Farmer Decisions that Shape Agro-Ecosystem Outcomes

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Farming for Ecosystem Services: New Directions for Long-term Ecological Research in Agriculture

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To learn more about measuring & modeling complex, dynamic systems (including the IMPACT model), see Chap. 7 and appendices of:

A Framework for Assessing the Effects of the Food System (2015)

http://www.iom.edu/foodsystem

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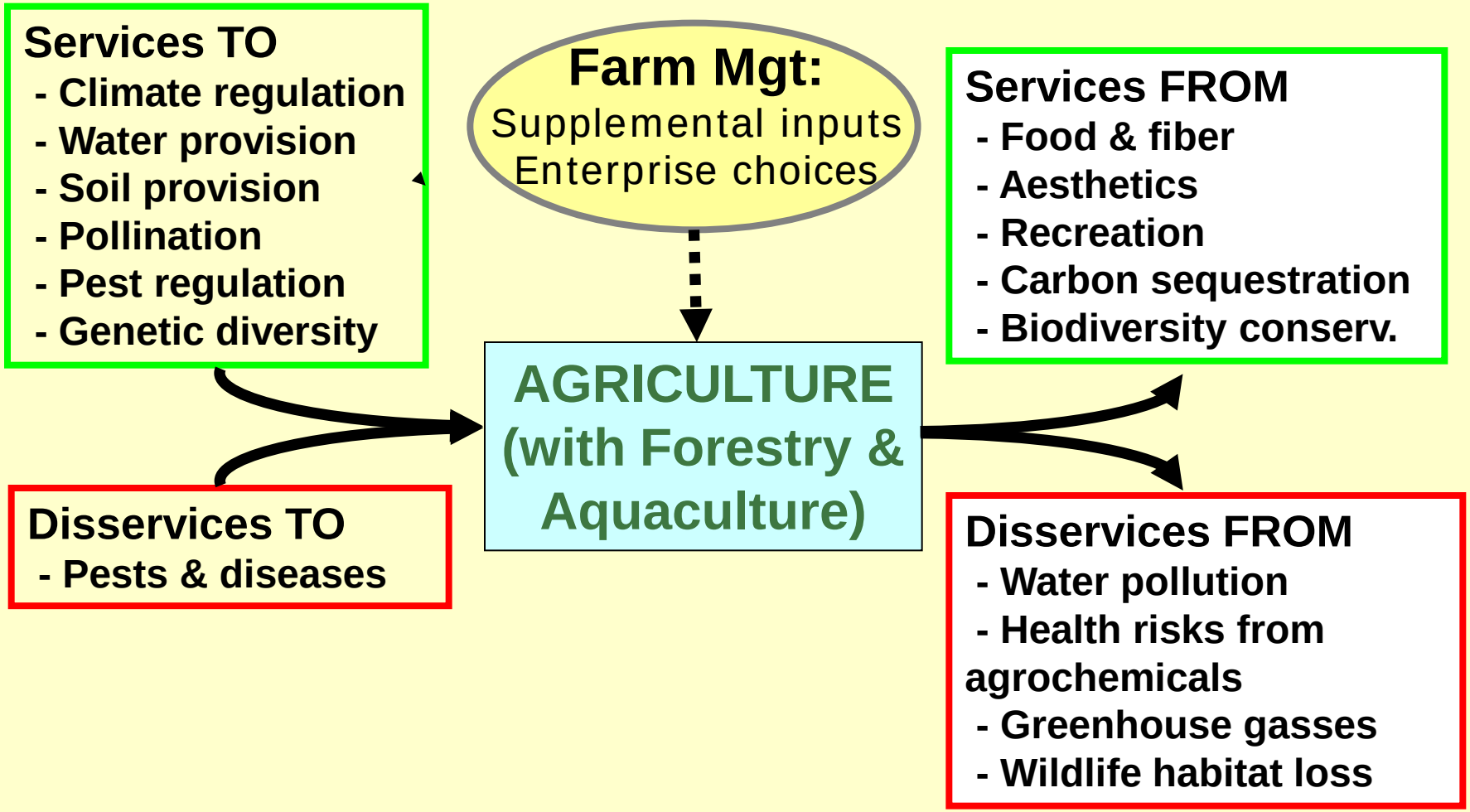
Biological research findings from KBS-LTER … and management subtext

- Greenhouse gas emissions are regulated by vegetation and microbial communities
  - → *Do not till; Keep vegetative cover; Build soil org. matter*
- Nitrogen movement regulated by vegetation and N application rate & timing
  - → *Plant cover crops; Reduce N; Apply N just-in-time*
- Pests are regulated by natural enemies that rely on habitat
  - → *Diversify crops; Enhance non-crop habitat; Avoid pesticides*

Agricultural ecosystems both receive and generate ecosystem services



Swinton et al, *Ecol Econ* 2007

Advocated for sustainable agriculture

- Designing landscapes for ecosystem services
- Farmers who …

Why Do Farmers Do What They Do?

- Why till?
- Why not curtail chemical inputs?
- Why not plant cover crops?
- Why not time chemical inputs to minimize risk of unwelcome side-effects?

