Estimating the Impact of Drought and Flooding on African Farmers

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Shun Chonabayashi
Theepakorn Jithitikulchai

Outline

1. Introduction
2. Methodology
3. Data
4. Results
5. Discussion and Conclusion

Motivation

- Various magnitudes and, occasionally, signs of the impact estimate
- Few regional studies that analyze the economic impact of drought and flooding on agricultural household livelihoods in Africa

Literature review on the economic impact of weather shocks and climate change on agricultural productivity

Study	Country/Region	Spatial Coverage	Model	Weather Shock Measure	Dependent Variable	Impact Estimate
Amare et al., 2018	Nigeria	National	IV-FE	Deviation of rainfall	Consumption	-37.0%
Asfaw et al., 2017	Zambia	Subnational	GLS-RE	Deviation of rainfall	Consumption	-2.9%
Blanc, 2012	SSA	Multi-country	Fixed Effect	Standardized precipitation index (SPI)	Crop Yield	-7.1%
Chonabayashi et al., 2020	Zambia	National	SNR	Self-reported drought	Agricultural income	-24.3%
Chonabayashi et al., 2020	Zambia	National	SNR	Self-reported flood	Agricultural income	-23.4%
Chuang, 2019	India	Subnational	SUR	Deviation of rainfall	Agricultural Income	-1.5%
Chuang, 2019	India	Subnational	SUR	Deviation of rainfall	Income	-0.8%
Cissé & Barrett, 2018	Kenya	National	GLM	Area average predicted losses ≥ 15% per the IBLI index	TLU	-18.0%
Gao & Mills, 2018	Ethiopia	National	Fixed Effect	Deviation of rainfall	Consumption	-18.2%
Gao & Mills, 2018	Ethiopia	National	Fixed Effect	Extreme heat degree days	Consumption	-2.4%
Horridge et al., 2005	Australia	National	CGE	Rainfall deficit	Income	-20.0%
Kubik & Maurel, 2016	Tanzania	National	OLS	Standardized precipitation evapotranspiration index (SPEI)	Crop Revenue	-31.0%
Kuwayama et al., 2019	United States	National	Panel Fixed Effect	Weeks of drought based on USDM classifications	Yield	-1.2%
Macours, 2012	Nicaragua	Subnational	2SLS	Self-reported drought	Consumption	-9.0%
Macours, 2012	Nicaragua	Subnational	2SLS	Self-reported drought	Income	-11.0%
Porter, 2012	Ethiopia	National	DIFF	Bottom quintile of rainfall distribution	Consumption	-19.6%
Porter, 2012	Ethiopia	National	Fixed Effect	Bottom quintile of rainfall distribution	Crop Income	-16.6%
Roberts et al., 2012	USA	Subnational	Nonlinear	Extreme heat degree days	Crop Production	-6.2%
Salvucci & Santos, 2020	Mozambique	National	DID	Flooded areas	Consumption	-11.0%

