2014 ReSAKSS Annual Conference
Addis Ababa · Ethiopia · 8-10 October
PROMOTING AGRICULTURAL TRADE TO ENHANCE RESILIENCE

Regional trade flows and resilience in COMESA and ECOWAS countries

HarvestChoice
BETTER CHOICES, BETTER LIVES

IFPRI

ReSAKSS Africa Wide
Regional Strategic Analysis and Knowledge Support System
FACILITATED BY IFPRI | A PROGRAM IN SUPPORT OF CAADP IMPLEMENTATION

Outline

- Background and motivation
- Methodology
- Data
- Descriptives
- Regression and simulation results
- Historical rainfall data analysis (maize)
- Conclusions

Background and motivation (1)

- Trade is affected by biophysical conditions and climate variability, mostly through production
- In turn, production characteristics and conditions are extremely heterogeneous across SSA
- Increasing need to assess to what extent households are resilient to shocks, and to assess how the latter shape trade flows
- Analysis focused on ECOWAS and COMESA countries, given their agreements on free trade areas

Background and motivation (2)

- ***Objective***: quantify the linkages between biophysical characteristics, production, and trade flows

- ***Question***: what is the impact of extreme weather shocks (excessive rain, prolonged drought, soil depletion,…) on exports and imports in COMESA and ECOWAS countries?

- ***Main idea***: if one shock occurs in a specific country, it not only affects that country but also all commercial partners involved, both on the import (through variation in income and/or changes in demand) and the export (through production) side

Methodology

- Panel data methods (for each country *i* at time *t*):

$y_{it} = N_{it} + C_{it} + Se_{it} + Pg_{it} + \mu_i + \varepsilon_{it}$, where

$y_{it} \rightarrow$ logarithm of agricultural production; net exports

$N_{it} \rightarrow$ matrix of natural (biophysical) risk variables

$C_{it} \rightarrow$ matrix of crop and livestock disease risk variables

$Se_{it} \rightarrow$ socio-economic factors

$Pg_{it} \rightarrow$ population and location of largest city/market, total crop land area

$\mu_i \rightarrow$ fixed effects controlling for the heterogeneity among countries

$\varepsilon_{it} \rightarrow$ error term

Data

y_{it} → FAO value of total agr. production; FAOTRADE (Exports FOB, Imports CIF) 1993-2010

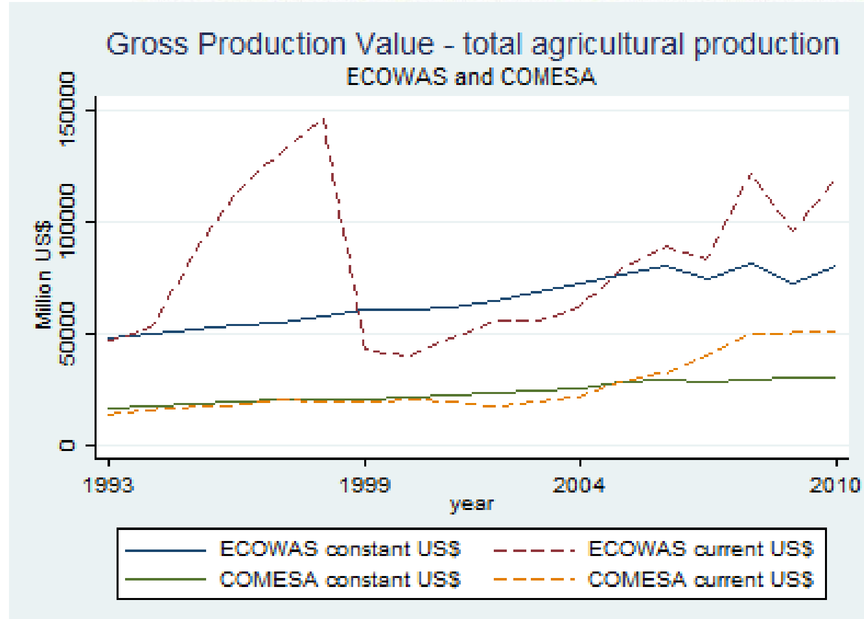
N_{it} → long-term rainfall (CRU, 1993-2010), temperature (1993-2010), NDVI (NASA, AVHRR, 1993-2009; MODIS 2010), soil quality (CIESIN, Columbia University, 2000), tree coverage (University of Maryland, 2000)

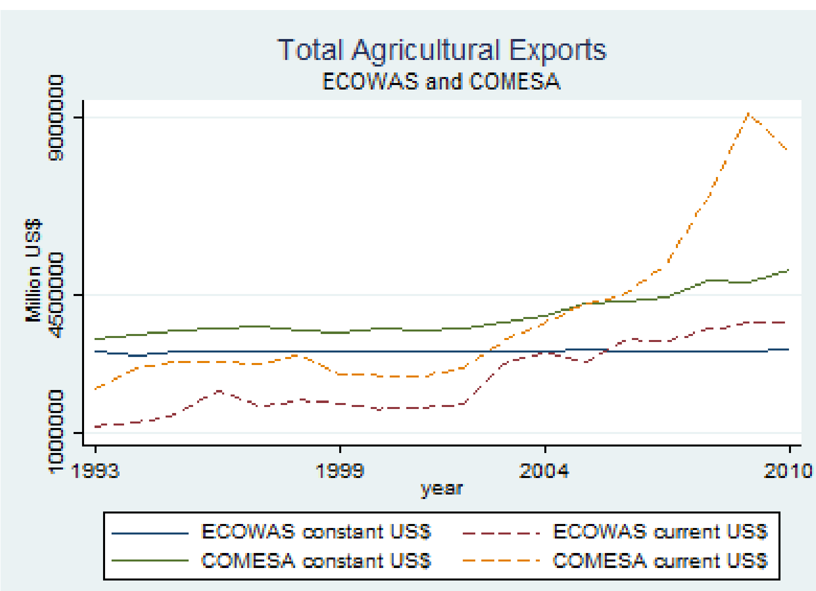
C_{it} → crop disease, pest, and weed prevalence (Rosegrant *et al.*, 2014)

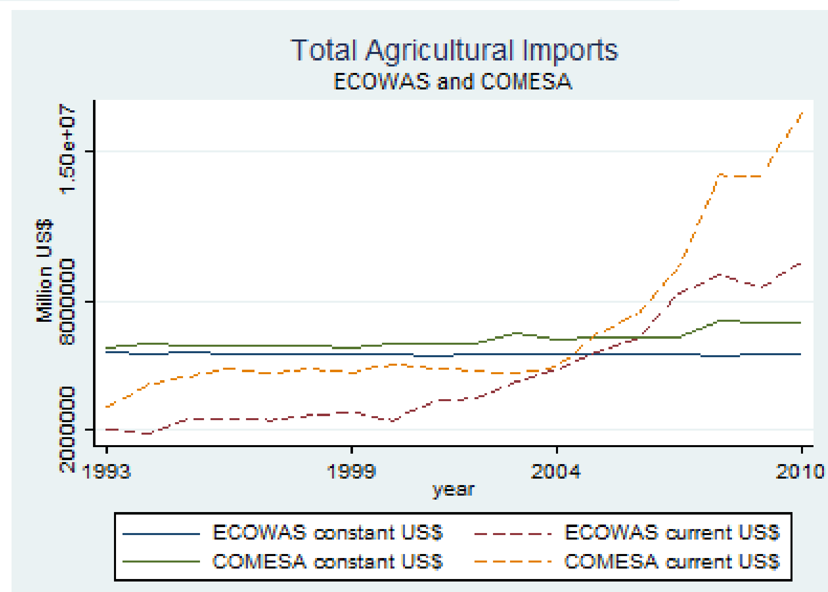
Se_{it} → total population (UN, 2012); GPD per capita, PPP (WDI, 2013)

Pg_{it} → population and location of the largest city/market (HarvestChoice); total crop land area (HarvestChoice)

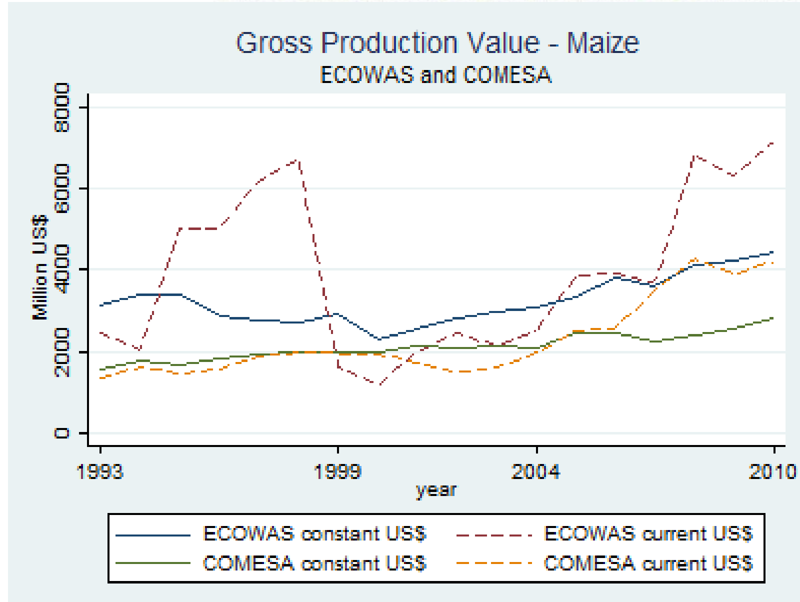
Descriptives (1): total agricultural production and trade flows

