Human health and pesticide use in Sub-Saharan Africa

Megan Sheahan

Precision Agriculture for Development

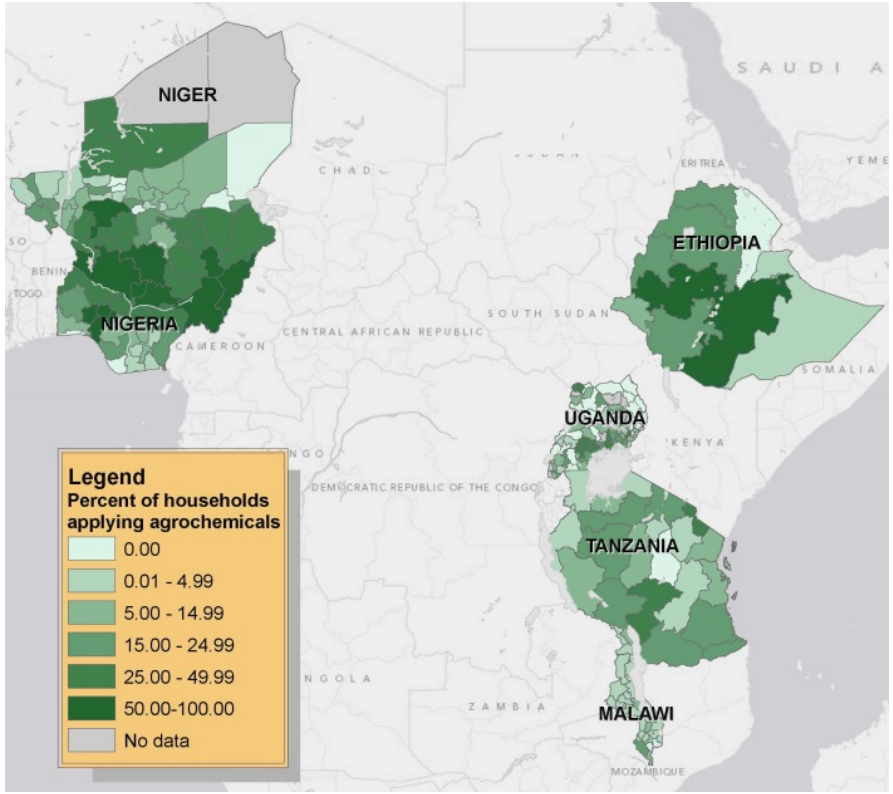
Presenting research done in collaboration with Christopher B. Barrett and Casey Goldvale while at Cornell University

Objectives

- Explore the relationship between "pesticide" use and the value of crop output at the plot level and a range of human health outcomes at the household level using national representative data from four SSA countries
- Extend previous research done using small sample sizes and particular farming contexts; determine if those lessons can be generalized across crops, including staples
    - Philippines: Antle and Pingali (1994)
    - Latin America: Crissman et al. (1994)
    - Africa: Ajayi and Waibel (2003), Houndekon et al. (2006), Maumbe and Swinton (2003), Ngowi et al. (2007), Ugwu et al. (2015)
- Reframe potential issue at the household level, not just ag laborer

Data

- Living Standards Measurement Study Integrated Surveys on Agriculture (LSMS-ISA)
- Use data from 4 of the 6 countries with available panels (where pesticides are used by > 10 percent of farming households)
  - Ethiopia: 2 rounds
  - Nigeria: 2 rounds
  - Tanzania: 3 rounds
  - Uganda: 3 rounds
- All agricultural households in balanced panels



Sheahan and Barrett (2017)

Data

"Pesticide" use

- Binary only (continuous measures contain mix of diluted and concentrated volumes)

Percent of agricultural households reporting use

	Ethiopia		Nigeria		Tanzania			Uganda		
	Y1	Y2	Y1	Y2	Y1	Y2	Y3	Y1	Y2	Y3
Any "pesticide"	31	36	34	38	15	13	14	15	15	15
Herbicide	27	29	22	26						
Pesticide	9	10	19	20						
Fungicide	4	3								

Health measures

- 6 measures: some linked to actual costs

Crop productivity measures

- Value of harvest using the crop income valuation methodology from the Rural Income Generating Activities (RIGA) project

Methods

Crop productivity outcomes associated with pesticide use

$$y_{jkgt} = \beta_0 + \beta_1 c_{jkgt} + \boldsymbol{\gamma v_{jkgt}} + \tau_t + \phi_{gt} + \omega_{kg} + \varepsilon_{jkgt}$$

Human health outcomes and costs associated with pesticide use

$$\boldsymbol{h_{kgt}} = \rho_0 + \rho_1 c_{kgt} + \vartheta_t + \mu_{gt} + k_g$$

Results: *crop productivity*

- Pesticide use is associated with increase in the value of harvest on a plot
  - Ethiopia: $19-32
  - Nigeria: $68-85
  - Tanzania: $40-62
  - Uganda: $38-52
- Log transformed specifications: remarkably consistent 33 percent increase in value of harvested output in 3 of 4 countries (Ethiopia, Tanzania, Uganda)

Results: *human health costs*

- **Value of health expenditures from sickness (curative work and treatments)**
  - Tanzania and Uganda: + in 2/3 specifications
  - Nigeria: + in 1/3 specifications
  - Results hold when controlling for household income in Tanzania and Uganda
- **Value of lost work time from sickness**
  - Nigeria: + in 1 of 3 specifications
  - Ethiopia and Uganda: + in 2 of 3 specifications
- **Value of combined costs**
  - Uganda: + relationship
  - Nigeria: no relationship

Results: *human health costs*

- Results hold in Ethiopia (strongly) and Nigeria (less strongly) when confining analysis to herbicides
  1. Measurement error: survey participants do not know the difference between chemical types
  2. Herbicides used in these contexts are high toxicity unlike other geographies
  3. Timing of data collection
- Results hold when confining to staple crops
  - Herbicides applied mostly to teff and wheat in Ethiopia; maize and rice in Nigeria

Results: *other human health variables*

- **Any day of work lost due to sickness**
  - + in nearly all cases
- **Fell sick in recent past**
  - + in all specifications for Ethiopia and Nigeria; + for only 2 in Uganda
- **Visiting a health worker**
  - + in Uganda and Nigeria (for curative care)
  - + in Ethiopia and Tanzania (although cannot isolate curative care)
- **Chronic illness**
  - No relationship in Ethiopia
  - + in Nigeria

Conclusions and implications

- There appear to be productivity-health trade-offs that motivate more focused investigations as to why adverse human health effects are now widely associated with pesticide use in African agriculture
- Important "wake up call" to researchers and policy makers that these relationships need to be studied more carefully (our results are not necessarily causal)
- Potential lessons to be learned for extension services (or other information transmission services) and regulators