Climate Change, Food Security and Conflict

DARREN HUDSON

PROFESSOR AND COMBEST ENDOWED CHAIR

DIRECTOR, INTERNATIONAL CENTER FOR AGRICULTURAL COMPETITIVENESS

Thanks to my co-authors/collaborators: MAJ Riley Post, MAJ Patrick Bell, Donna Mitchell, and Ryan Williams
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The Problem

The *water-food-climate* nexus and its potential for conflict creation have becomes a major topic of interest of late.

- 3 of 5 Democratic candidates in the Oct 13 presidential debate listed “climate change” as one if not the most important national security threat
- A recent report by Kelley et al. in the *Proceedings of the National Academy of Sciences* suggested that (climate change induced) drought in Syria caused food insecurity and migration and those led to the rise of ISIS (and the rebellion against Assad)
- A recent paper by Bellemare in the *American Journal of Agricultural Economics* suggests that rising food prices lead to social conflict

Can it really be that simple?

Objectives

We wish to examine the causal pathways between climate, food, and conflict. Primarily, we want to present an alternative view of the causal chain to help foster new research that can better contribute to policy solutions.

This presentation will focus on:

1. An empirical example of the climate change-water-food nexus and illustrate the difficulties in doing actual empirical investigations in this area
2. A new conceptual model of the food-conflict nexus

A Monte-Carlo Analysis of the Impact of Climate Change on Water and Food Security in Uzbekistan

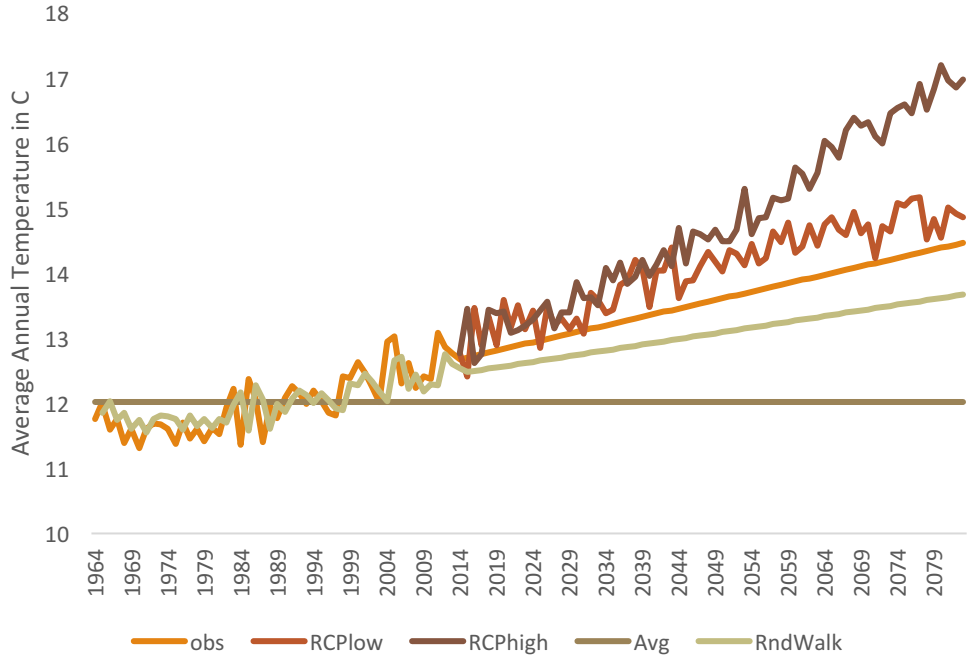
A SUMMARY OF A PAPER BY DONNA MITCHELL, DARREN HUDSON, RYAN WILLIAMS AND PHILLIP JOHNSON

