Final Progress Report
Sustainability Science Program, Harvard University
Term: September 1, 2011 – August 31, 2012
Submitted: July 2012

Name: Brian Dillon

Your field(s): Economics

Your degree program, institution and (expected) graduation date:
PhD, Agricultural Economics, Cornell University, 2012

Faculty host(s) at Harvard name and department:
Michael Kremer (Econ)
Rohini Pande (HKS)

Description of SSP-related research activity:
Agricultural economics research, with inputs from agronomy, soil science, atmospheric science, and public health research related to crop residue management

Title: Crop residue management as a farmer decision problem

Abstract: Although disposal of post-harvest crop residues is a significant step in the agricultural production cycle, the choice problem that farmers face when disposing of residues has received scant attention from economists. Burning some or all residue is common in many developing country agricultural systems, such as the rice-wheat system in India, cotton in East Africa, and sugar cane in numerous settings. The net welfare effects of this disposal method, at both the individual farmer level and the social level, are unclear. Emissions from crop residue burning account for substantial release of nitrogen and sulfur, and can have adverse respiratory health effects on nearby populations. However, burning can in some cases increase agricultural profits by lowering labor costs and breaking the reproductive cycle of pests. This project builds a framework for evaluating residue burning, and alternative residue disposal methods, that accounts for the multiple, critical channels by which residue disposal affects individual and aggregate welfare. A farmer decision model is developed that clarifies the relevant tradeoffs across the key affected dimensions: atmospheric carbon and nitrogen, soil fertility, pest reproduction, localized health effects, and labor costs. By calibrating the model for a number of key agricultural systems using empirical estimates from the agronomy, economics, public health, and atmospheric sciences literatures, private and social optimum disposal methods are derived.

Identification of the problem you address:
Addresses the gap in our understanding of how farmers deal with stalks, stubble, and other crop residues, emphasizing the human-environment interaction as much as the agricultural output problem, and focusing on the issue of optimal residue management in the face of environmental externalities. Residue burning has both long- and short-run impacts on soil macro- and micronutrients, and affects public health. Appropriate use of residues can have a substantial impact on demand for agricultural inputs such as nitrogen-based fertilizer.

Key question asked about the problem:
What are the optimal private and public uses of crop residues, taking into account the numerous channels by which crop residue disposal affects both the long run productivity of the farm and broader public goods such as air quality and atmospheric concentrations of N, S, and C.

The methods by which you answered that question:
Field work to gather necessary parameter values for the Tanzania cotton/maize system (March 2012); extensive literature review across multiple disciplines to identify other key parameter values; development of an economic model of crop residue management, calibration of the model for particular cropping systems, and simulation.

Principle literature upon which the research drew:
Public economics, agricultural household models in economics, public health (dealing with pollution from residue burning), agronomy, soil science, atmospheric science (particularly regarding N and S release from agricultural fields)

Empirical data acquisition description:
I interviewed cotton and maize farmers in rural Tanzania about their crop residue management practices, focusing on the data needed to calibrate the model of residue management

Geographical region studied:
Tanzania; I also have results from the literature for the rice-wheat system in the Indo-Gangetic plain

Recommendations that might be relevant for your problem:
In the end, the model should help identify policy levers that would induce farmers to undertake the optimal residue management practices from the perspective of the public as a whole (rather than the farmer him/herself).

A description of the final product(s) you have/are aiming to produce:
A paper for American Journal of Agricultural Economics or Ecological Economics, as well as a model that leads to multiple other papers down the same line.

Description of major other intellectual or professional advancement activity(ies) over the past academic year:
Wrote and submitted two major grant applications (to the World Bank and the NSF), co-wrote a grant application to the Gates Foundation; made substantial progress on a number of other papers:

- The Link Between Land Tenure Security and Agricultural Investment: Theory and Evidence from Zambia
- Partial Identification of Underlying Beliefs from Elicited Subjective Distributions
- Estimation of a Dynamic Agricultural Production Model with Observed, Subjective Distributions
- Ex Post Smoothing of Elicited Subjective Distributions
- Do the Poor, or the Impatient, Pay More? Evidence from Consumption Diaries in Tanzania
- Oil Prices and African Food Security

Citations for reports, papers, publications and presentations that built on your fellowship research:

Principal collaborators outside Harvard (list name and institution):
Chris Barrett, Cornell; Joachim De Weerdt, EDI Tanzania; Ted O'Donoghue, Cornell; Russell Toth, University of Sydney; David Lee, Cornell; Miguel Gomez, Cornell

Awards or grants that you have received this year for the current or coming year:
Renewal of half-time post-doc at Cornell; Gates Foundation grant ($192,000) for Oil Prices and African Food Security project with Cornell team; grant applications to World Bank (SIEF) and NSF under review.