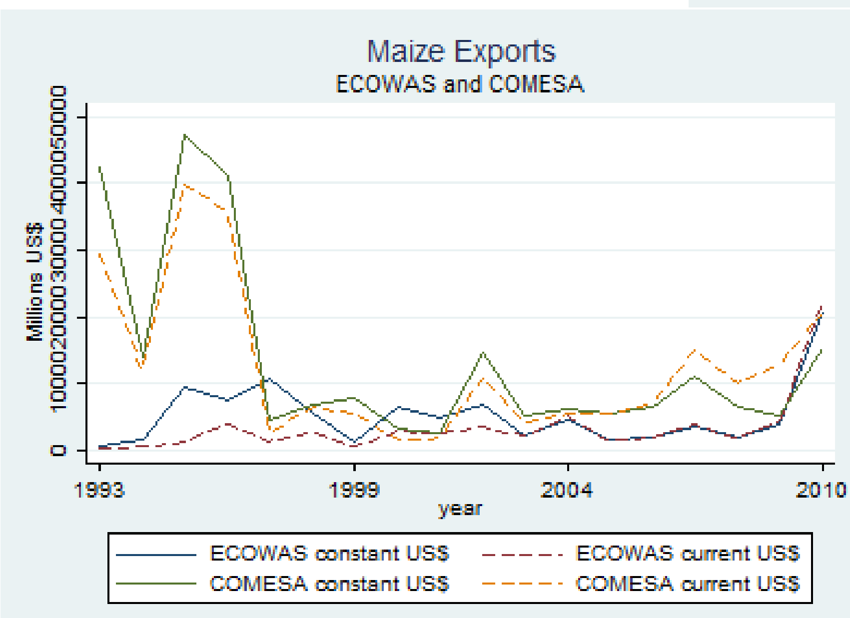






Descriptives (2): maize





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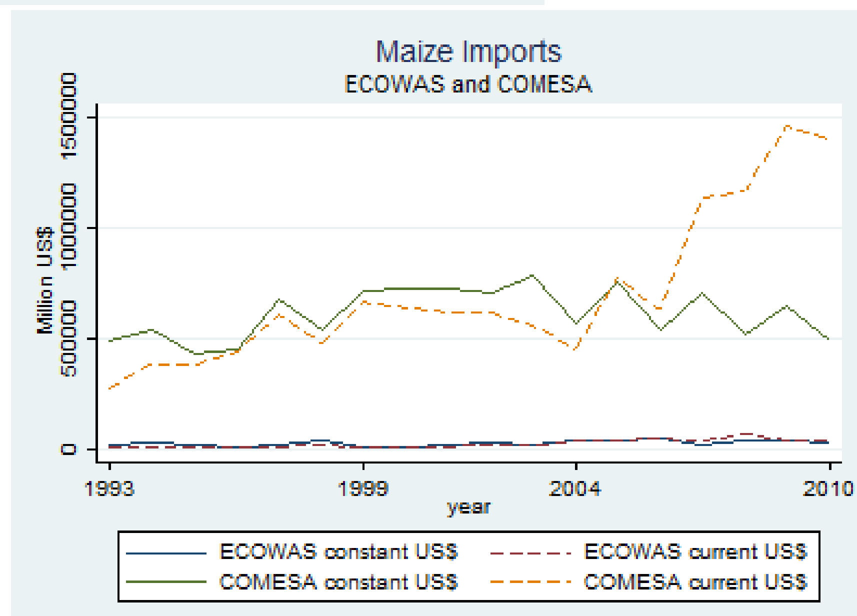
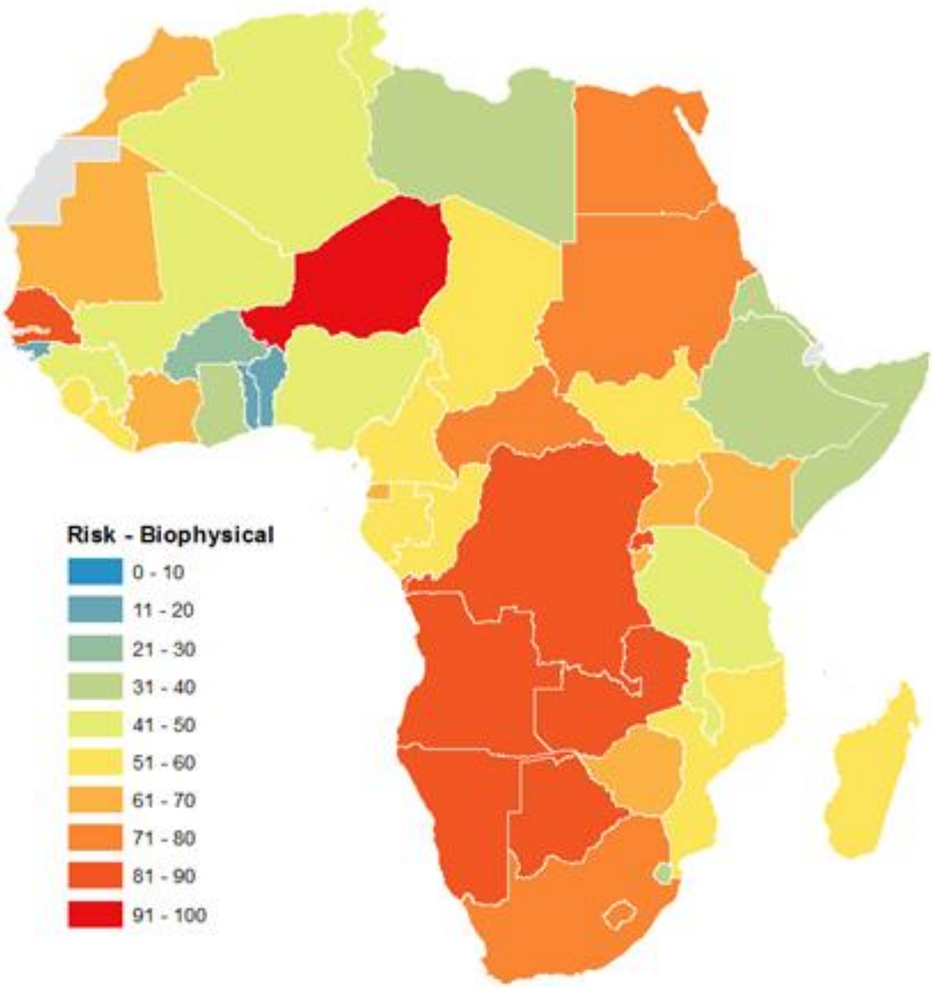
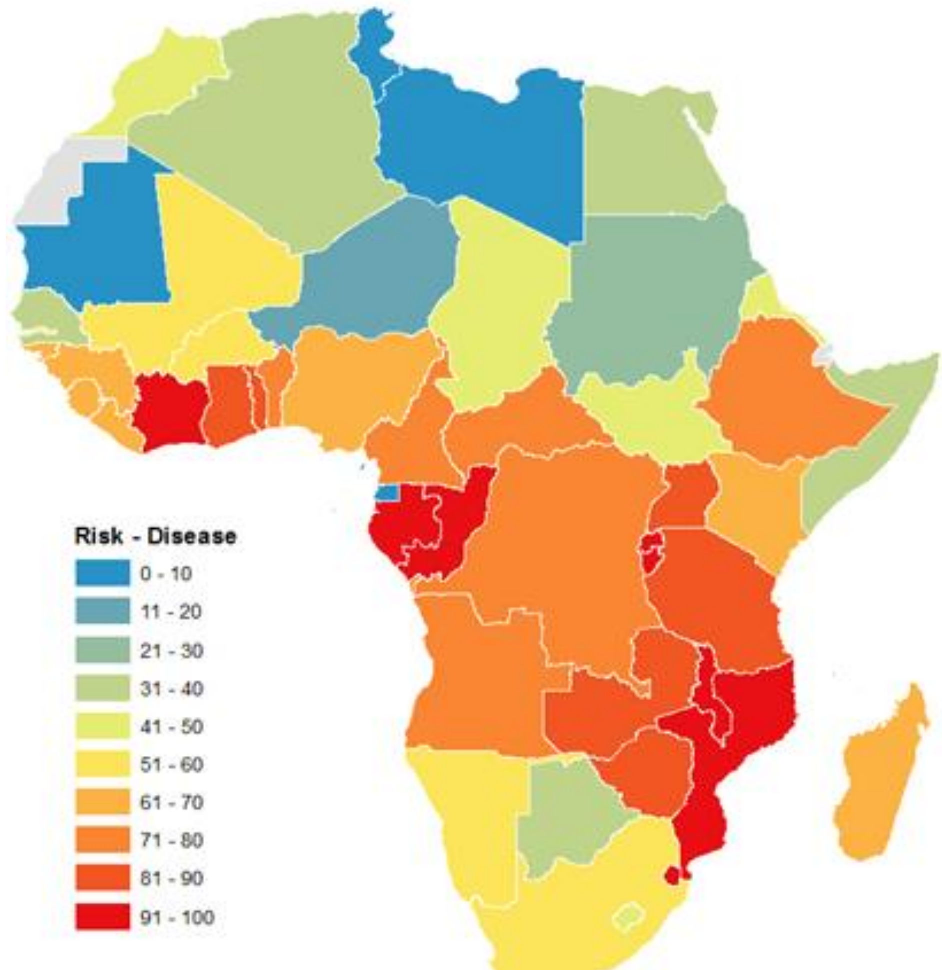


