

Economic development under climate change

Economy-wide and Regional Effects of Climate Change in Ethiopia

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Outline

1. Motivation
2. Objectives
3. Methodological Framework
4. Primary Impacts of Climate Change in Agriculture
5. Economy-wide and Regional effects of climate change
6. Would structural change help?

1. Motivation

- Climate change is unequivocal (IPCC, 2014)
- Climate change do has profound effects on the economic prosperity and development of LDCs (Stern, 2007; IPCC, 2014)
- Ethiopia is a case in point where **agriculture**

*~ 40% GDP, 75% export earnings, 9/10 major export items (NBE, 2016),
~ 82% employment (NLFS, 2013)*

- However, agriculture in Ethiopia is traditional and virtually rain-fed
~This makes agricultural productivity is susceptible to environmental changes in Ethiopia

- **Any environmental change threatens the economic prospect of Ethiopia**

2. Objectives

- Economy-wide and Regional Effects of Climate Change
- Would Structural Change Dampen Adverse Effects ?

3. Methodological Framework

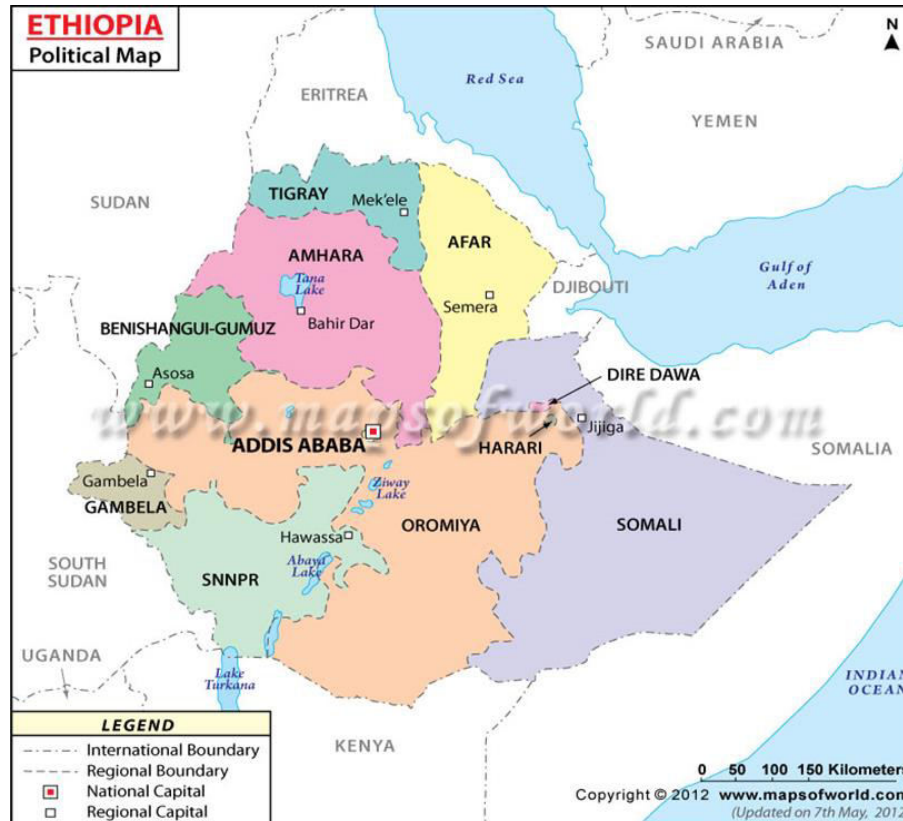
3.1. Economy-wide/CGE Analysis

- CGE model is a system of linear and non-linear equations

$$Z=XY$$

- Changes in X and/or Y induces changes in Z --> Economy-wide analysis
- ❑ We apply the IFPRI- CGE model which is suitable for low-income countries (Lofgren et al., 2002)
- ❑ Calibration: structural features of Ethiopia as low income country

Methodology...



Source: www.mapsofworld.com

Methodology...

3.2. Regional Analysis

- A top-down approach (Dixon et al., 1982; Higgs et al., 1988)

$$Q_i^r = s_i^r \cdot Q_i^e \quad \text{----->} \quad q_i^r = q_i^e$$

- *Production technology of a given industry is similar across regions*
- *Regional Module* depicting economic structure in region r
 - *Economic structure in region r --> Relative to national economic structure*
 - *Economic structure in region r --> Extent of diversification in a region*

Methodology...

