Title: Agricultural Productivity, Water Scarcity and Climate Change in Sub-Saharan Africa

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➢ INTRODUCTION

- Increased agriculture productivity in Sub-Saharan Africa (SSA) is important for poverty reduction and food security (70% of the poor live in rural areas and depend on agriculture for their livelihoods)
- Agriculture in SSA is very sensitive to **climate variability** (about 98% of the agriculture is rainfed, and only 5% of cropland is irrigated)
- The effects of increasing **water scarcity** (physical and economic) due to climate change could be devastating and need to be examined

➢ OBJECTIVES

- Modify total factor productivity (TFP) measurements to include the impact of water scarcity and climatic factors
- Examine the effects of precipitation, drought, irrigation and temperature on TFP growth rates.

➢ METHODS

1. Parametric Stochastic Translog Production Frontier

$$\ln Y_{it} = a_o + \sum_{j=1}^{5} b_j x_{ijt} + \frac{1}{2}\sum_{j=1}^{5} c_{jj} x_{jj}^2 + \sum_{j=1}^{5}\sum_{k>1}^{5} c_{jk} x_{ijt} x_{ikt} + b_t t + \frac{1}{2} b_{tt} t^2 + \sum_{j=1}^{5} b_{jt} x_{ijt} t + d_1 P_{it} + d_2 P_{it}^2 + f_1 h_{it} + f_2 h_{it}^2 + \varepsilon_{it}$$

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

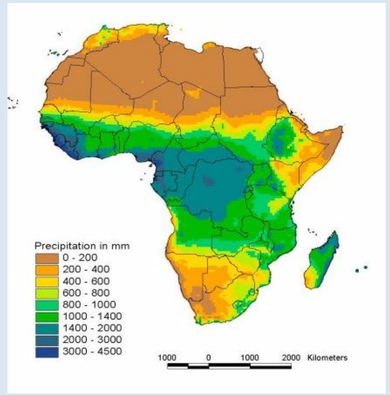
where i= 1,…,41 countries; J and k=1,…,5 the inputs (fertilizer, livestock, machinery, labor, and land). Period t=1,..,40; h is temperature, P is precipitation.

2. Standard Precipitation Index (SPI): used to construct drought variable

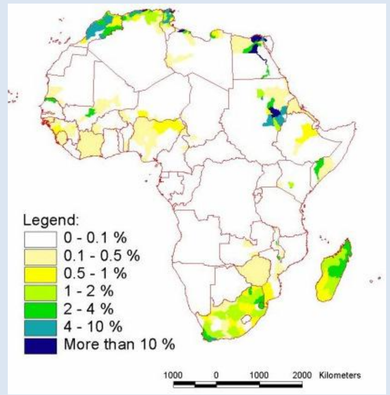
➢ RESULTS

- Precipitation and temperature are positively associated with agricultural production up to a certain threshold;
- Once drought is accounted for, the gap in countries agricultural performance decreases;
- Once irrigation is accounted for, the gap in countries performance increases.

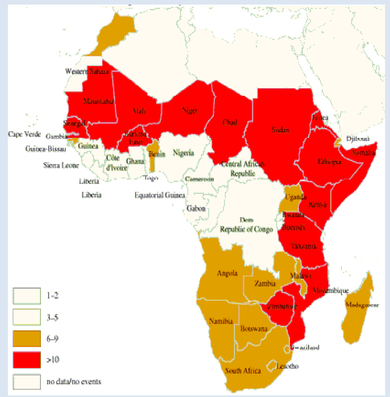
Average annual Precipitation



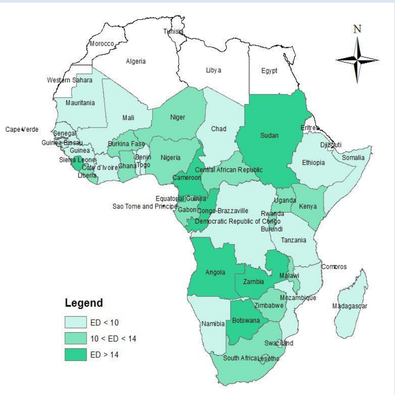
Irrigated areas



Drought events (1970=2004)

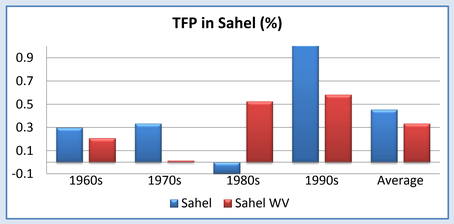


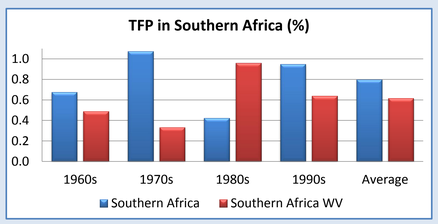
Drought from 6-month SPI

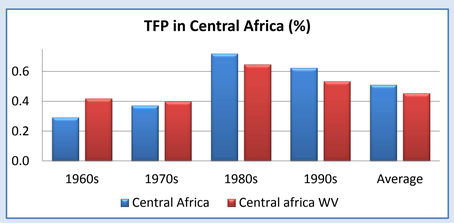


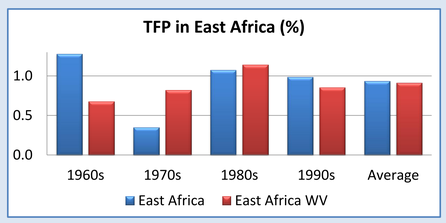
➢ RESULTS (…)

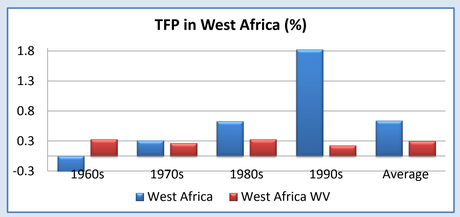
TFP = Total factor productivity
TFP WV = Total factor productivity with water and climatic factors





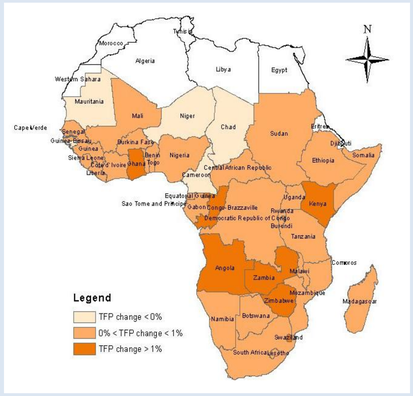






Decades	TFP (%)	TFP WV (%)
1960s	0.41	0.44
1970s	0.46	0.46
1980s	0.54	0.72
1990s	1.19	0.51
Average (1960-2000)	0.66	0.54

Average SSA TFP growth rates (%)



➢ CONCLUSION

- Taking water and climatic factors into account in TFP measurements results in lower TFP growth rates-providing a better understanding of reduced water availability in a region that is already food insecure
- Sahel and southern Africa have experienced the lowest TFP rates

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