Descriptives (3): biophysical variables

Growing conditions risk index

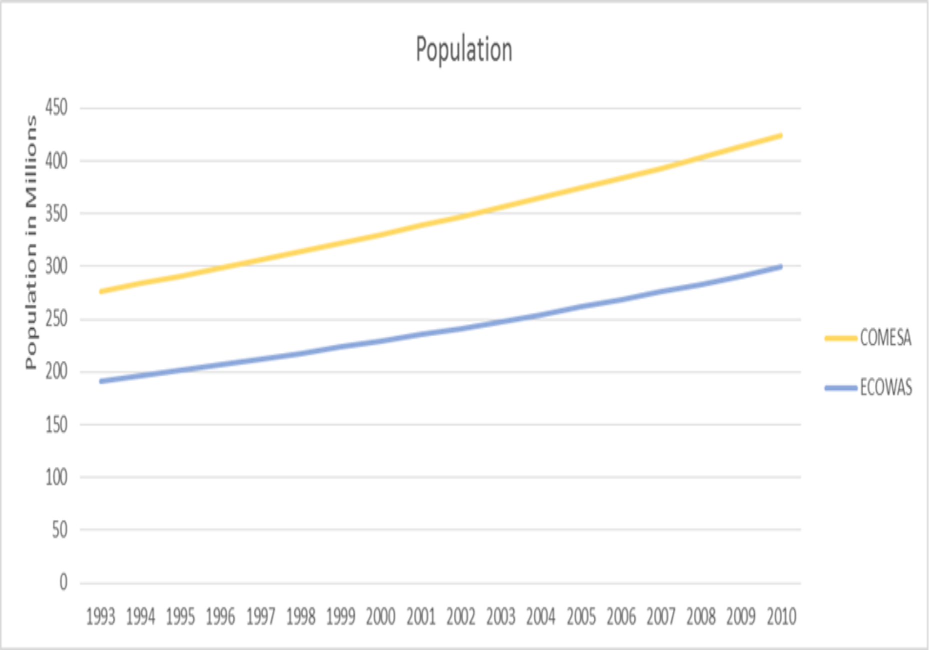


Disease risk index



Descriptives (4): socio-economic factors

Population

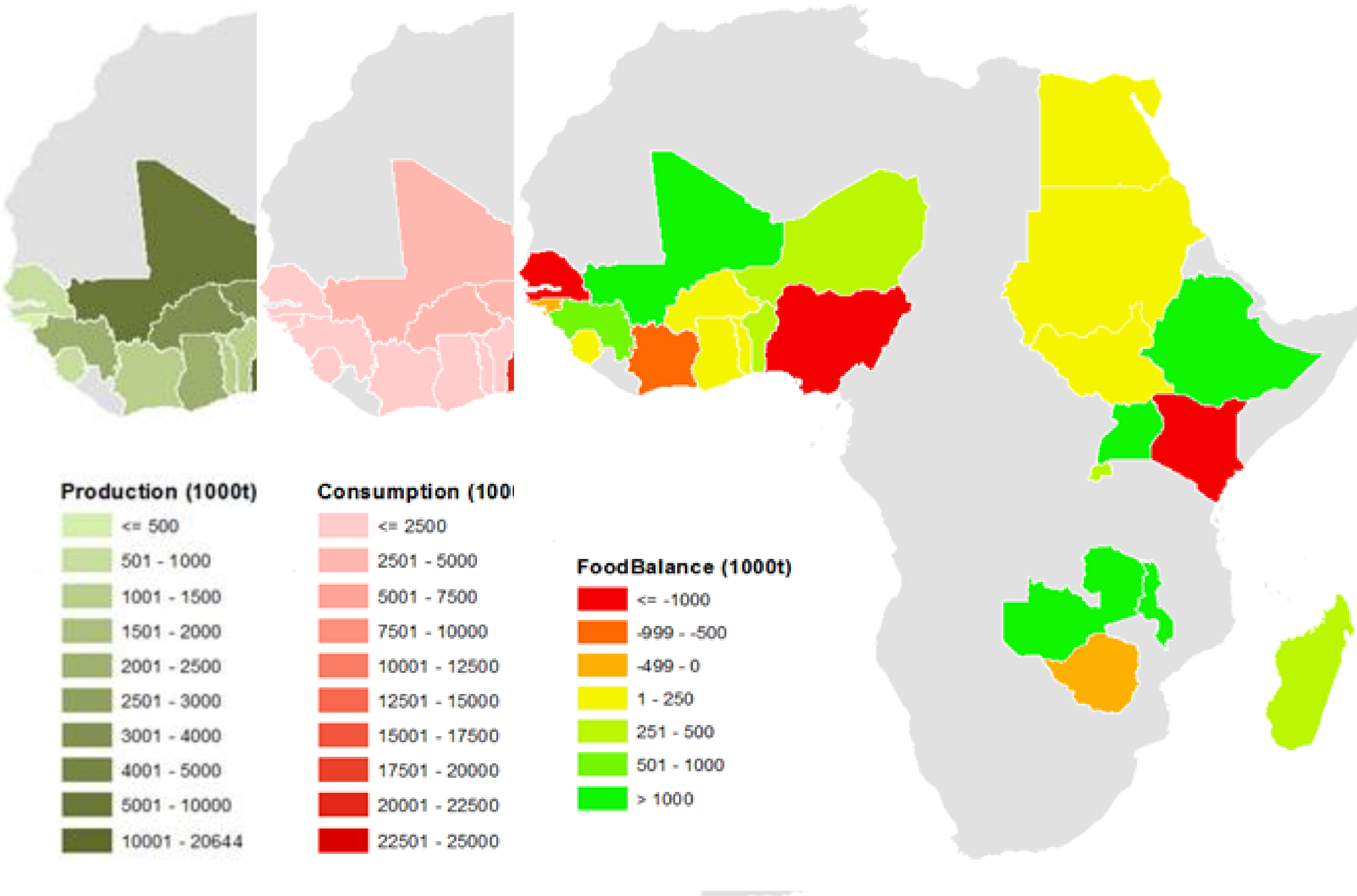


GPD per-capita, PPP

No major shock in socio-economic environment at the regional level overall

Descriptives (5): cereal deficit hotspots

Production Consumption Food balance



Regression results on value of net exports

	OLS		Random-effects		Fixed-effects		IV Panel fixed-effects		IV Panel error-correction	
	coef	**se**	**coef**	**se**	**coef**	**se**	**coef**	**se**	**coef**	**se**
Rainfall	0.000	0.000	0.000**	0.000	0.000**	0.000				
Temperature	-1.131***	0.403	-0.364	0.431	-0.361	0.440				
Temperature (squared)	0.022***	0.008	0.005	0.009	0.005	0.009				
NDVI	1.570**	0.774	1.482***	0.516	1.478***	0.518				
Low soil quality	-0.094***	0.013	-0.106**	0.046						
Tree coverage (%)	0.015***	0.003	0.018	0.012						
Crop disease prevalence	2.863***	0.631	3.889	2.692						
Weeds prevalence	0.206	0.507	-0.155	1.467						
Pest prevalence	4.694**	1.950	1.779	6.384						
Total population (million)	-0.023***	0.007	-0.015***	0.006	-0.014**	0.006	-0.021**	0.008	-0.022***	0.007
GDP per capita, PPP (constant 2011 international $)	-0.000***	0.000	-0.001***	0.000	-0.001***	0.000	-0.001***	0.000	-0.001***	0.000
Latitude of largest city	-0.011	0.007	-0.014	0.030					0.004	0.027
Longitude of largest city	0.014***	0.004	0.014	0.017					-0.004	0.013
Population of largest city	0.553***	0.083	0.942***	0.258					0.506**	0.208
Total crop land area	0.000	0.000	-0.000	0.000					-0.000**	0.000
Log of gross production value in constant prices 2004-6							0.880***	0.277	0.811***	0.232
Constant	11.480***	4.251	6.275	7.062	6.502	5.452	-4.166**	1.926	-4.024**	1.627
Number of observations	414		414		414		306		306	
Adjusted R2	0.605				0.381					

