

Climate Change, the Adoption of Improved Varieties, and Property Rights: Implications on Welfare

Mintewab Bezabih

Grantham Research Institute

Mare Sarr

University of Capetown

Gregor Singer

Grantham Research Institute



Grantham Research Institute on
Climate Change and
the Environment



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POLITICAL SCIENCE

Motivation

- Adoption of improved varieties:
 - a classical route to agricultural development, escape from poverty trap
 - has the potential of yielding high returns
 - India and Mexico
 - uptake of improved varieties has been particularly slow in Africa; Ethiopia's figures even lower.
- Why do small scale African farmers not adopt farming technologies that have proven so effective elsewhere?
 - Constraints to adoption
 - Potential returns from the adoption

Previous studies

- empirical literature on a host of key factors affecting adoption.
 - including risk
- welfare literature: comparison of welfare outcomes between adopters and non-adopters
 - recent, less emphasis on risk
- The role of secure property rights in adapting to climate change
 - very recent; limited coverage

Limitations

- The vast majority of previous studies
 - do not explicitly look into the effect of climate change on adoption and/or welfare.
- cross -section analyses (omitted variable bias).
- Very few studies link up the following findings:
 - well defined rights to land are known to increase incentives for technology adoption.
 - Land related investment: major adaptation strategies.

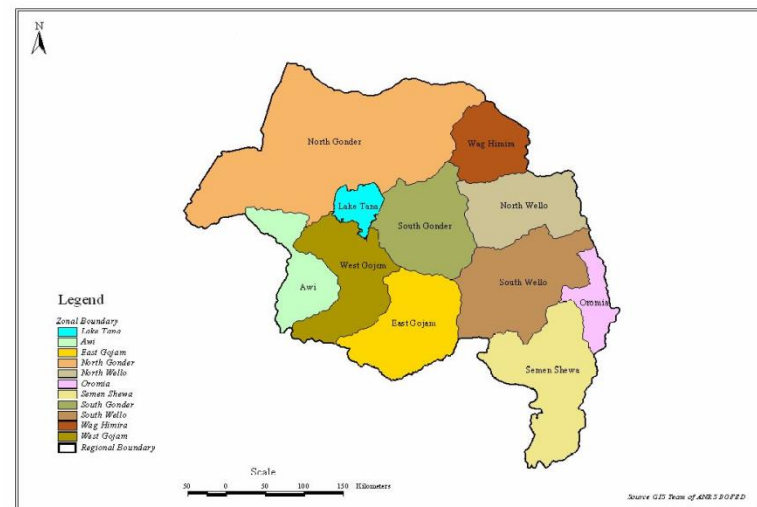
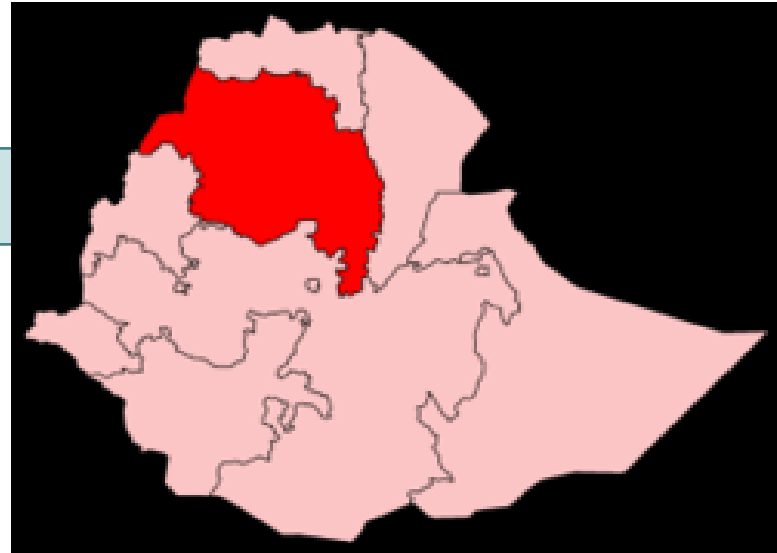
contributions

- understanding the dynamics in the adoption of improved seeds
 - Crops that have been focuses of international breeding programs (maize, wheat).
 - Staple crops that have lesser international significance (teff).
- Panel data features
 - enables for controlling for unobservables.
- Explicit consideration of the impact of climatic factors.
- investigating the role of the land certification program
 - understanding of the relationship between adaptation and property rights.

Data

Sustainable Land Management Survey
2005 & 2007

- Amhara regional state of Ethiopia
- Two Zones: East Gojjam and South Wollo
- 14 Kebeles (7 East Gojjam & 7 South Wollo)
- About 1720 households per survey year