Purpose and Methods

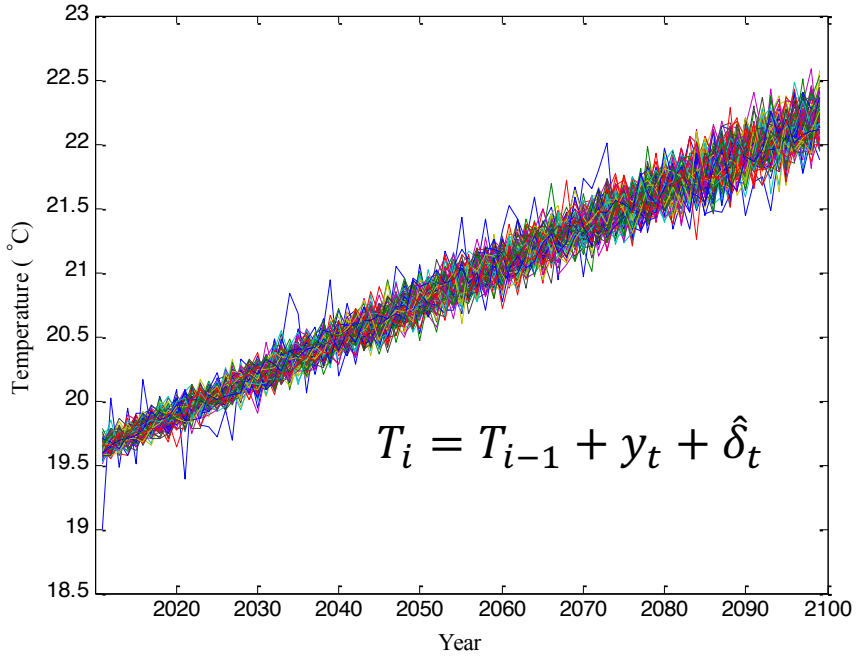
- Examine the impact of projected climate change on the key Khorezm production region of Uzbekistan.
  - This region lies along the Amu Darya river system and largely relies on stream flows from the Tuyamuyun Hydro Complex (THC) reservoir system.
- Use Monte Carlo simulation of climate projections for the region in conjunction with crop production models (DSSAT) to simulate production possibilities given water availability.
  - Climate data were downscaled to the region…more on this later
  - DSSAT is a crop growth simulator that takes weather, soil, and technology data and estimates production functions: we used cotton, rice, wheat, and tomatoes (a representative vegetable crop for the region)
- Estimate profit-maximizing crop decisions subject to water availability, fixed prices (a weakness), and policy variables (Uzbekistan maintains a 40% acreage quota for cotton)

Climate Simulation

AVERAGE ANNUAL TEMPERATURES



MONTE CARLO SIMULATED TEMPS (LOW CO2)



Optimization

Objective is to maximize the net present value of producer profits over time:

$$MAX\ NPV = \sum_{t=1}^{n} NR_t (1+r)^{-t}$$

where NPV is the net present value, NR is the net revenue, and r is the social discount rate; NR is given by:

$$NR_t = \sum_i \sum_k \theta_{ikt} \{P_i Y_{ikt}[WA_{ikt}, WP_{ikt}] - C_{ik}(WP_{ikt})\}$$

where i represents the crops grown, k represents the irrigation technology, Θ is the percentage of crop i produced using technology k, P_i is the price of crop i, WA_{ikt} and WP_{ikt} are the water applied and water pumped per acre, Y_{ikt} are the production functions (estimated from DSSAT), and C_{ikt} are the costs per acre.

Scenarios

- Baseline—Based on projected climate with no alteration in policy or projected water availability (except with changes in precipitation) to the end of the century
- Scenario 1—50% reduction in average stream flows, all other conditions the same
- Scenario 2—50% reduction in average stream flows with elimination of the cotton acreage quota

Results—Anticipated Yields

Crop	Near-Term			Mid-Century			Century		
	Baseline	Scenario 1	Scenario 2	Baseline	Scenario 1	Scenario 2	Baseline	Scenario 1	Scenario 2
Cotton (lb/ac)	1338	1243	1239	1390	1192	1173	1214	1113	1096
Rice (bu/ac)	91	87	88	91	81	86	92	84	89
Wheat (bu/ac)	55	53	53	56	56	56	62	62	62
Tomatoes (lb/ac)	700	338	349	683	494	571	719	583	532