Regression results on value of maize net exports

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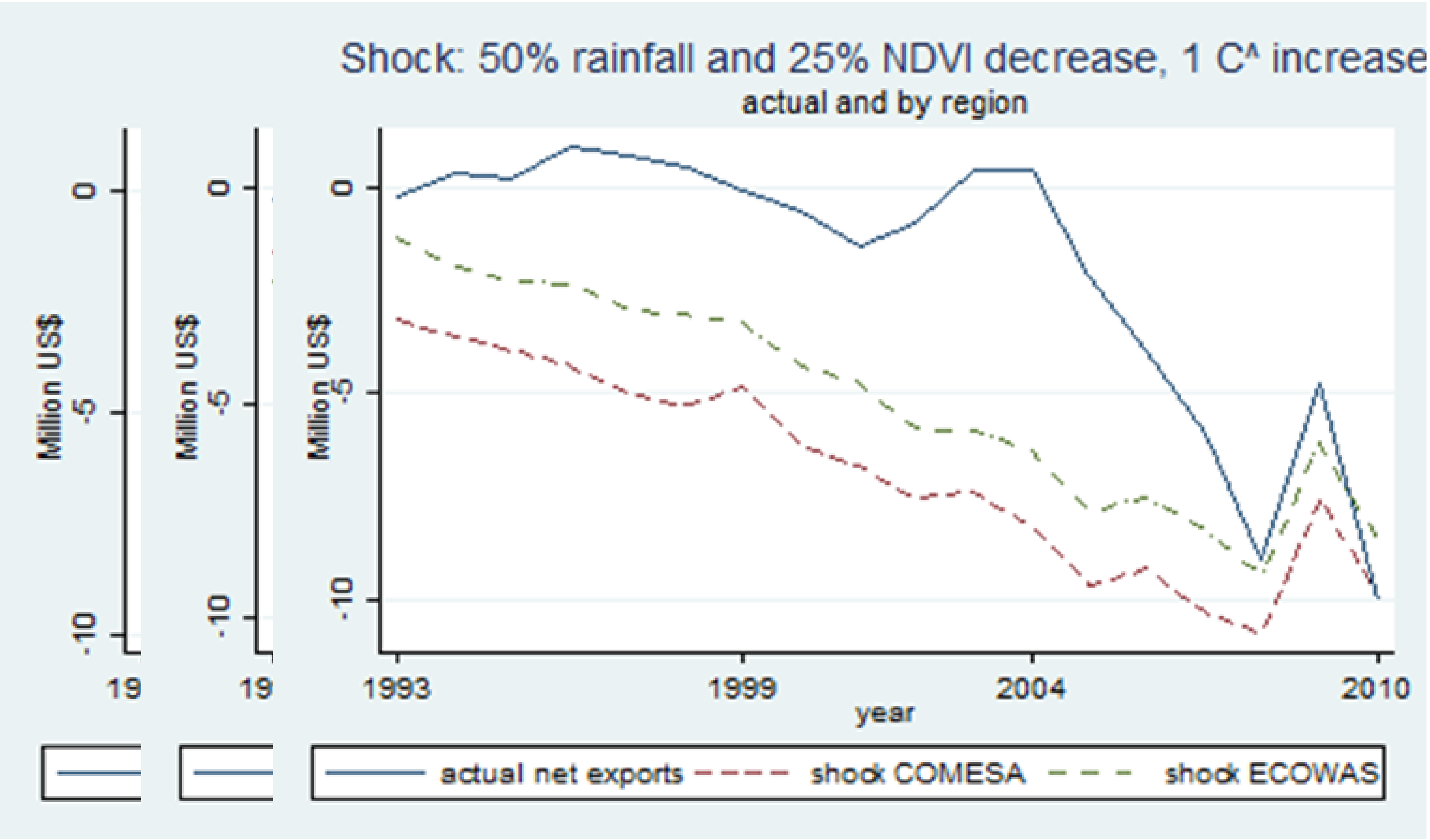
	OLS_maize		Random-effects		Fixed-effects	
	coef	se	coef	se	coef	se
Rainfall	-0.000	0.000	0.000	0.000	0.000	0.000
Temperature	-0.254***	0.044	-0.284***	0.062	-0.336***	0.067
Temperature (squared)	0.006***	0.001	0.006***	0.001	0.006***	0.001
NDVI maize	-0.009	0.088	-0.016	0.091	-0.062	0.085
Low soil quality maize	0.002***	0.000	0.002***	0.001		
Tree coverage (%) maize	-0.001	0.001	-0.002	0.003		
Crop disease prevalence	-0.096	0.069	-0.007	0.138		
Weeds prevalence	-0.269***	0.062	-0.432***	0.103		
Pest prevalence	1.220***	0.242	1.064**	0.414		
Total population (million)	0.001	0.001	0.002**	0.001	0.004***	0.001
GDP per capita, PPP (constant 2011 international $)	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000
Latitude of largest city	-0.003***	0.001	-0.004***	0.001		
Longitude of largest city	0.001**	0.000	0.001	0.001		
Population of largest city (million)	-0.007	0.011	0.009	0.019		
Total crop land area	0.000	0.000	-0.000	0.000		
Log of gross production value of maize in constant						
Constant	1.874***	0.453	2.604***	0.679	4.520***	0.826
Number of observations	378		378		396	
Adjusted R2	0.770				0.284	

Simulations



Historical rainfall data analysis in rainfed maize areas (1)

- ***Background:*** production surplus and deficit happen at the same time in the same region; famines are often the result of inability to transfer surplus to deficit areas.

- ***Objective:*** identify areas with below-normal rainfall (less than 75% of 30-year average) and areas with above-normal rainfall (more than 125% of 30-year average)

- ***Question:*** is there historical evidence of co-existence of deficit and surplus areas within the same geographic scope?

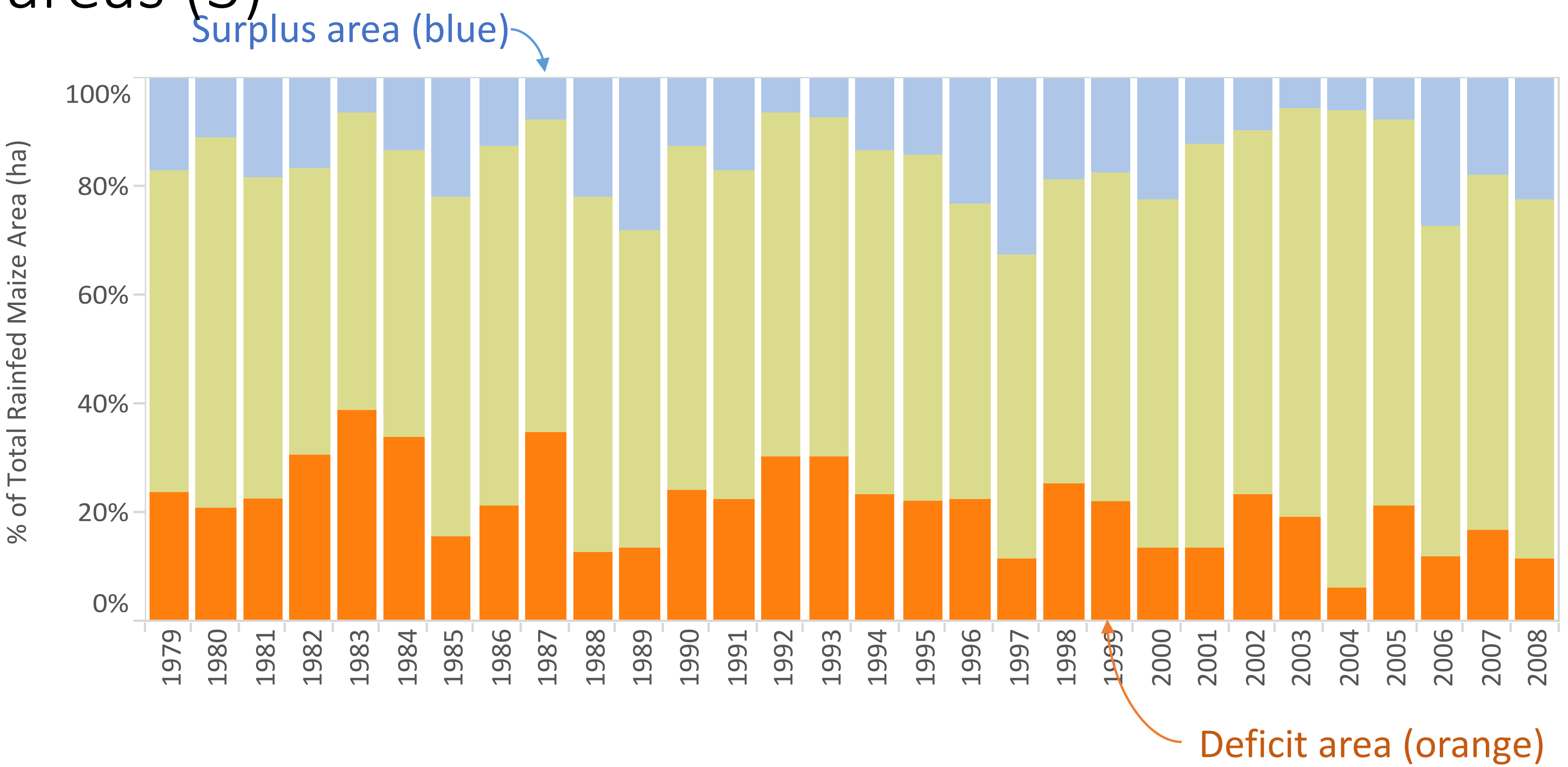
- ***Main idea:*** areas with above-normal rainfall can produce surplus that can be transferred to areas with below-normal rainfall to mitigate production loss, thus enhancing resilience

Historical rainfall data analysis in rainfed maize areas (2)

Data & Method

- Monthly historical rainfall data (60 km resolution) for 1979-2008 (30 years)-> University of East Anglia.
- Gridded rainfed planting month data for baseline climate conditions-> CCAFS (Philip Thornton), original data at 10km aggregated to 60km.
- Rainfed maize growing area-> HarvestChoice's SPAM 2005, original data at 10km aggregated to 60km.
- First two-month total rainfall at each grid cell used to classify each season as below normal, normal, or above normal.
- 30-year average rainfall was computed at each grid cell

Historical rainfall data analysis in rainfed maize areas (3)

