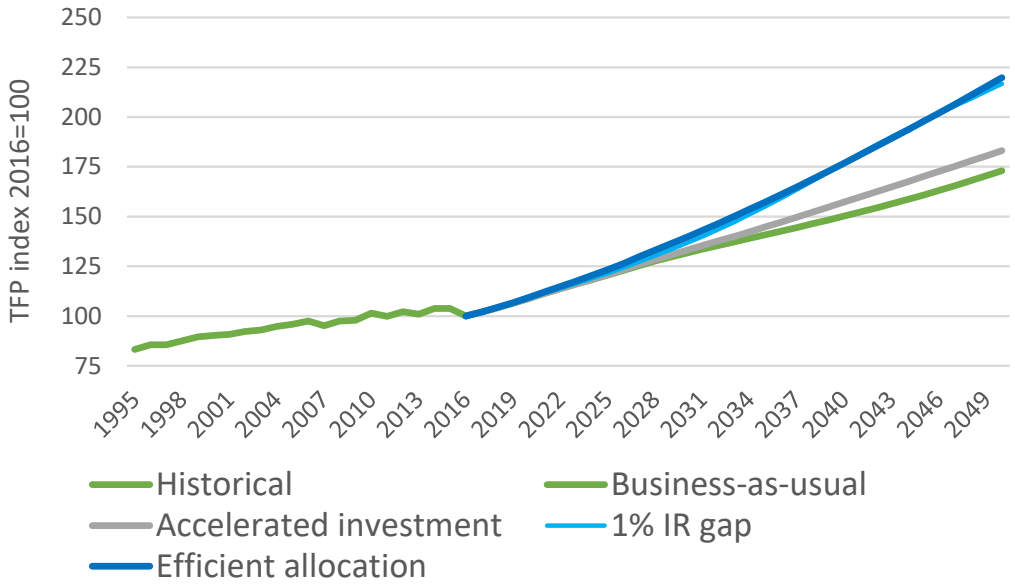
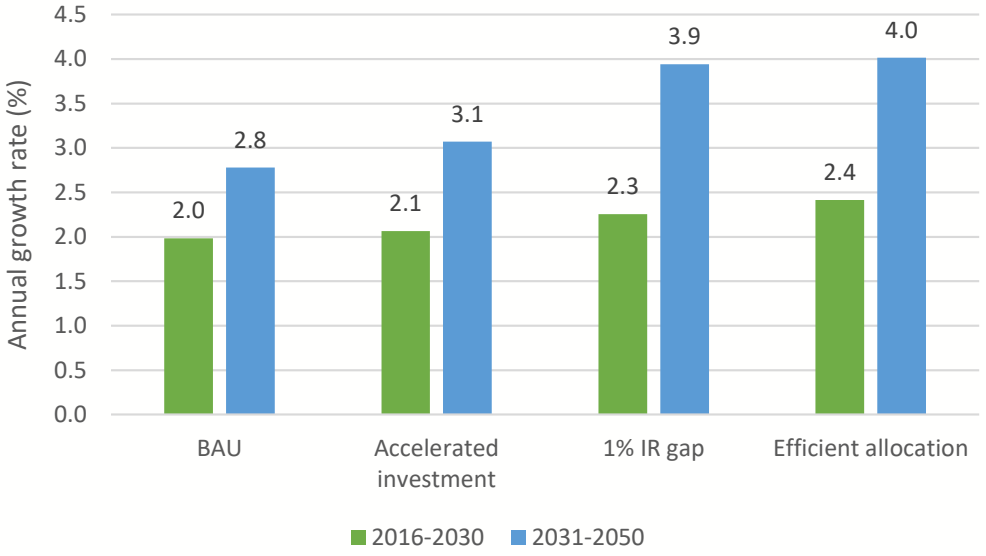
PRODUCTIVITY IMPACT OF INCREASED R&D INVESTMENT

- 1% average annual TFP growth between 1990 and 2016.
- Continued investment at historical rates (BAU scenario) would result in accelerated annual TFP growth (2.0% until 2030 and 2.8% during 2030-2050).
- Increased R&D investment could accelerate annual TFP growth after 2030 to nearly 4.0% under the *Efficient-allocation* and the *1%-gap* scenarios (a very high and overly optimistic rate of TFP growth).
- The *1%-gap* scenario would require higher investment to reach the same result.

