Agricultural Productivity and Climate Change in Sub-Saharan Africa

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AGRICULTURAL PRODUCTIVITY AND CLIMATE CHANGE IN SUB-SAHARAN AFRICA

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Introduction

In Sub-Saharan Africa (SSA), rural poverty accounts for 90% of total poverty and about 80% of the poor depends on agriculture for their livelihoods (Dixon, Gulliver, and Gibbon 2001).
Rain-fed agricultural dominates agricultural production in SSA, covering around 97% of total cropland and exposes agricultural production to high seasonal rainfall variability. (The International Food Policy Research Institute (IFPRI)).
SAA is the most vulnerable region to climate change because of its climate variability and widespread poverty which limits adaptative capacity. This could seriously worsen livelihood conditions for the rural poor and increase food insecurity in the region.

Objectives

- Obtain measures of agricultural productivity covering 46 countries in SAA.
- Examine the potential role of some factors (including irrigation and drought) in explaining the difference in countries performances.

Model

- **P**arametric Stochastic Translog Production Frontier;

$$\ln Y_{it} = a_o + \sum_{j=1}^{5} b_j x_{ijt} + \frac{1}{2}\sum_{j=1}^{5} c_{jj} x_{jj}^2 + \sum_{j=1}^{5}\sum_{k>j}^{5} c_{jk} x_{ijt} x_{ikt} + b_t t + \frac{1}{2} b_{tt} t^2 + \sum_{j=1}^{5} b_{jt} x_{ijt} t + \varepsilon_{it}$$

$$\varepsilon_{it} = -u_{it} + v_{it}$$

$$where \quad i = 1,\ldots,46 \ countries. \quad J \ and \ k = 1,\ldots,5 \ inputs. \ t = 1,\ldots,46 \quad time \quad period.$$

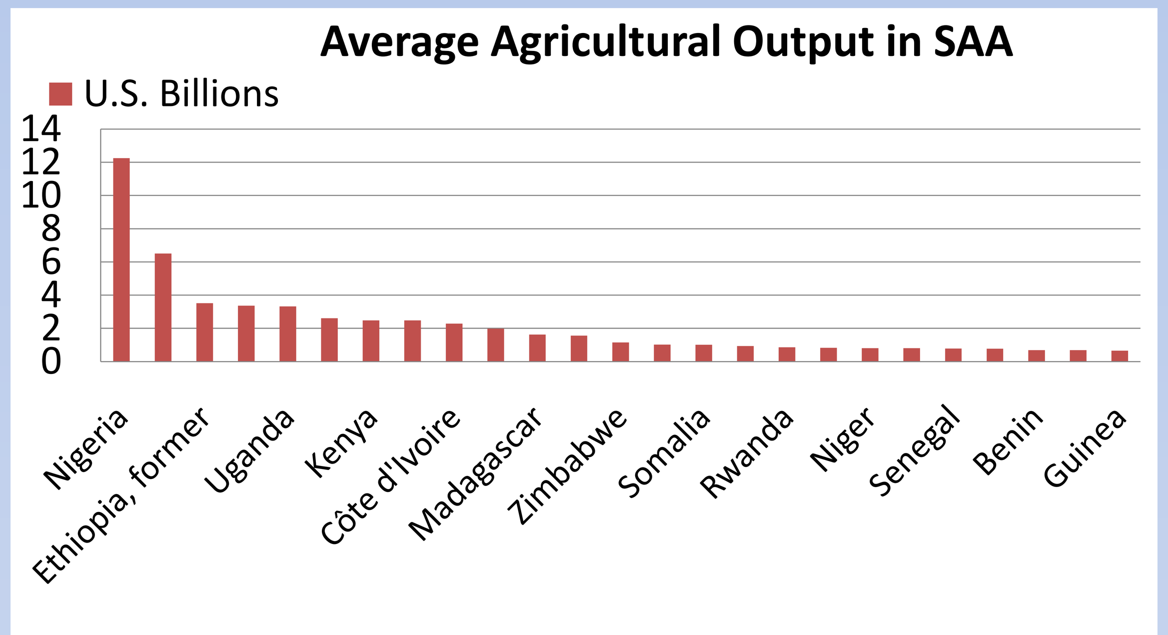
- Non-Parametric, non-Stochastic Malmquist Index.
- These two approaches complement each other given that in general, specification error is a problem in econometric studies especially when technological change is monotonic.