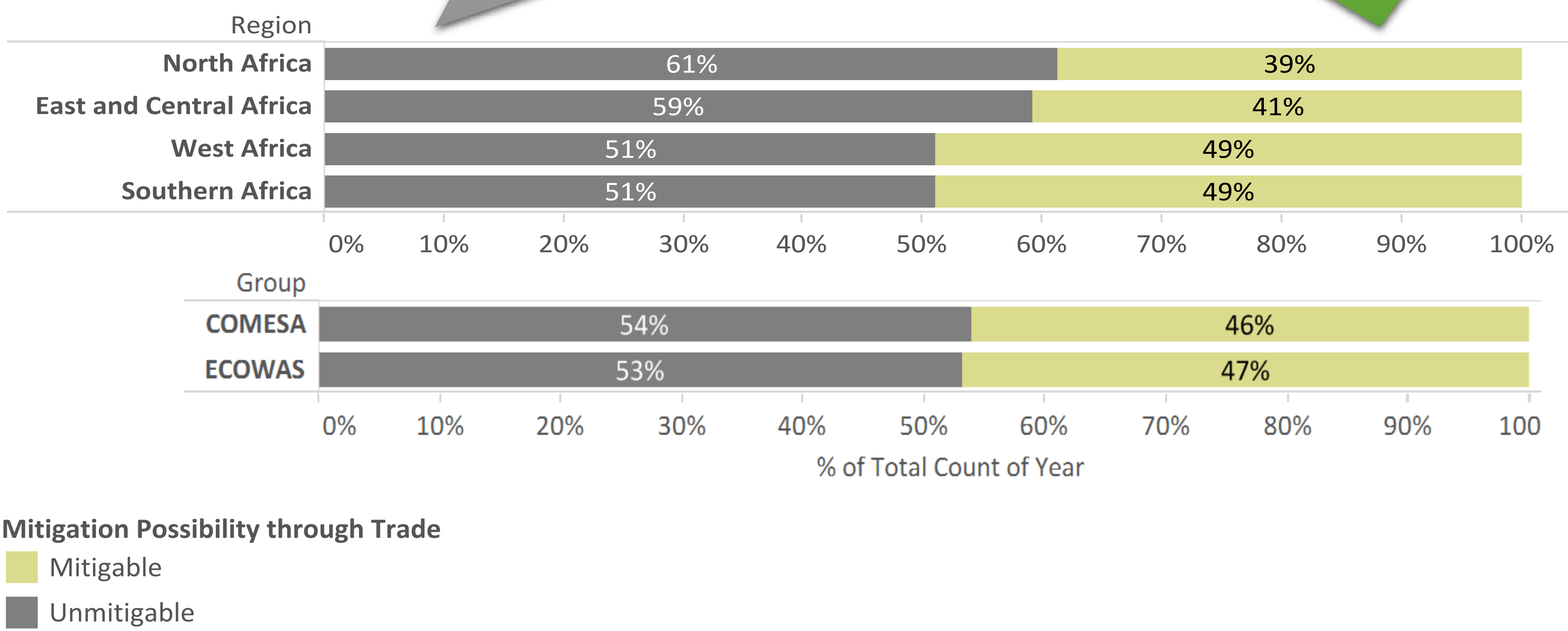


Every year, some areas in Africa suffer from drought. Though, there are areas where rainfall is higher than normal, that may produce more than normal, taking advantage of reduced risk of investing on other inputs such as fertilizers and high-yielding varieties.

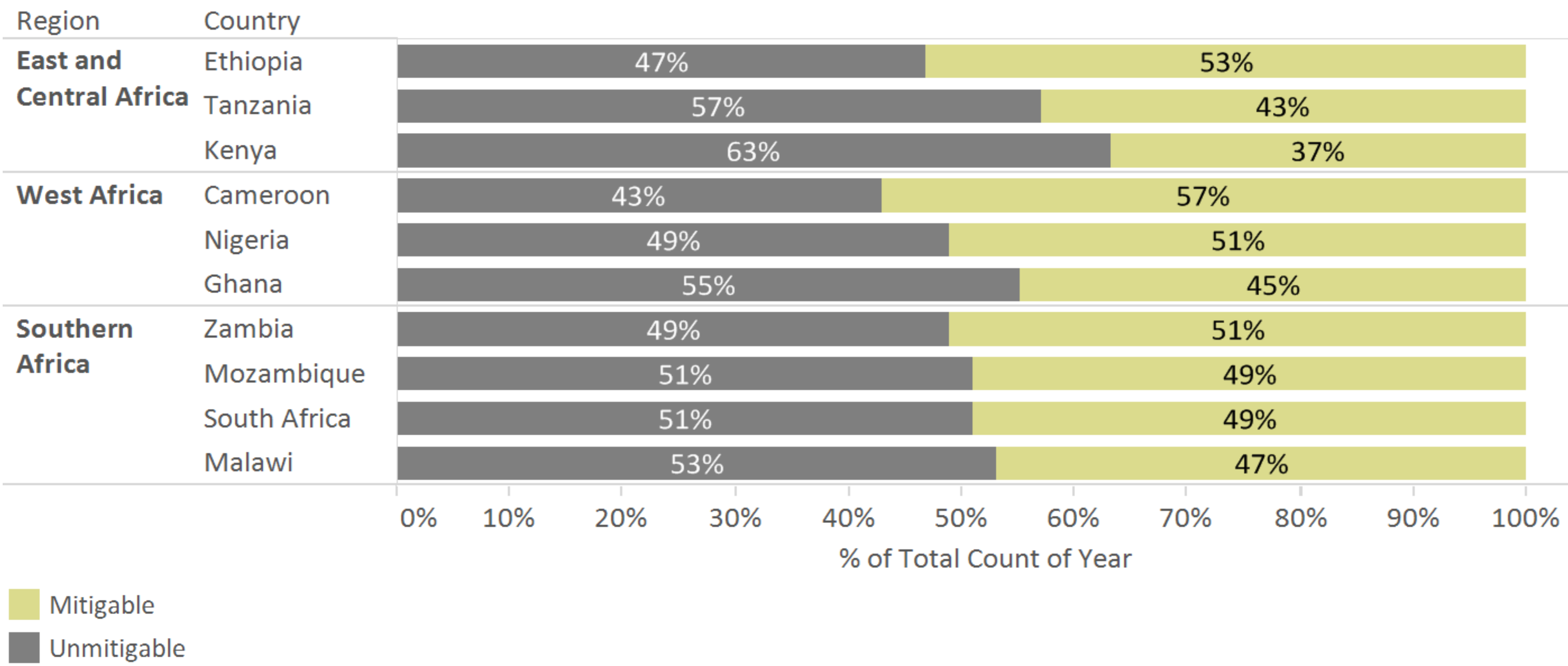
Historical rainfall data analysis in rainfed maize areas (4)

Percentage of years when the total area under **deficit is larger** than surplus

Percentage of years when the total area under **surplus is larger** than deficit



Historical rainfall data analysis in rainfed maize areas (5)



Within region, there are variable range of such drought-mitigation possibility at country-level. Top-10 maize producing countries in Africa are included in the chart. In East and Central Africa, the possibility is highest in Ethiopia (53%) and lowest in Kenya (37%) and. In West Africa, highest in Cameroon (57%) and lowest in Ghana (45%). In Southern Africa, highest in Zambia (51%) and lowest in Malawi (47%).

Conclusions (1)

- Our analysis shows that biophysical variables are strongly correlated with net exports, when agricultural production is not controlled for.
- However, when a 2SLS model is adopted (controlling for endogeneity of production), biophysical variables are excellent predictors of total agricultural output that, in turn, is the strongest determinant of trade flows.
- These results would allow to simulate the impact of a shock in climate-related variables first on production, and then trade flows, looking at the relationship between resilience and trade.
- Additionally, simulations can be conducted by regional aggregations, country, and commodity, addressing the heterogeneity in responses according to the climate conditions and openness of the economy.

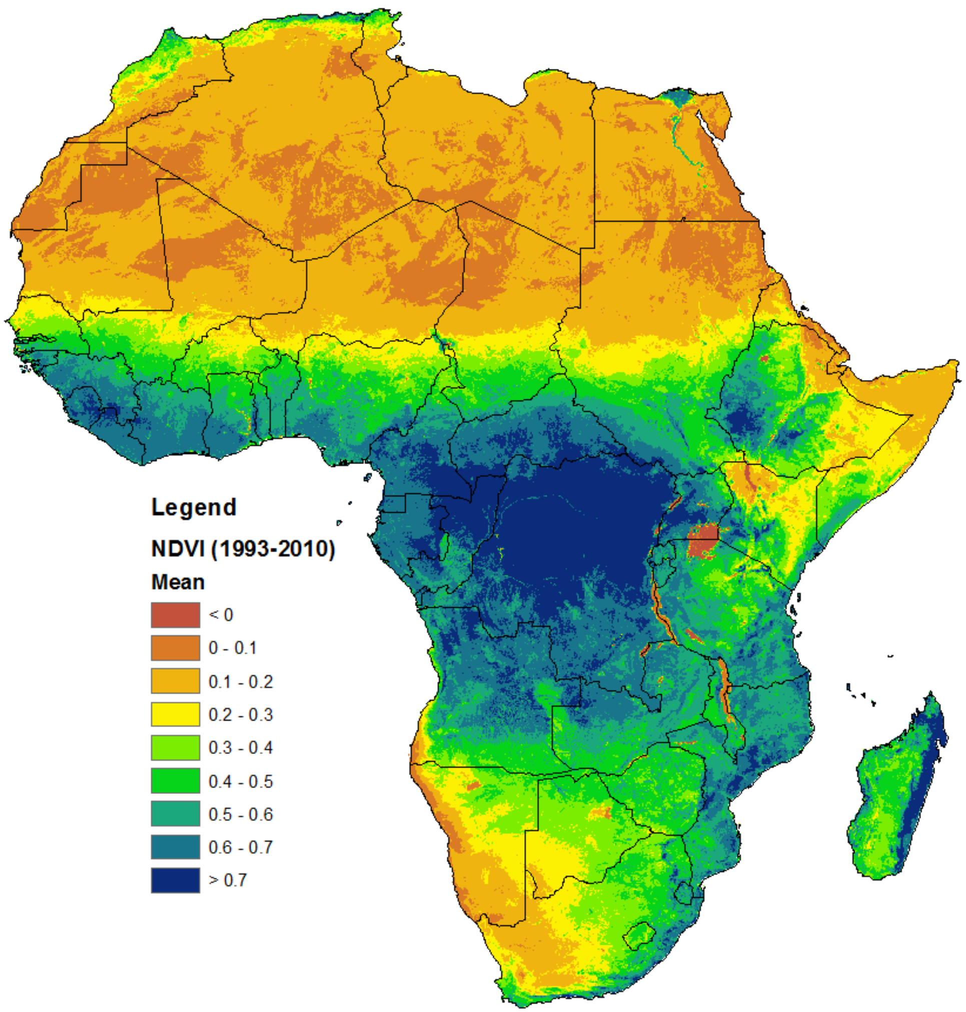
Conclusions (2)

