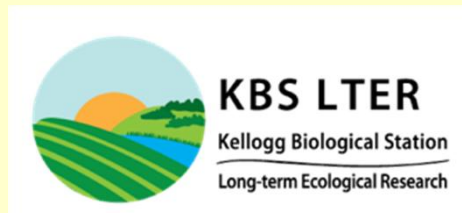


KBS-LTER Human Dynamics: Farming for Ecosystem Services

Scott M. Swinton



MICHIGAN STATE
UNIVERSITY

Department of Agricultural,
Food, and Resource Economics

KBS-LTER All Scientists Meeting, April 5, 2013

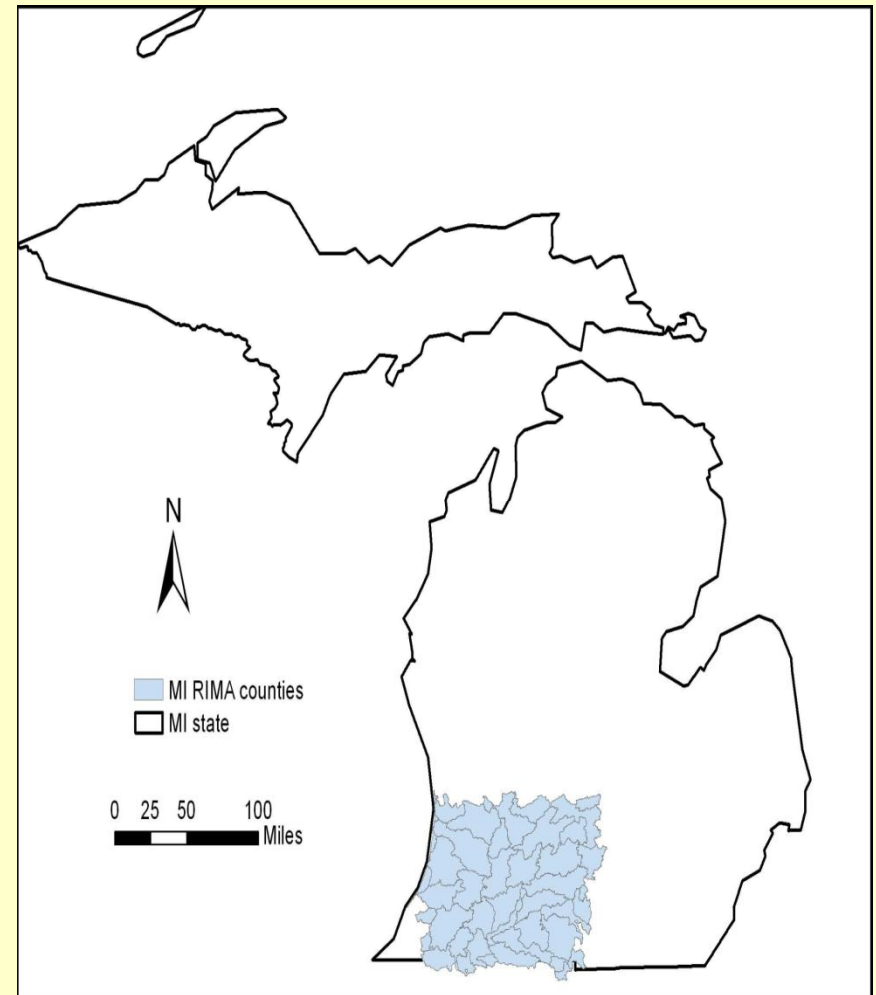


Human dynamics objectives for current quinquennium

- **Economic valuation and policy for multiple ecosystem services (ES) over time**
 - *Maintaining ES with rising supply of energy biomass.*
- **Coordination of landscape-level ES across farms**
 - *Farmer coordination to reduce P runoff.*
- **Socio-economic evaluation of new cropping practices**
 - *Perennial wheat: Meeting threshold for adoption.*