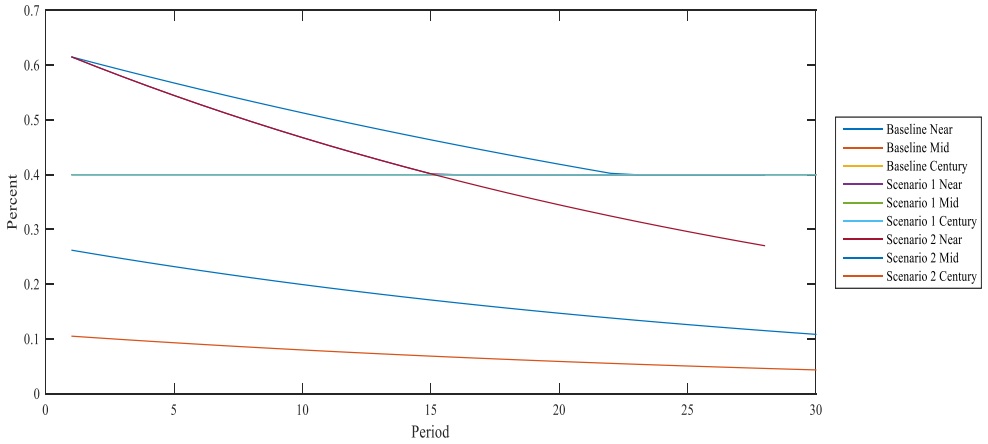
Low emissions scenario; actually see slight increases in yields mid-century (except tomatoes); effect is more pronounced in high emissions scenario

Results—Producer Returns

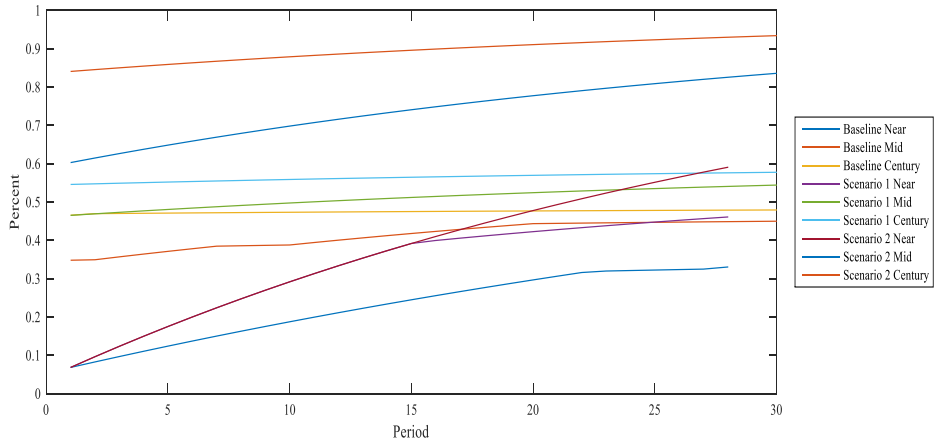
Period	Baseline ($/ac)	Scenario 1 (% Change from Baseline)	Scenario 2 (% Change from Baseline)
Near	$475.91	-79.08%	-78.85%
Mid	$392.39	-99.55%	-86.91%
Century	$477.73	-85.74%	-83.89%