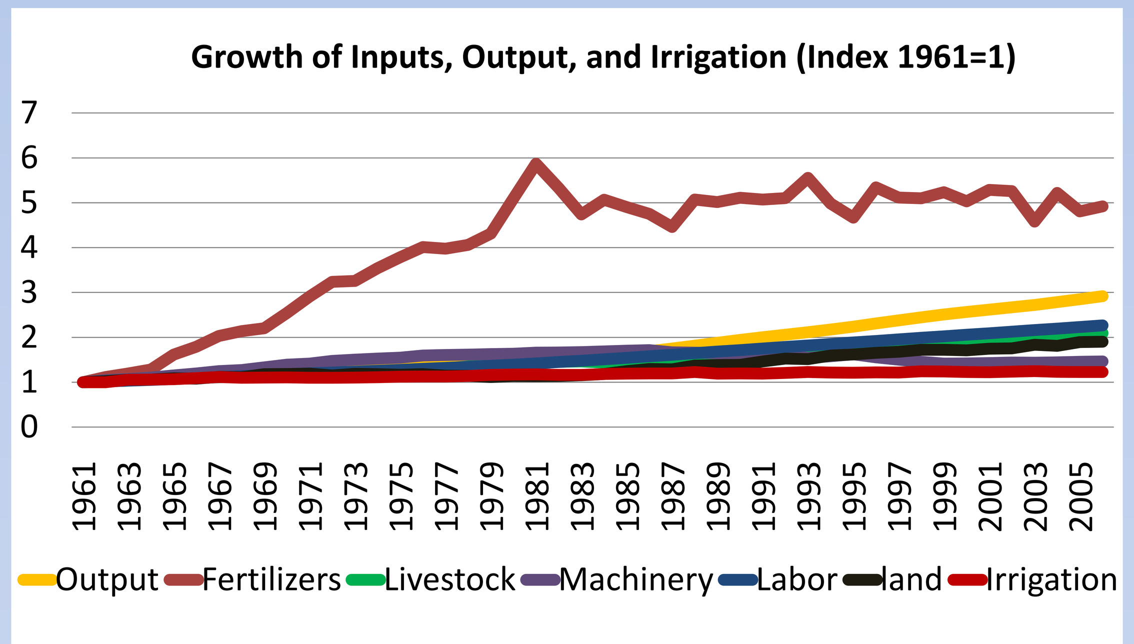
Data

- 46 countries, from 1961-2006
- Output: Agricultural Gross Production.
- Inputs: Fertilizers, Livestock, Machinery, Labor, Land.
- Efficiency changing variables: irrigation, drought, armed conflicts, war, colonial heritage, years after independence,

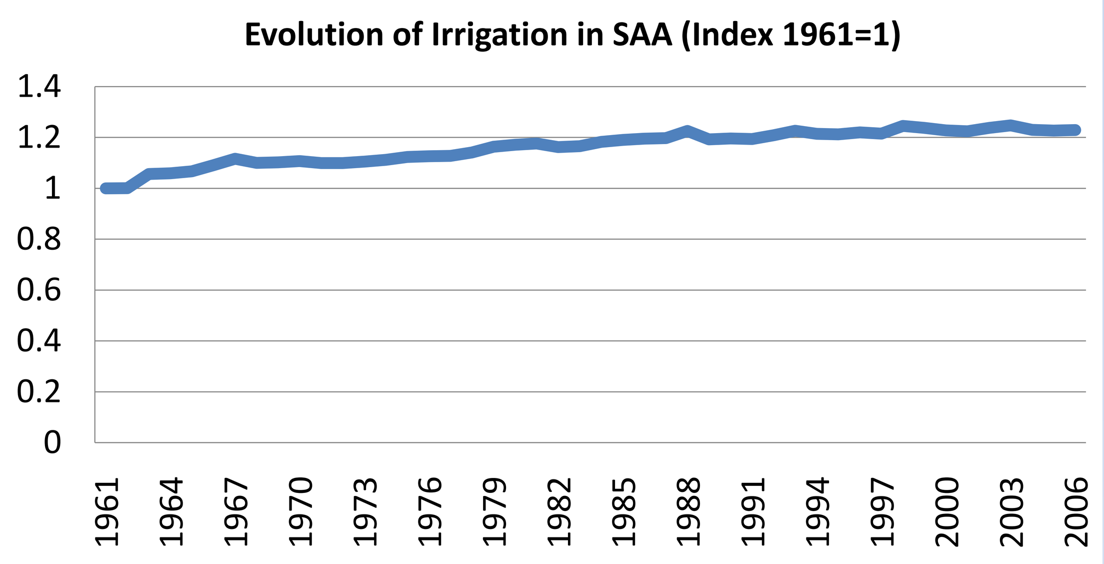
Irrigation, Drought, and climate change in SAA