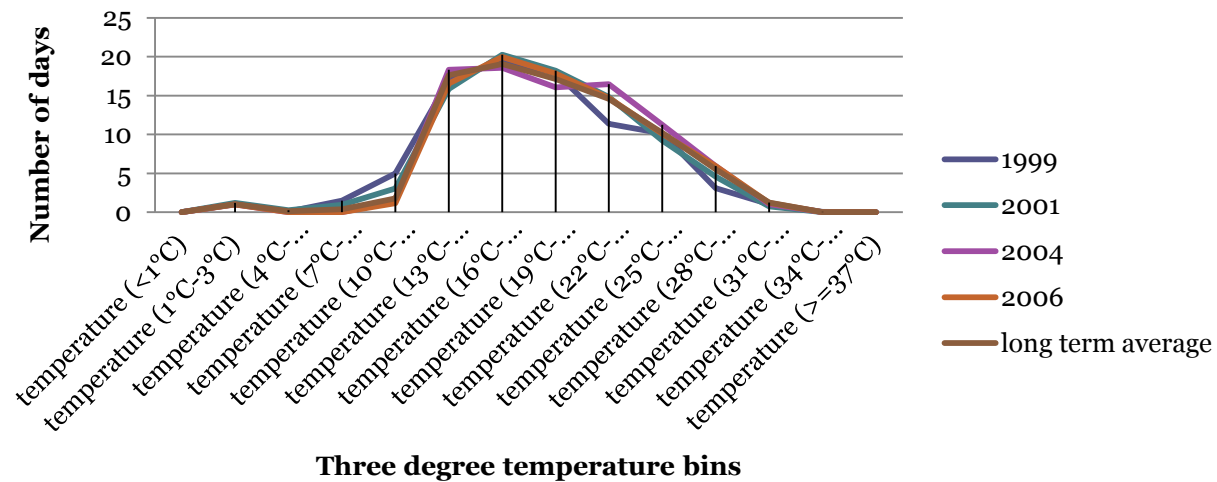
Data :contd.

- Data source: rainfall and temperature observations
 - Ethiopian meteorology authority: monthly rainfall and daily temperature observations over 30 years for 8 stations close to the study villages.
 - Interpolated at a household level using the Inverse Distance Weighing method.

Temperature:

- **Non linearity:**
 - Plant growth depends on the cumulative exposure to heat and precipitation during the growing season (agronomic studies).
 - Plants cannot absorb heat below a specific threshold or extra heat above a ceiling, the effect of heat accumulation tends to be nonlinear.
- **Range-based distribution**

Distribution of summer temperature values over the short and long term



Analytical approach

- Assessment of the impact of climatic factors on
 - Adoption of improved varieties
 - Alternative welfare measures
- Accurate identification of:
 - The impact of adoption on welfare
 - The impact of land certification on adaptation

Empirical strategy

- (i) A semi-parametric method based on matching
- (iii) DiD: a parametric household fixed effects regression.
- (iii) marginal structural model (MSM)
- Other considerations
 - Test of the common trends assumption.
 - Alternative panel data estimations.

DiD regression estimator

- DiD enables controlling for non-trend based unobservables

$$y_{it} = \alpha_i + \beta \cdot a_{it} + \gamma_t + \delta \cdot Z_{it} + \epsilon_{it} \quad (3)$$

Results: determinants of adoption

	Adoption		
	Maize	Wheat	Teff
Farmer training	1.013*** (0.304)	1.137*** (0.344)	1.469** (0.587)
Trust of head in traders	0.198 (0.124)	0.519*** (0.140)	-0.0609 (0.273)
Degree of risk aversion	0.0513 (0.0865)	0.00267 (0.103)	-0.114 (0.203)
Summer average rainfall variability last five years (CV)	-13.04 (16.08)	-41.30*** (11.05)	-6.353 (11.80)

Results: semi parametric estimation

Table 3: Matching DiD hybrid estimates

	Production	Input productivity	Net income
Maize	174.7** (77.9)	23.3*** (8.7)	48.9** (25.2)
Wheat	55.8 (179.3)	7.4 (6.1)	55.7 (56.8)
Teff	-278.6 (255.0)	-9.7 (11.1)	-38.1 (201.4)

Notes: Bandwidth for kernel matching is 0.05. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3/26/2015

Results: Mundlak's fixed effects regression -maize, wheat, teff

	(1) Production	(2) Input productivity	(3) Net crop income	(4) Net crop income
Medium summer temp. (hours with 11 to 27 deg.)	0.420*** (0.0887)	0.0369*** (0.0136)	0.166*** (0.0292)	0.166*** (0.0292)
Rainfall mid-growing (mm in September)	4.326** (1.697)	0.240 (0.269)	1.657*** (0.482)	1.656*** (0.482)

	(1) Production	(2) Input productivity	(3) Net crop income	(4) Net crop income
Medium summer temp. (hours with 11 to 27 deg.)	0.919*** (0.218)	-0.00339 (0.00694)	0.245*** (0.0663)	0.245*** (0.0664)
Rainfall mid-growing (mm in September)	4.568*	0.218**	0.802	0.796

	(1) Production	(2) Input productivity	(3) Net crop income	(4) Net crop income
Medium summer temp. (hours with 11 to 27 deg.)	0.580*** (0.0800)	0.0219*** (0.00805)	0.435*** (0.0528)	0.433*** (0.0528)
Rainfall mid-growing (mm in September)	-0.217 (1.280)	-0.0496 (0.104)	0.810 (0.825)	0.795 (0.824)

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Results: certification impacts

	(1)	(2)	(3)	(4)
	Production	Input productivity	Net crop income	Gross crop income
cert_temp	-0.600 ^{***}	0.0123	-0.279 ^{***}	-0.280 ^{***}
	(0.186)	(0.0155)	(0.0951)	(0.0951)
cert_rain	4.859 ^{***}	-0.476 ^{***}	1.084	1.087
	(1.651)	(0.137)	(0.850)	(0.850)

conclusions

- Climate measures have distinctively varying impacts on the adoption and welfare of different crops.
- Certification is found to have climate mitigating impacts.
- Varying (monetary) benefits from adoption need to be studied in correspondence with findings from agronomic or plant breeding studies.
- The rationale behind sticking to local/landrace varieties, for reasons other than direct productivity benefits, needs to be studied further.