- Climate-related variables are key for profitable farming (as well as flourishing trade flows) indicating the importance of agriculture adaptation and mitigation strategies to increase smallholder farmers' resilience to natural shocks.
- Indeed, our historical rainfall data analysis shows good potential for mitigating losses in maize production through trade flows, at country, regional, or continental level, if the complexities of trade allow.
- The possibility of drought mitigation (i.e., larger areas of above normal rainfall than less than normal) is higher in West and Southern Africa (~50%) than North and Eastern Central Africa (~40%).
- Caveats apply…

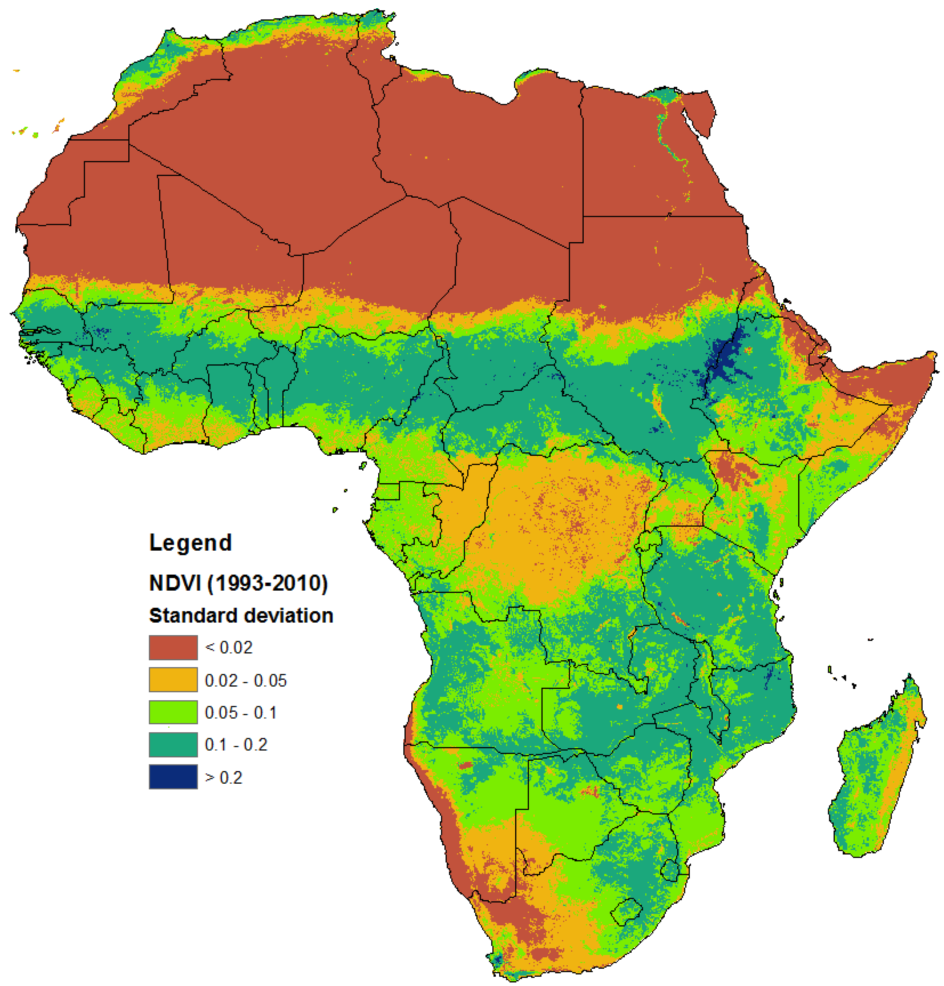
Thank you

Descriptives/3: biophysical variables

Average NDVI 1993-2010

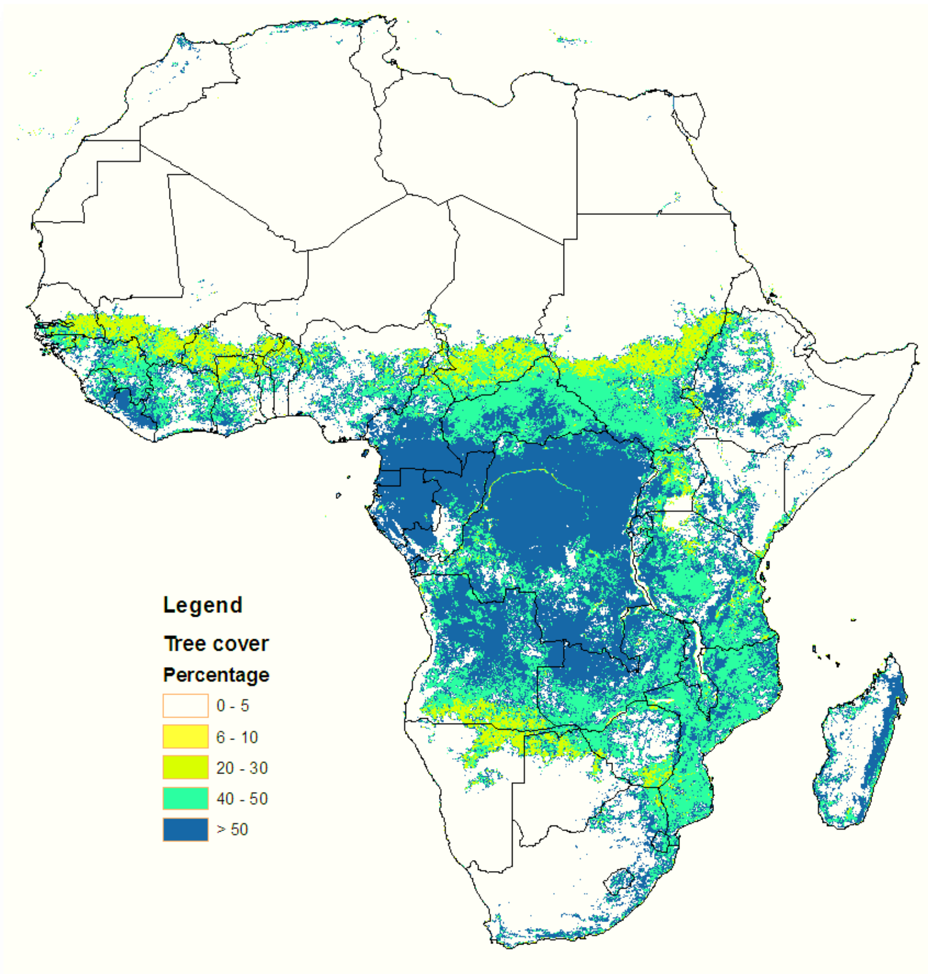


Std. Dev. NDVI 1993-2010