Policy to mitigate environmental harm from intensified cropping for bioenergy

- Simulation of most profitable land use in SW Michigan
- EPIC simulates crop yield + 5 environ. outcomes
 - Soil erosion
 - Soil carbon loss
 - Nitrate leaching to water
 - Phosphorus runoff to water
 - Greenhouse gas (GHG) flux (CO₂ + N₂O + methane)



Most cost-effective options among 3 environ policy types

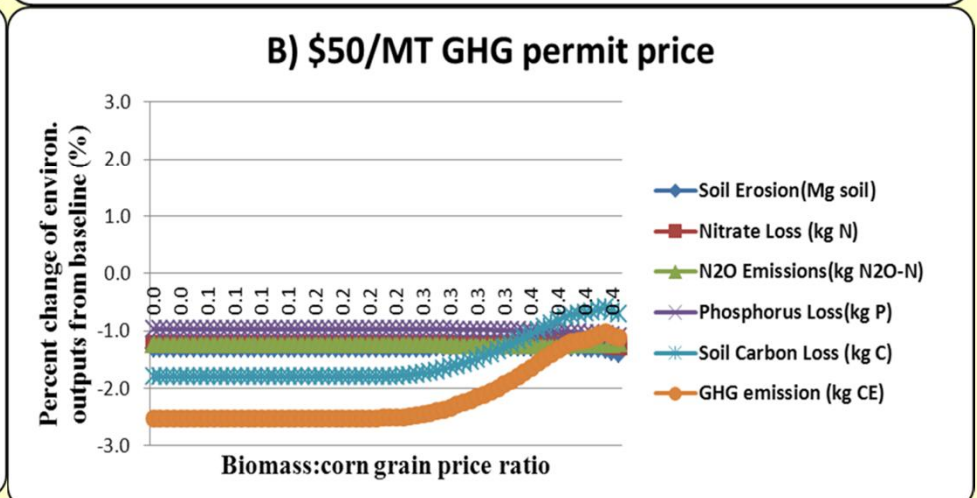
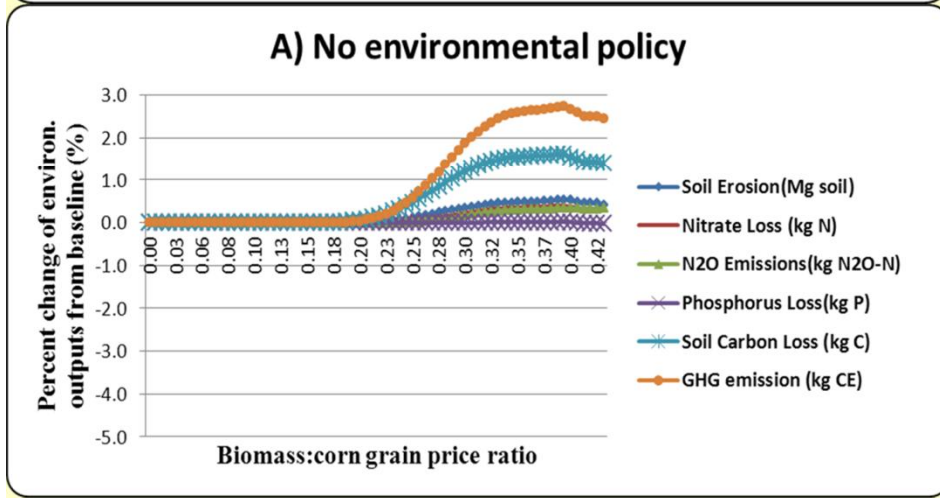
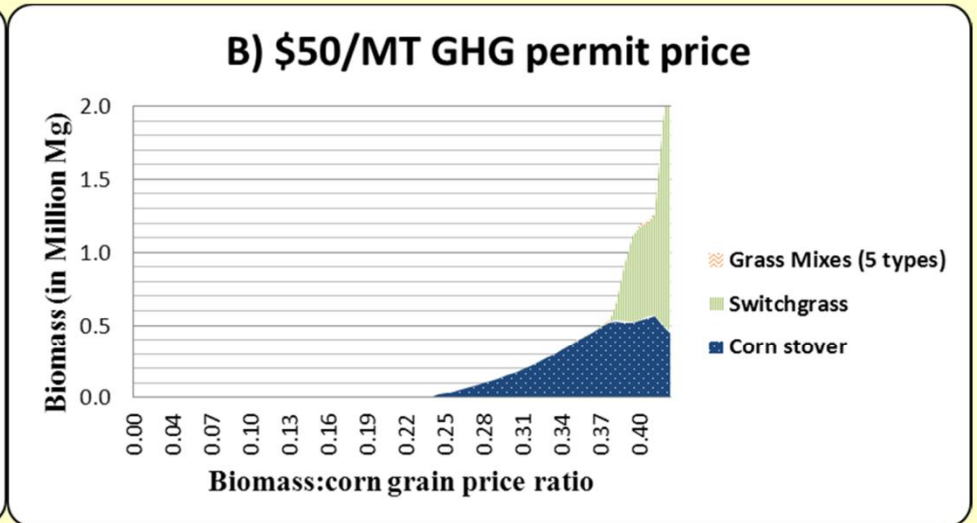
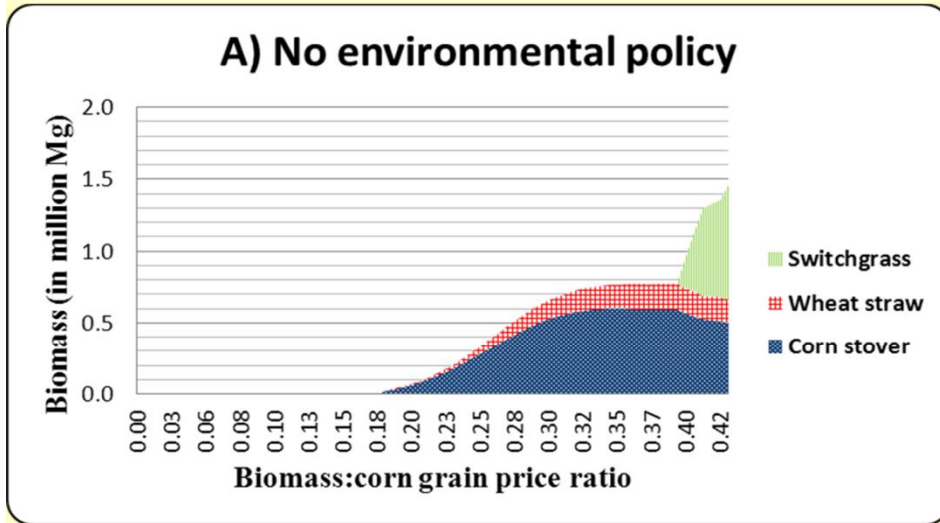
- **Fertilizer tax 100%**
 - Focus on input, not output
 - No effect on tillage
 - Negligible environ gain
 - Cuts farm net income