Results—Food Production

COTTON



WHEAT



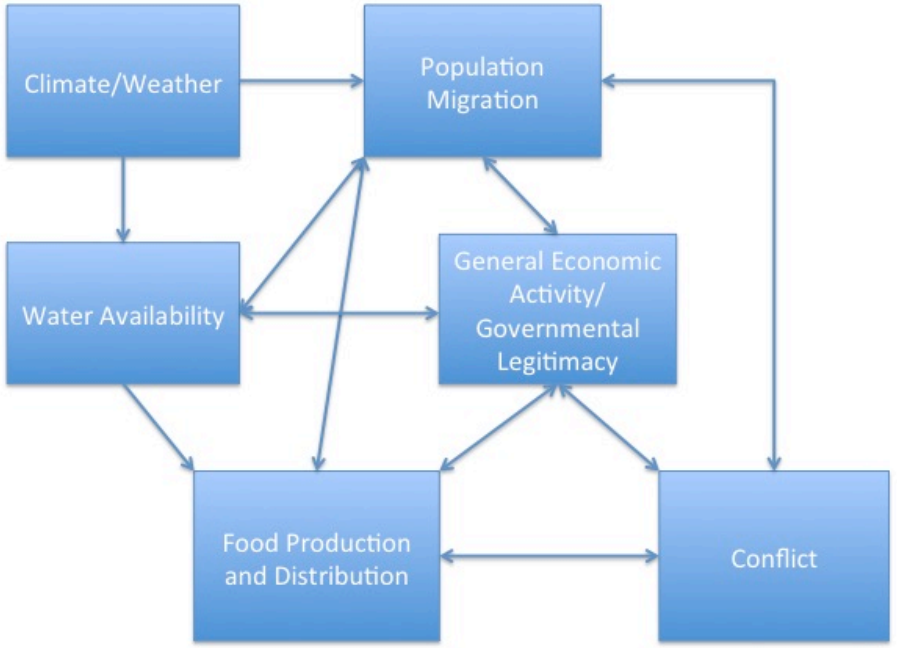
Conclusions

- The Uzbek food production situation is not terribly sensitive to climate change, *per se*. Farmer profitability is impacted, but overall food production is expected to rise to end of century.
- Food production is sensitive to water availability, but even in the 50% flow reduction scenario, they still had sufficient water to produce the same complement of crops.
- Food production is most hampered by policy—cotton acreage quota is significantly limiting shifts to more profitable food crops.
- This analysis highlights to extreme difficulty in doing meaningful empirical work in this area…too many moving parts, disjointed models, and climate modeling provides its own set of empirical challenges as well

Does Climate Change and Food Insecurity Lead to Civil Conflict? And So What if It Does?

RILEY POST, DARREN HUDSON, PATRICK BELL, DONNA MITCHELL, AND RYAN WILLIAMS

Returning to the Problem of Food Security and Conflict—Traditional Pathways



Source: Mitchell et al. (2015)