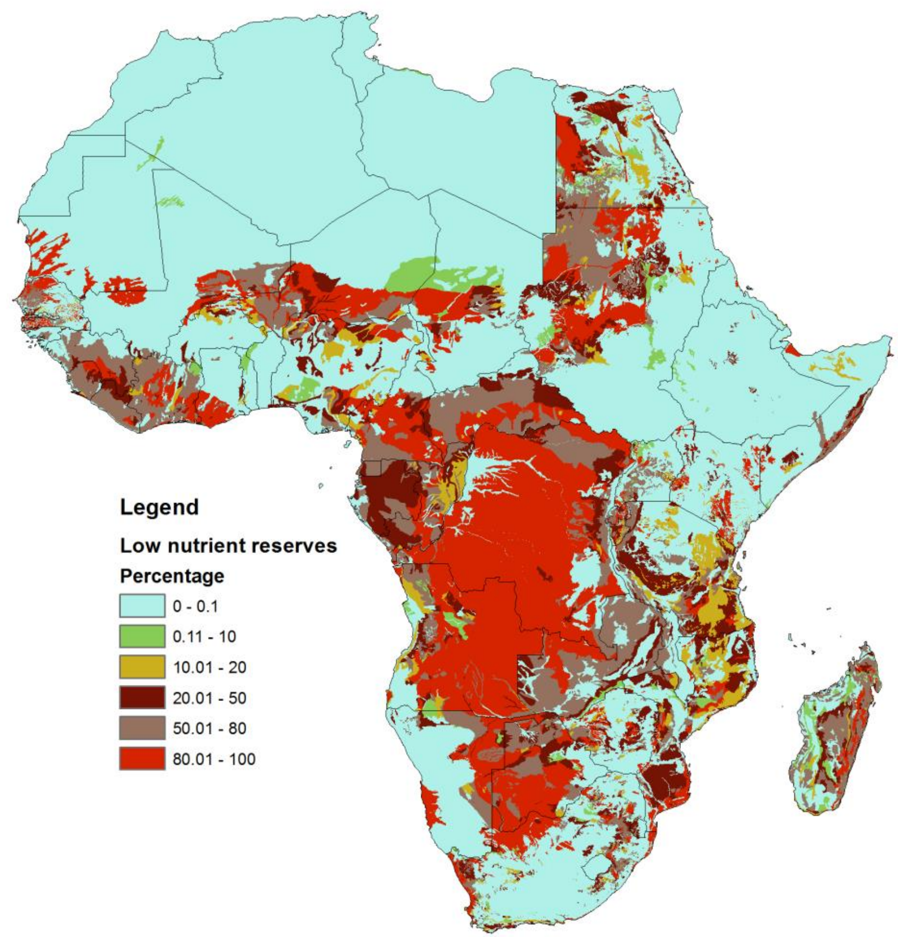


Descriptives/3: biophysical variables

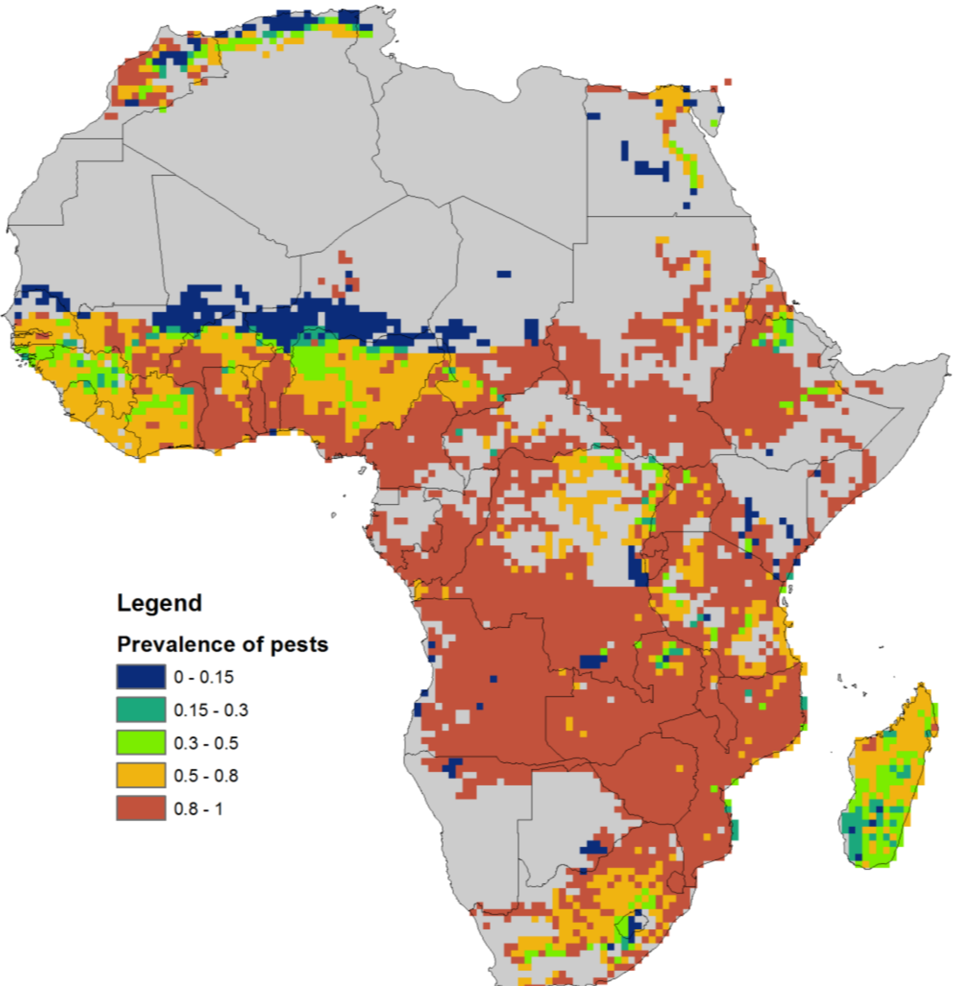
Tree coverage, 2000

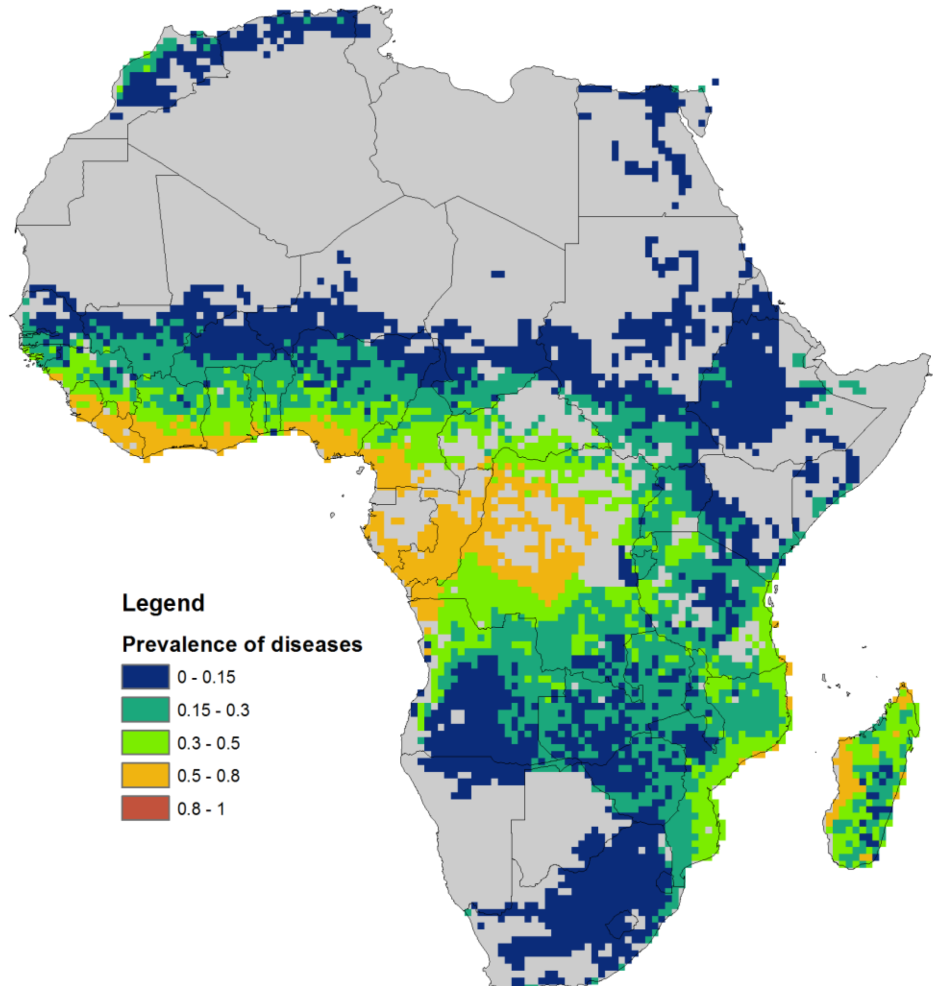


Soil nutrients, 2000

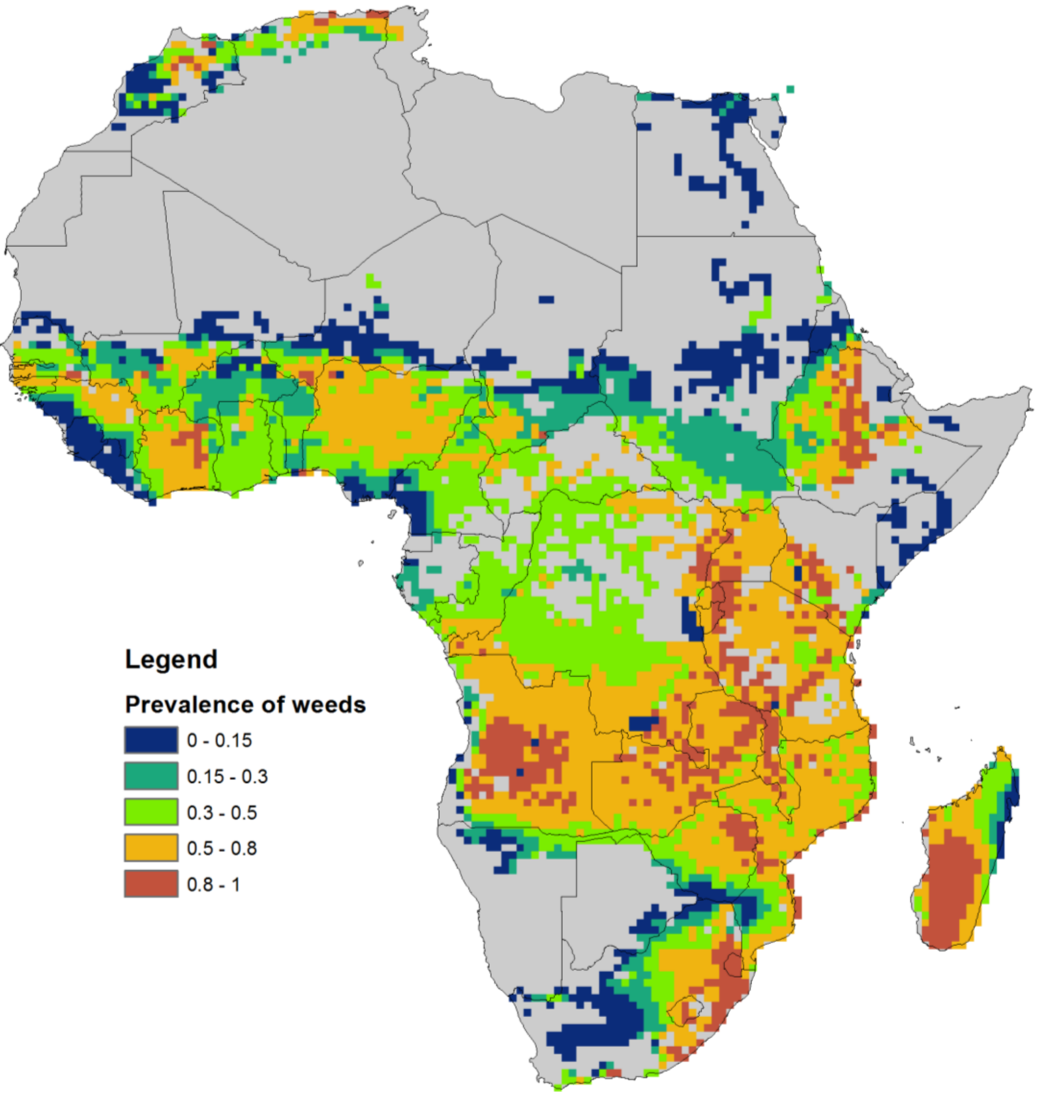


Descriptives/4: crop pest and disease prevalence

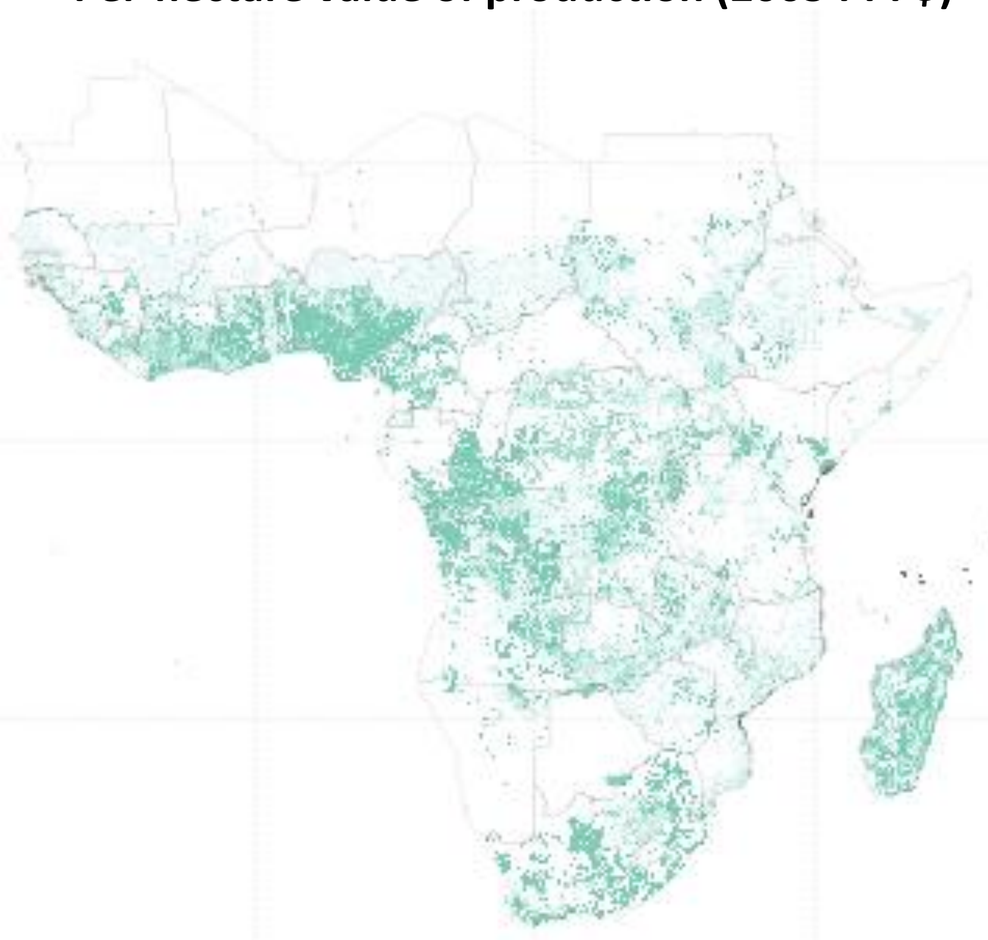




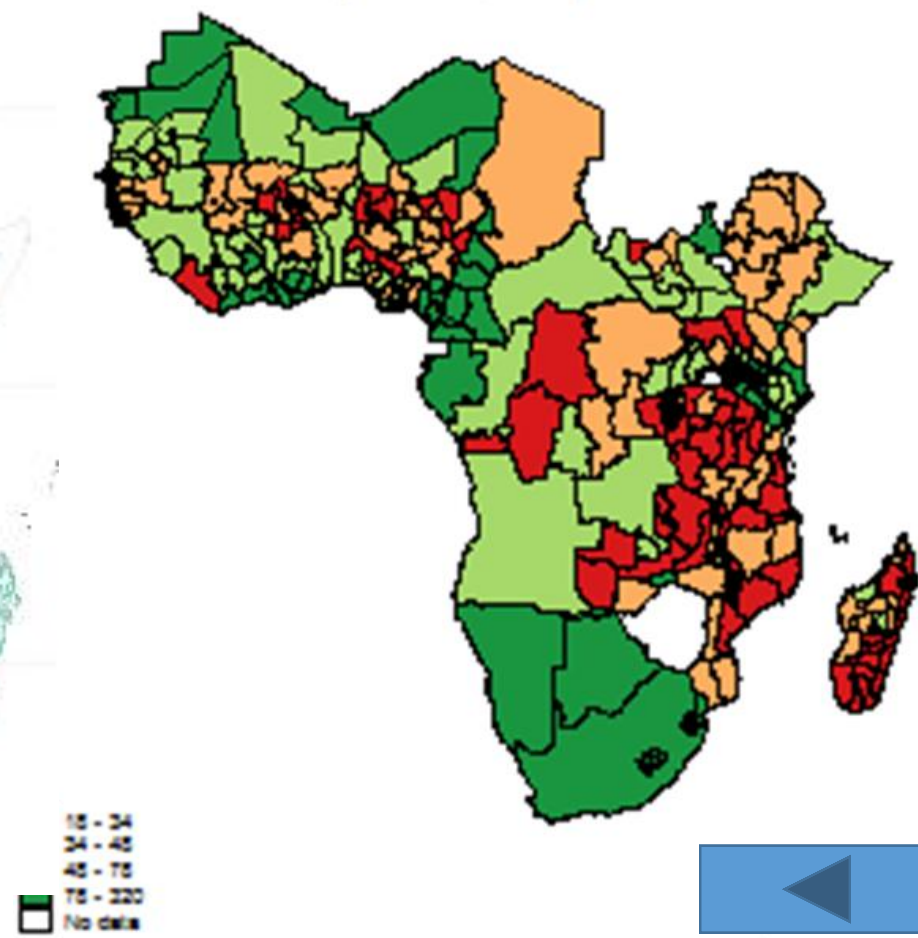
Descriptives/5: weed prevalence



Per-hectare value of production (2005 PPP$)



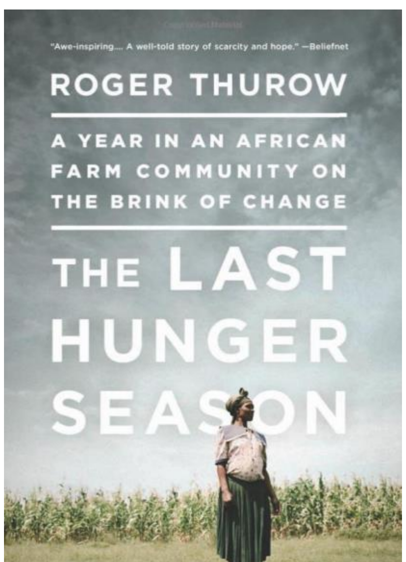
Per-capita consumption
(2005 PPP$/month)



Motivation

craziness. The world price of maize was soaring to record highs, but Kenya's farmers weren't benefitting since local prices were depressed by post-harvest surpluses. In addition, a grand African paradox was beginning to form in Kenya: food shortages and surpluses side by side, simultaneous feast and famine. Drought was spreading in the northern and eastern reaches of Kenya, threatening herders and their livestock. The government declared a food shortage in the country and said it would be necessary to import food, either by purchasing from neighboring countries or inviting food aid, to feed the growing ranks of the hungry. Estimates were that anywhere between two and five million Kenyans would need food assistance in the coming months. At the same time, farmers in the breadbasket regions of western Kenya and the Rift Valley were complaining about the low prices they were receiving for their maize.

"Can the government tell us what food shortage they are talking about?" an incredulous North Rift parliamentarian was quoted as saying in the Kenyan newspaper, *Daily Nation*. "Most farmers have maize, but there is no market."



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