- **No-till subsidy \$50/ha**
 - Focus on input, not output
 - Modest GHG, water gain
 - Raises farm net income
 - Costly to government

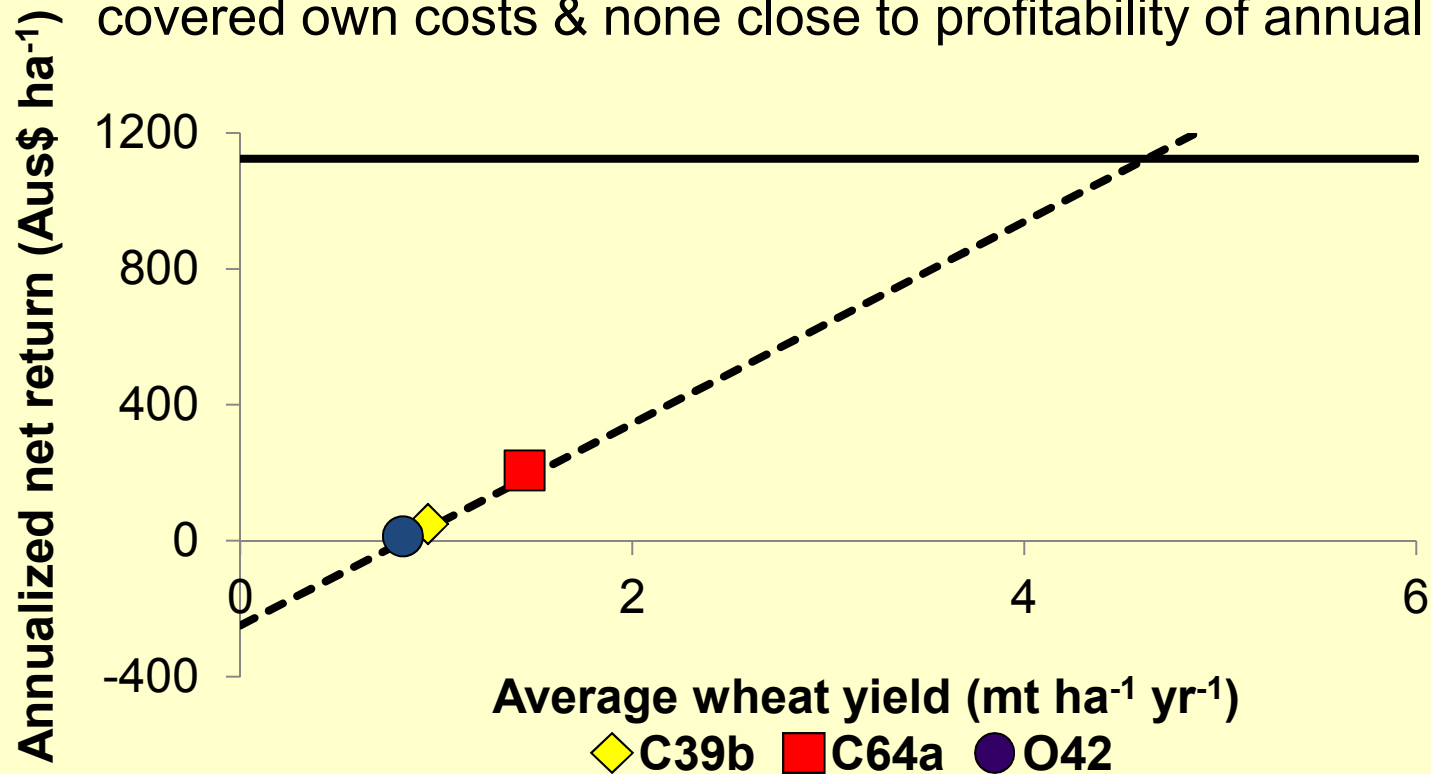
- **Carbon credit \$50/MT**
 - Focus on ES output
 - Cuts N fert, tillage
 - Modest income gain
 - Cost borne by emitters

Closer look: How do GHG emission permits deter environ. damage of harvesting biomass?