Methodological framework

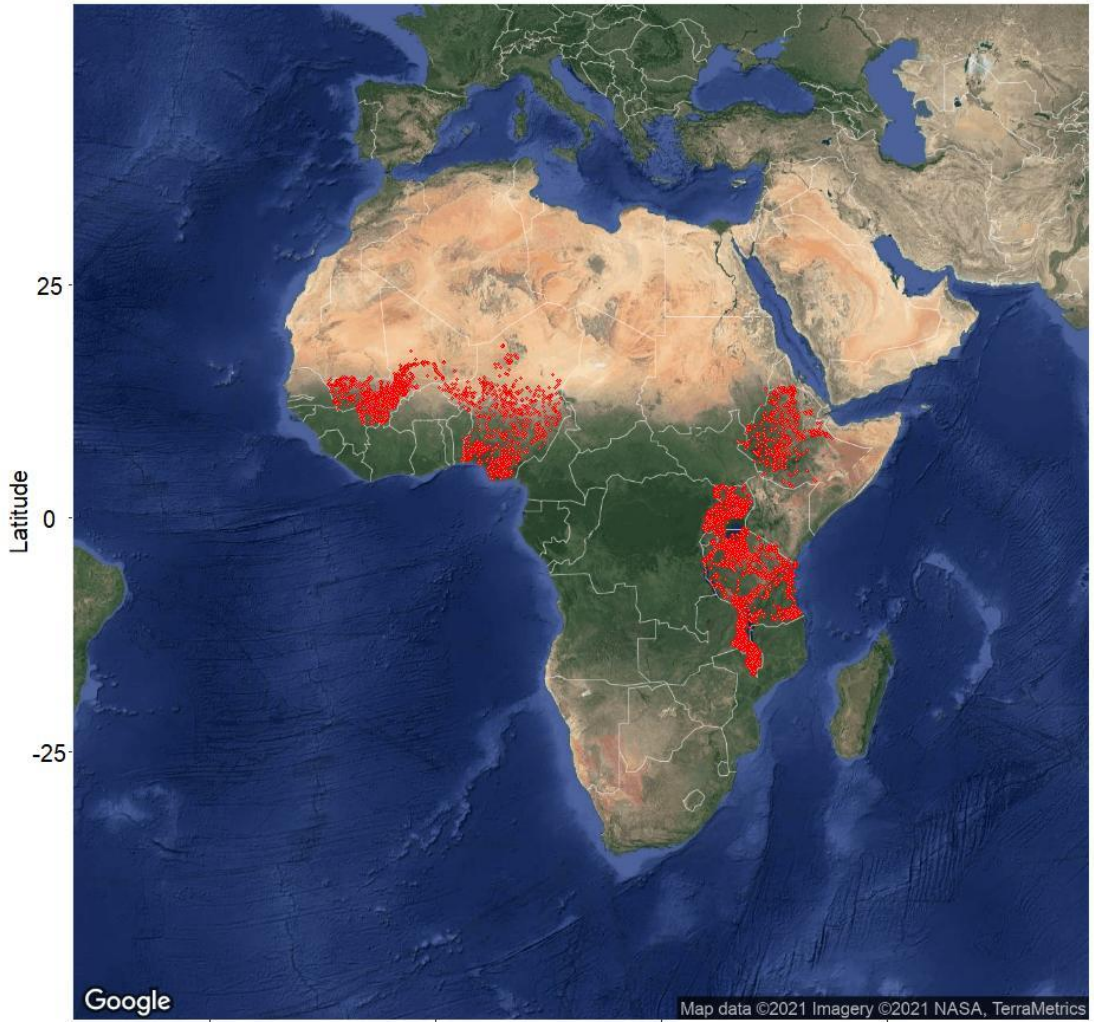
- Most similar to the hedonic studies that model farmland values and rents as a function of temperature, precipitation, soil type, and other physical and socioeconomic variables
- Identification based on the exploitation of variation in net farm income and drought/flood occurrence across sample households
- A repeated cross-sectional analysis by pooling the household survey data for 2009-2016.

Empirical strategy

$$ihs\left(Y_{i(t),t,p}\right) = \beta_0 + \beta_D D_{i(t),t,p} + \beta_F F_{i(t),t,p} + \delta' \boldsymbol{X}_{i(t),t,p} + \epsilon_t + \vartheta_c + \varepsilon_{i(t),t,p}$$

- $ihs(Y_{i(t),t,p})$: the inverse hyperbolic sine transformed version of crop net income per hectare for a household *i(t)* in cross-sectional time or year *t*
- $D_{i(t),t,p}$ and $F_{i(t),t,p}$: dummy variables that indicate an incidence of drought and flood respectively
- $\boldsymbol{X}_{i(t),t,p}$: covariates that include both time-varying and invariant observable variables such as socioeconomic, geographic, climatic, household, and farmland characteristics
- ϵ_t and ϑ_c: year and country dummy variables to control for the possible year effect and time-invariant unobservable country differences, respectively,
- $\varepsilon_{i(t),t,p}$: an error term

Living Standards Measurement Study – Integrity Surveys on Agriculture (LSMS-ISA)



Pooled multi-country household data with the total of 82,281 observations for 2009 through 2016

	2009	2010	2011	2012	2013	2014	2015	2016	Total
Ethiopia					x		x		2
Malawi		x			x			x	3
Niger			x						1
Nigeria		x		x			x		3
Uganda	x	x	x						3
Total	1	3	2	1	2	0	2	1	13

Marginal effects of drought and flood on agricultural net income in Sub-Saharan Africa

	Crop net income per ha							Livestock net income	Ag. net income
	All farms	Irrigated	Rainfed	Crop only	Mix	Poor	Non-poor		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Drought incidence	-0.402 **	-0.427 *	-0.405 **	-0.47 *	-0.402 **	-0.422 **	-0.389 *	0.101	-0.173
	(0.033)	(0.073)	(0.036)	(0.06)	(0.033)	(0.042)	(0.057)	(0.495)	(0.12)
Flood incidence	-0.988 ***	-1.29 ***	-0.977 **	-1.318 **	-0.988 ***	-1.046 ***	-1.041 **	0.199	-0.673 **
	(0.007)	(0.006)	(0.011)	(0.016)	(0.007)	(0.006)	(0.023)	(0.413)	(0.015)

Main findings

1. Robust negative impacts of drought and flood on crop net income in Africa
2. Heterogeneous effects across different levels of poverty and agricultural diversification
3. Context-specific effectiveness of fertilizer and electricity

Policy implications

Irrigation, agricultural diversification, and policy reduction as mitigation strategies to cope with adverse effects of extreme weather events on crop production such as drought and flood