TFP trends under different investment scenarios



Annual TFP growth rates under different scenarios



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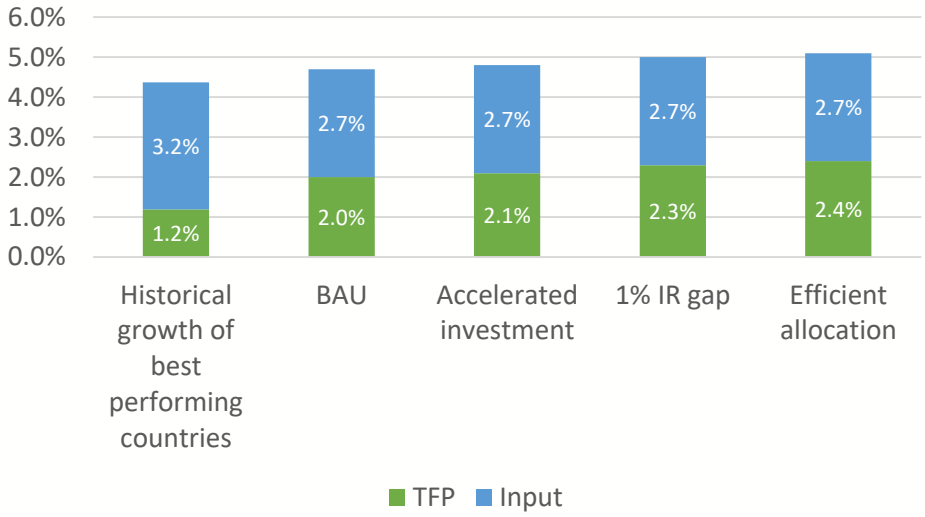
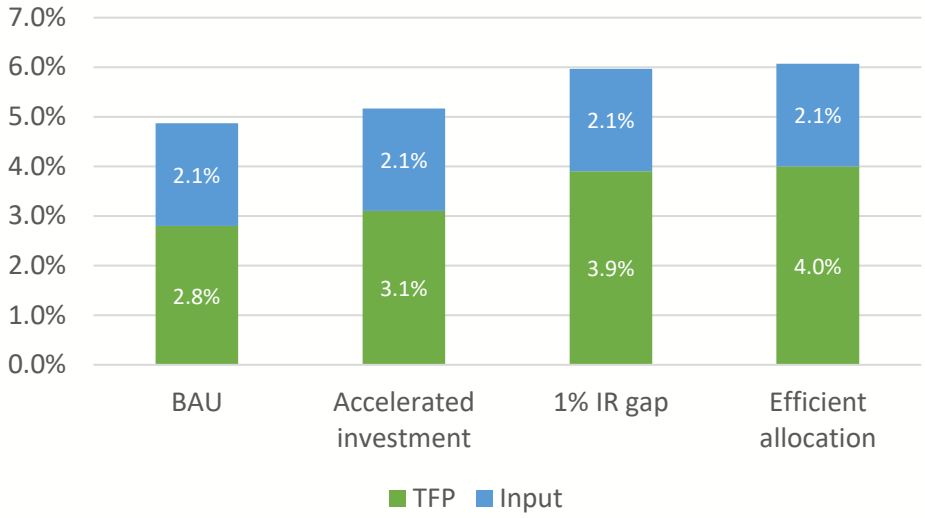
6% OUTPUT GROWTH?

- Growth in Africa's best performing countries during 1990-2016 was above 4% per year driven by input growth (growth of land, fertilizer, feed, animal stock, and machinery).
- Expected reduction in the incorporation of new land in the future (compensated in part by higher use of capital and inputs) would result in reduced input growth.
- TFP growth is expected to play a bigger role in future growth than in the past.
- Because of the lagged effects of research, 6% annual growth in agriculture could only be reached after 2030 (other things being equal) with increased R&D investment and/or more efficient research systems.

Contribution of TFP and input growth into medium-term (2016–2030) output growth



Contribution of TFP and input growth into long-term (2030–2050) output growth



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CONCLUSION

AFRICAN COUNTRIES NEED TO INCREASE AGRICULTURAL R&D INVESTMENT. THE KEY QUESTION IS: HOW?

- The intensity ratio is not a good measure of underinvestment.
- Even if it were, increasing investment across the board to reach 1% of AgGDP will not give Africa the best return to investment.
- A better approach is to define regional investment priorities together with subregional collaboration between countries.

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Policy Recommendations

- Higher rates of R&D investment are needed, but improving investment allocation and enhancing efficiency of research systems is key.
- Pool resources regionally to overcome budget constraints, undersupply of researchers, and small and inefficient systems:
  - ✓ Promote research collaboration between efficient systems and smaller and/or inefficient systems to enhance critical mass in main research areas, avoid duplication of efforts, and increase the return of limited resources
  - ✓ Direct donor funding to support these regional programs instead of spreading resources too thin across countries
  - ✓ Work with donors and regional partnerships, conditioning funding to participation in these programs
  - ✓ Increase investment based on efficiency of research systems combined with regional collaboration between countries.

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Recommendations for BR process

- Monitoring performance is a crucial element to improve efficiency and achieve institutional goals:
  - ✓ Consider adopting more meaningful R&D indicators as part of the BR process
  - ✓ Harmonize R&D data collection and methodology
  - ✓ Strengthen linkages between AU-SAFGRAD, countries, and ASTI for future data collection rounds

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Thank you

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