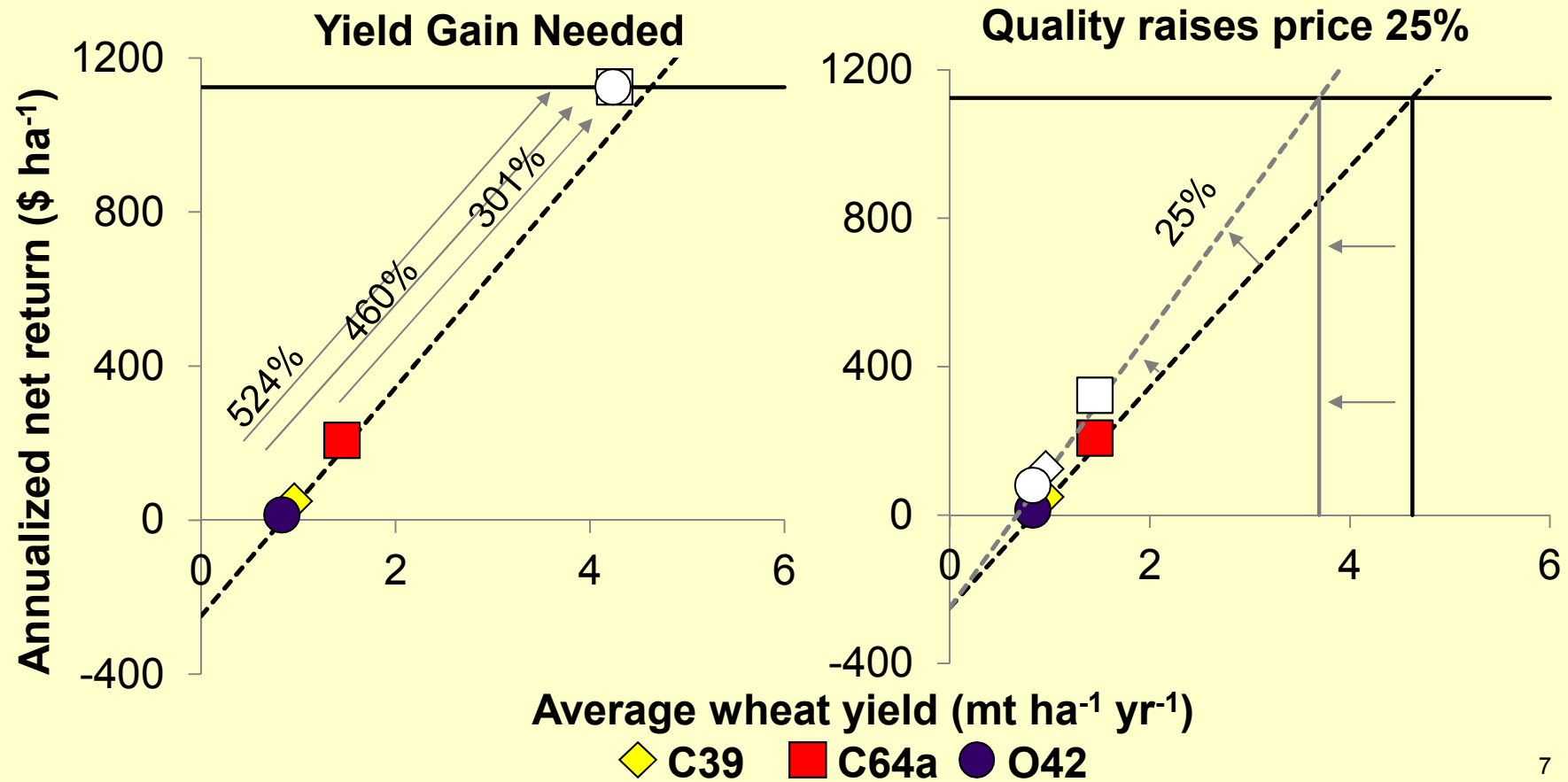
Perennial wheat: Crossing the adoptability threshold

- Perennial grains offer ES benefits.
- PW lines at KBS often not perennial, so hard to analyze.
- Analyzed 28 PW lines from Australia with multi-year survival; only 4 covered own costs & none close to profitability of annual wheat.



Framework for PW improvements needed

- Grain yield up 300-500% to break even w/ annual wheat.
- Quality gain or environ. payments insufficient in plausible ranges.