Characterizing the Literature

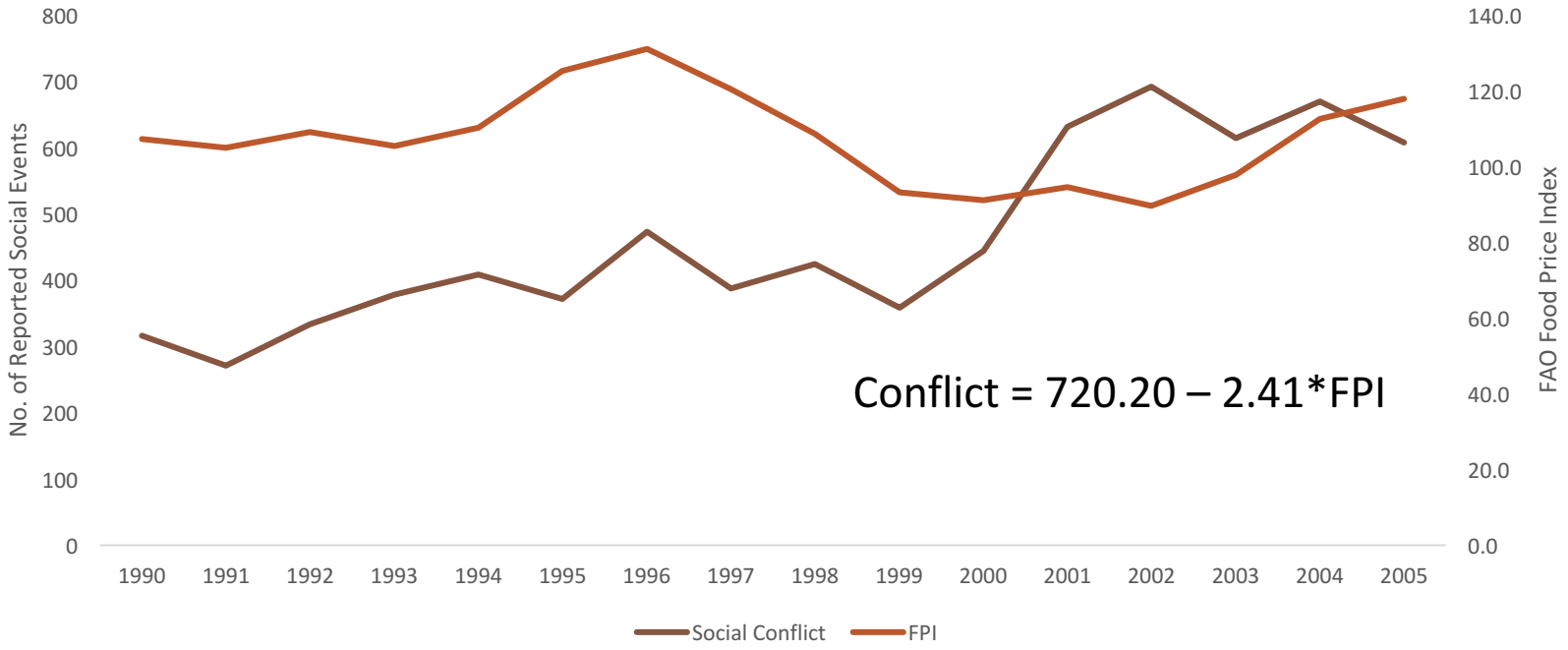
- Migration
  - Climate change and weather events lead to mass migration ▸ famine/food shortages ▸ conflicts
    - Why no conflict on the Great Plains of the United States…prolonged drought?
- Economic Well-Being
  - Food price increases ▸ strain on family budgets ▸ conflict
  - Poverty ▸ relative deprivation ▸ conflict

Aggregate associations are fine, but conflict is fundamentally an individual decision

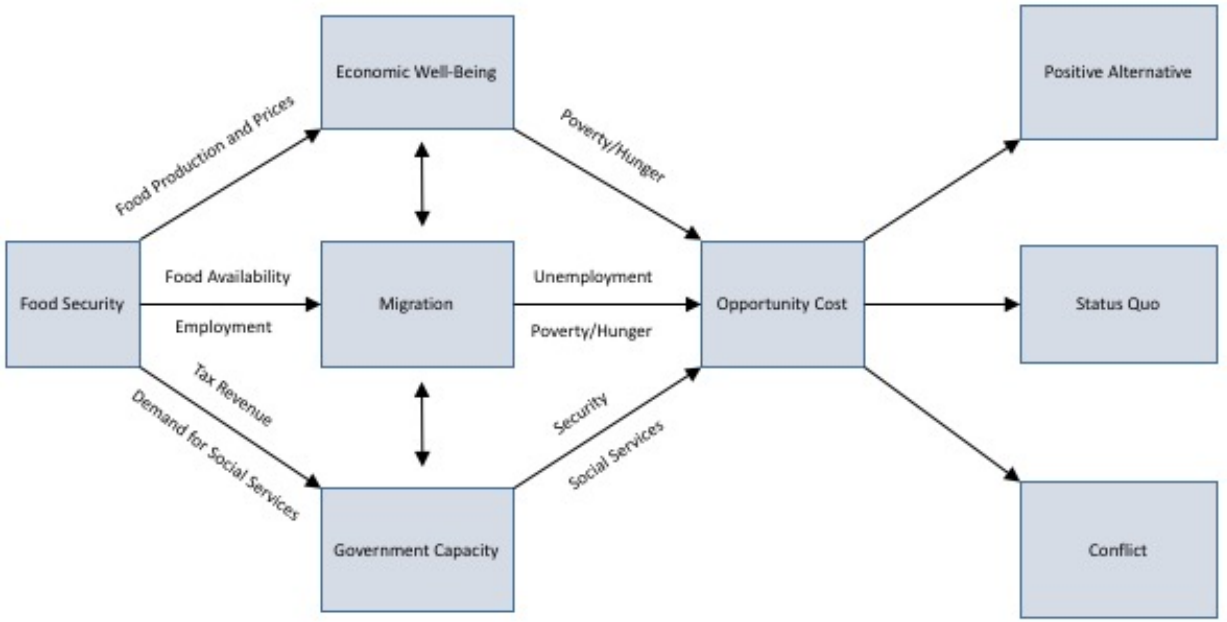
- Grievance/Government Legitimacy
  - Relative deprivation ▸ extreme grievance ▸ decision to engage in conflict
  - Government inability to respond ▸ grievance ▸ conflict