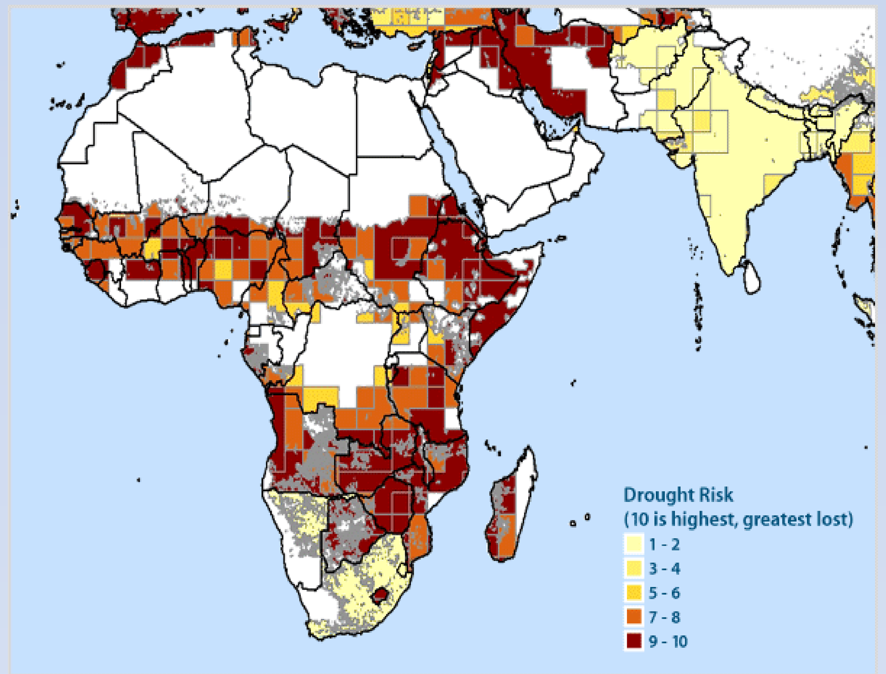
Output growth rates between 1961-2006 were about 2.5%. Increased agricultural productivity and irrigation would help agriculture play its role as an engine of growth and poverty reduction.

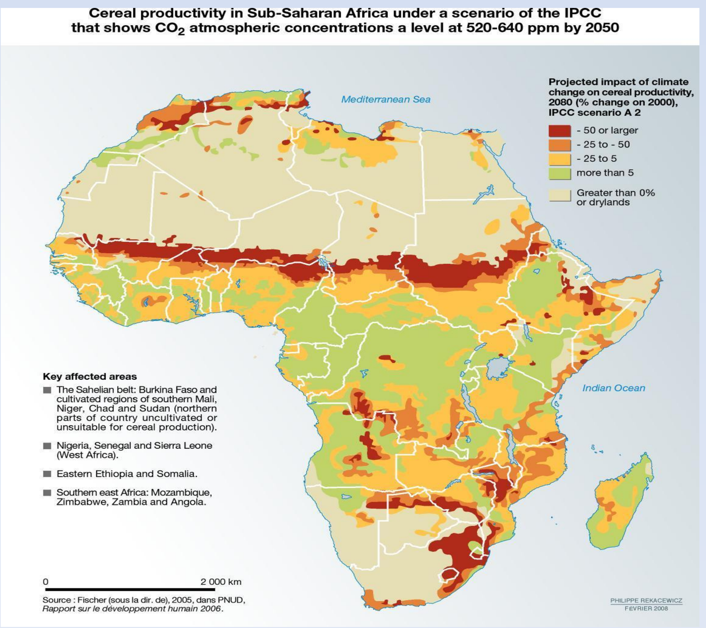




- IFPRI reports that irrigation water supply reliability, the ratio of water consumption to requirements, is expected to worsen in SSA due to climate change.
- SAA has the potential for expanding irrigation and increasing agricultural productivity.