Coordinating farmer behavior to reduce P runoff

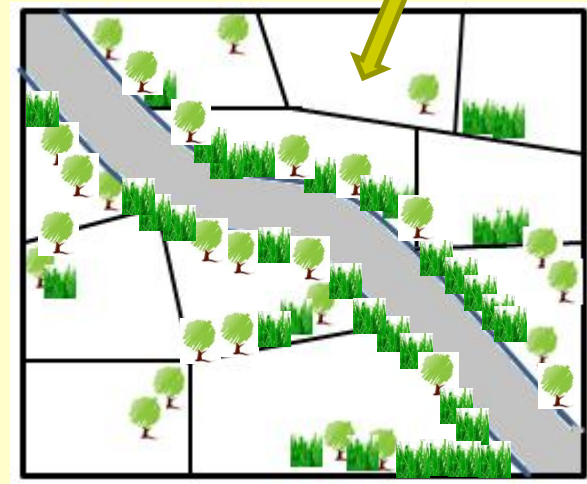
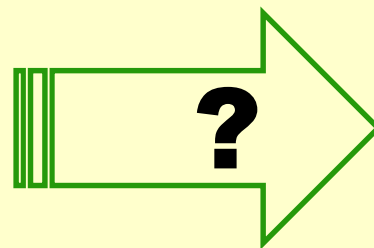
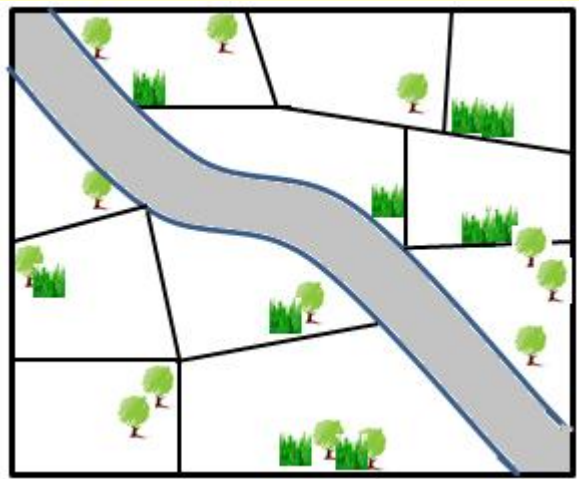


- How to motivate farmers to adopt environmental stewardship practices (ESP) to improve aquatic ecology?
 - Which incentives are most cost-effective?
- How might farmers ***coordinate*** the management of agricultural lands to improve Lake Erie Water quality?
 - Is there an optimal mix of management practices that would lead to cost-effective improvements?
 - How do we move toward optimized landscape management?

Funding: GLPF via TNC

Opportunities with farmer auctions where low bidder wins (see Leah Harris poster)

- Payment for ES variants:
 - Subsidy vs tax reduction vs price premium
 - Insurance to cover risk of ESP adoption
- Can groups of farmers coordinate ESP adoption to maximize environmental benefits with minimal costs?



Farmer bids identify costs of ESPs; Ecological models identify benefits

- Aquatic ecological models predict outcomes of Δ Ag mgt. (esp. soluble P)
 - SWAT models flow from field to stream.
 - Hydrological model of in-stream flow to Lake Erie.
 - Lake Erie aquatic ecology model predicts algal blooms.
- Environ impact increases with soil erodibility & proximity to Lake Erie.



Tailoring research method to research question

- Bioeconomic optimization
 - Egbendewe-Mondzozo et al. 2013. “Maintaining Environmental Quality while Expanding Energy Biomass Production: Sub-regional U.S. Policy Simulations.” **Energy Policy** (in press).
 - Zhang & Swinton. 2012. “Optimal Control of Soybean Aphid in the Presence of Natural Enemies & Implied Value of Their Ecosystem Services.” **J. Env. Mgt** 96.
- Surveys
 - Ma et al. 2012. “Farmers’ Willingness to Participate in Payment-for-Environmental-Services Programs.” **J. Agric. Economics** 63:604-626.
- Price analysis
 - Ma & Swinton. 2012. “Hedonic Valuation of Farmland Using Sale Prices versus Appraised Values.” **Land Economics** 88:1-15.
- Budgeting (breakeven thresholds)
 - Reeling et al. 2013. “Incorporating public benefits into a framework for evaluating adoptability of conservation technologies: The case of perennial wheat.”
- Experimental auctions – next.

Recent people and grants

A Few Key People



Key Funders

- NSF
- Dept of Energy (GLBRC)
 - Many KBS-LTER PI's
- USDA Organic Farming Research Initiative
 - S. Snapp
- Great Lakes Protection Fund (w/ Nature Conservancy & LimnoTech)
 - J. Kerr & R. Richardson, MSU