- Effects on regional GDP depends on

---> *The type of exogenous shock/policy reform*

---> *Economic structure of a region*

4. Primary impacts

- Production in agriculture inherently affected by climate (Adams et al., 1998; Padgham, 2009)
- Climate change affects biophysical growth and development of crops and livestock

4.1. Crop Responses

- Biophysical models are used to simulate, and

1. LPJmL - HadGEM3-ES-8.5
2. EPIC - HadGEM3-ES-8.5

- Obtain effects on crop yields (output/farm)

$$\Delta Y^c = \frac{Y_f^c - Y_p^c}{Y_p^c} \times 100$$

- Productivity changes (Knox et al., 2012; Müller and Robertson, 2014)

Impacts....

4.2. Livestock Responses

- There exists no, at least, publicly available biophysical model for livestock (Weindl et al., 2015; Robinson et al., 2013)
- Focused only feed availability and quality
- About 85% of animal feed (AgSS, 2004-2014) in Ethiopia is directly affected by climate change

$$\Delta Y_L = 0.3 \times (0.59 \times \Delta Y_G + 0.28 \times \Delta Y_C)$$

- About 86% of smallholder farmers are engaged in mixed farming (AgSS, 2014)

Impacts...

4.3. Migration

- Ethiopian rural livelihood is inextricably linked to agriculture
 - 83% of rural labor is agricultural labor (NLFS, 2013)
 - 99% of agricultural labor is employed in crop and livestock (NLFS, 2013)
 - 92% of agricultural labor is fulltime (CSA, EDRI, and IFPRI, 2006)
 - >65% households' expenditure is derived from agriculture (HICES, 2011)
 - 60% agricultural produce is directly consumed by rural households (AgSS; 2014)
- The agricultural land per rural population is declining (FAO, 2015; NBE, 2015)
 - From 1.04 ha in 1995 to 0.42 ha in 2050 (CSA-FAO, 2014; FAO, 2015)

Impacts....

Table: Climate change impact scenarios

	Parameter	LPJmL	EPIC
Grain production	Productivity	-10%	-26%
Livestock production	Productivity	-2%	-5%
Agricultural labor	Supply	-2%	-4%
Unskilled labor	Supply	+36%	+73

Source: Based on Villora et al. (2014), AgSS(2006), NLFS(2005), EDRI(2009)

5. Economy-wide and Regional Effects

- Economy-wide Effects

Macroeconomic, Sectoral, Factor markets, Households welfare

- Regional Effects

Regional GDP for eleven administrative units (level 1)

Results

Table : Economy-wide and Regional Effects of Climate Change in Ethiopia (%)

	LPJmL	EPIC	LPJmL+M	EPIC+M
EV				
Rural HHs	-3.1	-9.4	-3.5	-9.9
Urban HHs	-3.1	-10.1	-3.6	-11.2
GDP				
Ethiopia	-2.7	-7.6	-2.9	-7.6
Amhara	-3.8	-10.2	-4.1	-10.3
Addis Ababa	0.2	0.8	1.1	2.4

Results

- Effects on Private Consumption, GDP, and Export are profound
- International trade mix will be altered
 - ↓ *agricultural exports*, ↑ *agricultural imports*
 - ↑ *non-agricultural exports*, ↓ *non-agricultural imports*
- Welfare effects are slightly worse for urban households
 - Because bulk of agricultural production is non marketed (EDRI, 2009)*
- Regions where agriculture is the mainstay are affected more
 - Include the three largest regions of the country: Oromia, Amhara, South NNP*
- Climate change induced migration may worsen regional inequality
 - Out-migrants from agriculture will mainly move into urban regions like Addis Ababa*

6. Would Structural Change Dampen the Effects?

- Debate (Kocornik-Mina and Fankhauser, 2015)
- Urban Regions less impacted
- Therefore, would structural change dampen the adverse effects?
- Relax some structural rigidities in the economy

1. Scenario A: Labor market (migration possible to other labor segments)

[Skilled, Professionals, and Administrative Workers]

2. Scenarios B: Transaction margins

[Huge Investment: Transport, Power ---> -10%]

3. Scenario C: Commodity market structure and Households

Demand

[All commodities are marketed, void of mandatory minimum consumption, higher income elasticities]

Structural Change



Thank you!

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