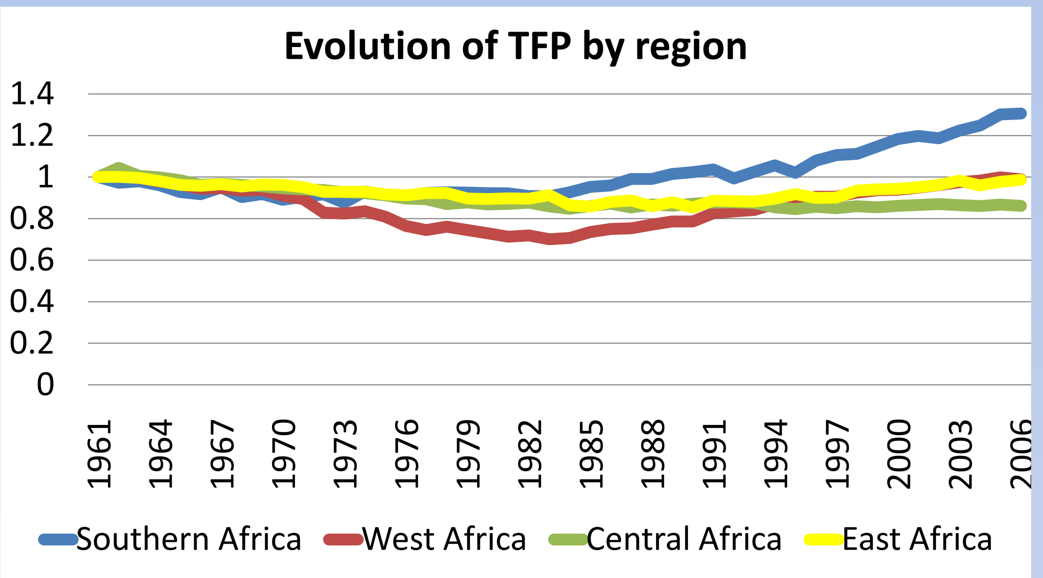


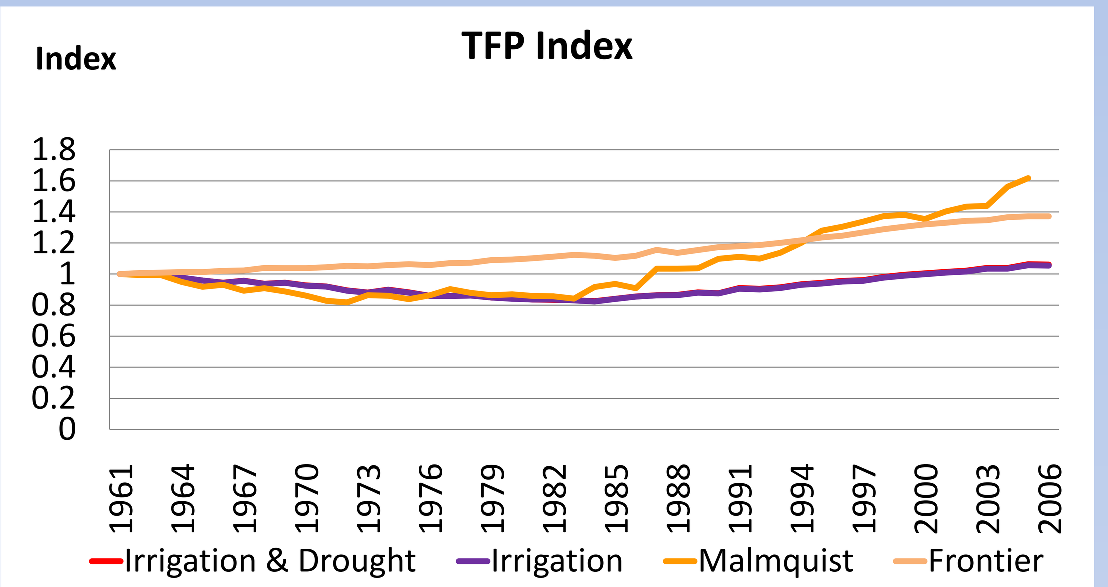




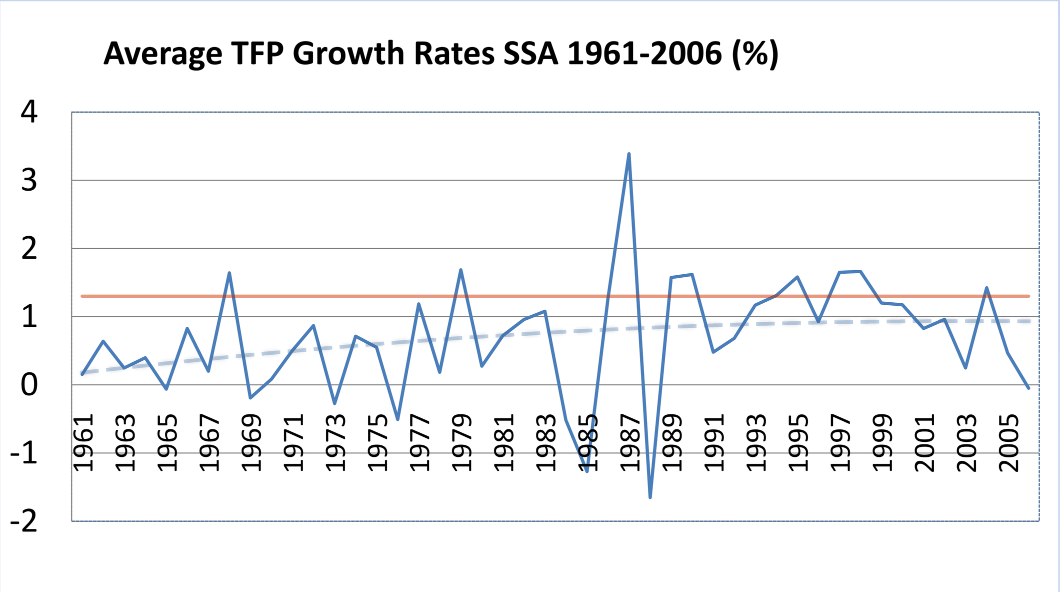
- United Nations Convention to Combat Desertification (UNCCD) indicates that drought and desertification in SAA are serious challenges on threats facing sustainable development in the region.
- Increased climate variability and droughts due to climate change will negatively affect agricultural production.

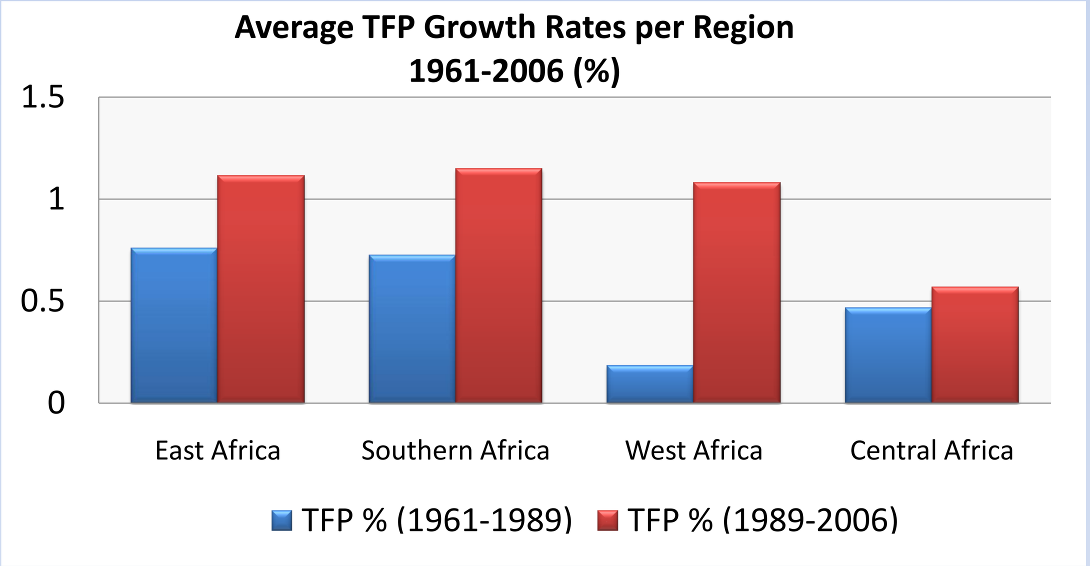
Results





- Positive growth rates from 1990 to 2006 (1.09%).
- Southern Africa and West Africa performed better with higher productivity rates.
- Malmquist and Stochastic Frontier Methods show consistent results (low TFP growth rates) from 1961 to mid-1980s then both indicate increasing TFP growth rates.





Conclusion

- The region exhibited positive growth rates of 0.12% between 1961-2006 and 1.09% between 1990-2006.
- No evidence **of slowdown but improvement in TFP**
- South Africa and Nigeria have the highest irrigation ratio and the higher TFP growth rates.
- **Irrigation: positive impact on TFP**; Drought: Negative impact on TFP; armed conflicts: negative impacts on TFP.
- Irrigation and improvements in agricultural productivity are key variables, not only for future economic development, poverty reduction, and food security in SAA but also for climate change adaptation.
- Next step: Incorporate CO_2 emissions as a bad output using a distance function. Preliminary results indicate lower TFP rates in SSA.

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