Being upset at one's situation is a necessary, but insufficient condition for conflict choice…something is missing

Further Evidence on the Limits of the Food Price Argument



The Opportunity Cost of Conflict as a New Paradigm



Why Opportunity Cost?

- An opportunity cost-centric approach allows a translation of the macro effects—poverty, deprivation, grievance, food prices, climate/migration, etc.—into a cost/benefit framework for the individual's decision
- Allows a clearer delineation of how policy is likely to impact individual decisions and better assess the potential costs and benefits of government action on the potential for conflict choice rather than simply addressing symptoms
- Some may argue this approach is redundant because isn't opportunity cost *implied* within the other macro variables? Macro variables provide insights, but do not address the question of *why* a person chooses conflict
- Opportunity cost model opens itself to behavioral research on why people choose or not choose to engage in conflict
  - Information cascades and the role of social media on the perceptions of the benefits/costs of conflict
  - Information asymmetries about costs/benefits
  - The role of risk preferences in conflict choice

A Complex System

- Effective demand/poverty/production risk
- Food aid, infrastructure, corruption
- Economic growth/income distribution
- Incentives, property rights, and government legitimacy
- Natural resources, government reserves/borrowing capacity, “virtual water”

Failed Institutions

All of the cited examples--climate, water, food price and availability, poverty, migration, etc.– are mitigated or exacerbated by failed governmental and social institutions

Failed institutions contribute to a lowering of opportunity costs to individuals—what is their alternative?

Complex Adaptive Systems

- Is a system fragile, robust, or anti-fragile?
  - Anti-fragile—The Hydra—actually thrives on adversity
  - Robust—The Phoenix—survives adversity to live another day
  - Fragile—Sword of Damocles—breaks under adverse events
- Fragile institutions are not capable of adequately responding to adverse events; their lack of response lowers the opportunity cost of conflict

- Complex does not necessarily mean complicated—simple rules govern complex systems…in our case, opportunity cost dictates action
- To get a robust outcome, systems must make the opportunity cost of conflict greater than the opportunity cost of stasis

Practical Conflict Research

- Does climate change cause conflict?
  - No, *per se*. Climate change is just one of many beginning points in causal chains. It is neither necessary nor sufficient.
  - Climate change is a stressor or precursor, but there are better avenues of research.
- Best to focus on the opportunity cost of individuals
  - What impacts economic well-being, migration, and government capacity
    - Food security impacts all of these…we need research into how those impacts are translated and the factors that affect the strength of that relationship
      - For example, we know that food storage policies create deadweight losses, but what does that deadweight loss buy in terms of government capacity to address shocks to food supply/price? What is the government giving up in capacity to purchase those items through the deadweight loss?
      - What impacts do microfinance/credit policy and/or insurance programs have on the three factors
      - What impacts do social safety nets have on migration and economic well-being?