How Do Farmers Make Decisions?
A Conceptual Framework

- Goals & objectives: What do they seek?
  - Profit (Revenues - direct costs - opportunity costs)
  - Stewardship
  - Other (health, friends, eminence …)
- Resources and barriers: Are they constrained?
  - Knowledge
  - Equipment, time and labor
  - Land & water traits
  - Regulations & commercial standards

Learning about farmer decisions

- Interviews: Individual and in groups

- Decision setting with budget constraints to evoke real-world choices:
  - Surveys: Would you change farming practices for a specific payment?
  - Auctions: What is the smallest payment you would accept to change practices?

What would induce you to manage for more environmental benefits?

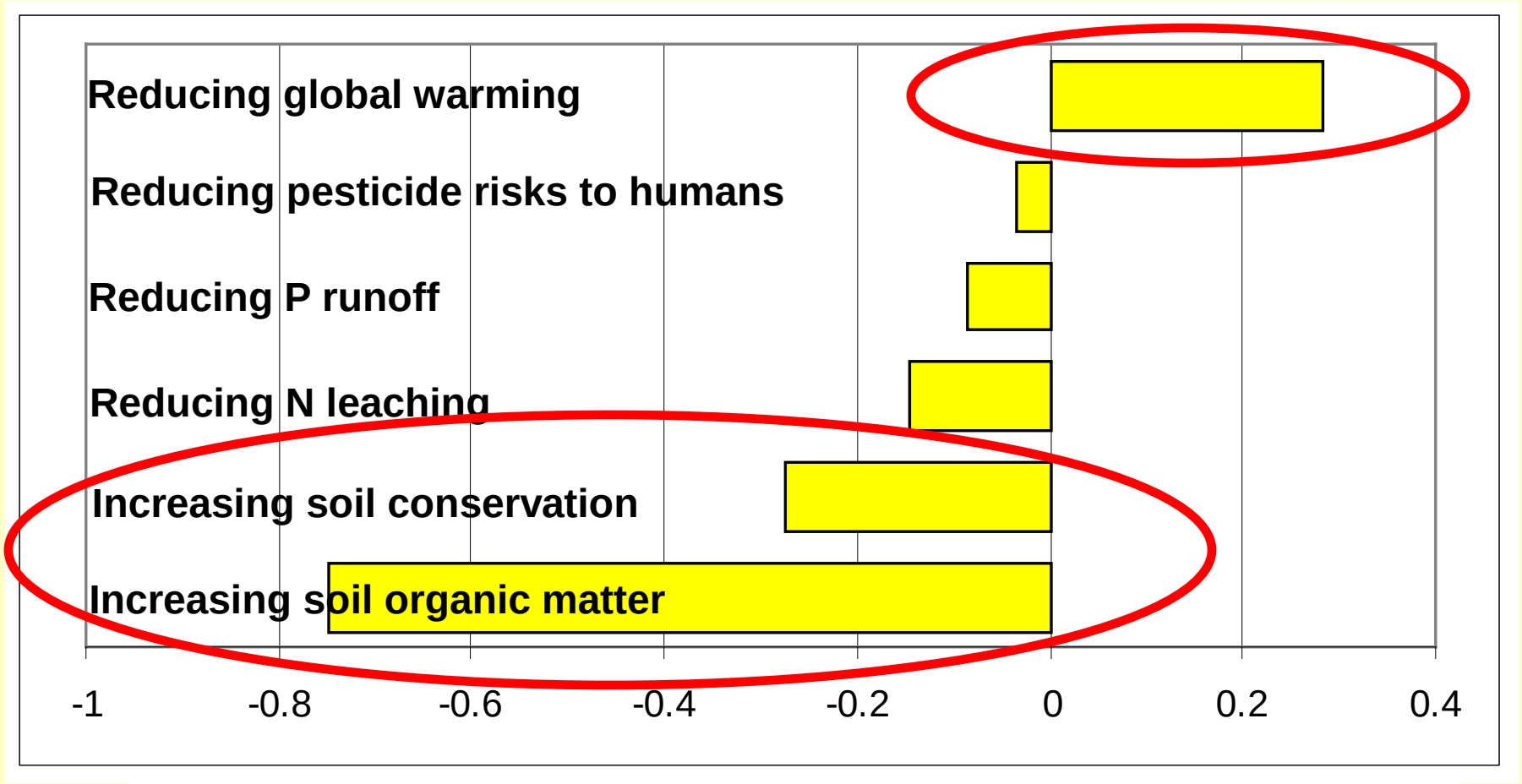
- “earning more per acre”
- “I would be willing to try something new to be a better steward of the land”
- “maybe help environment, increase organic matter”

Knowledge: Farmers well-informed, but beliefs don't always match behavior

- Cropping practices affect environmental quality (>80% agree).
- Less tillage conserves soil(>80% agree).
  - 83% use reduced tillage
  - 56% use no-till
  - 32% use no-till 4 years in a row
- Winter cover crops conserve soil & Cover crops boost soil fertility (>80% agree).
  - But only 19% grow cover before corn.

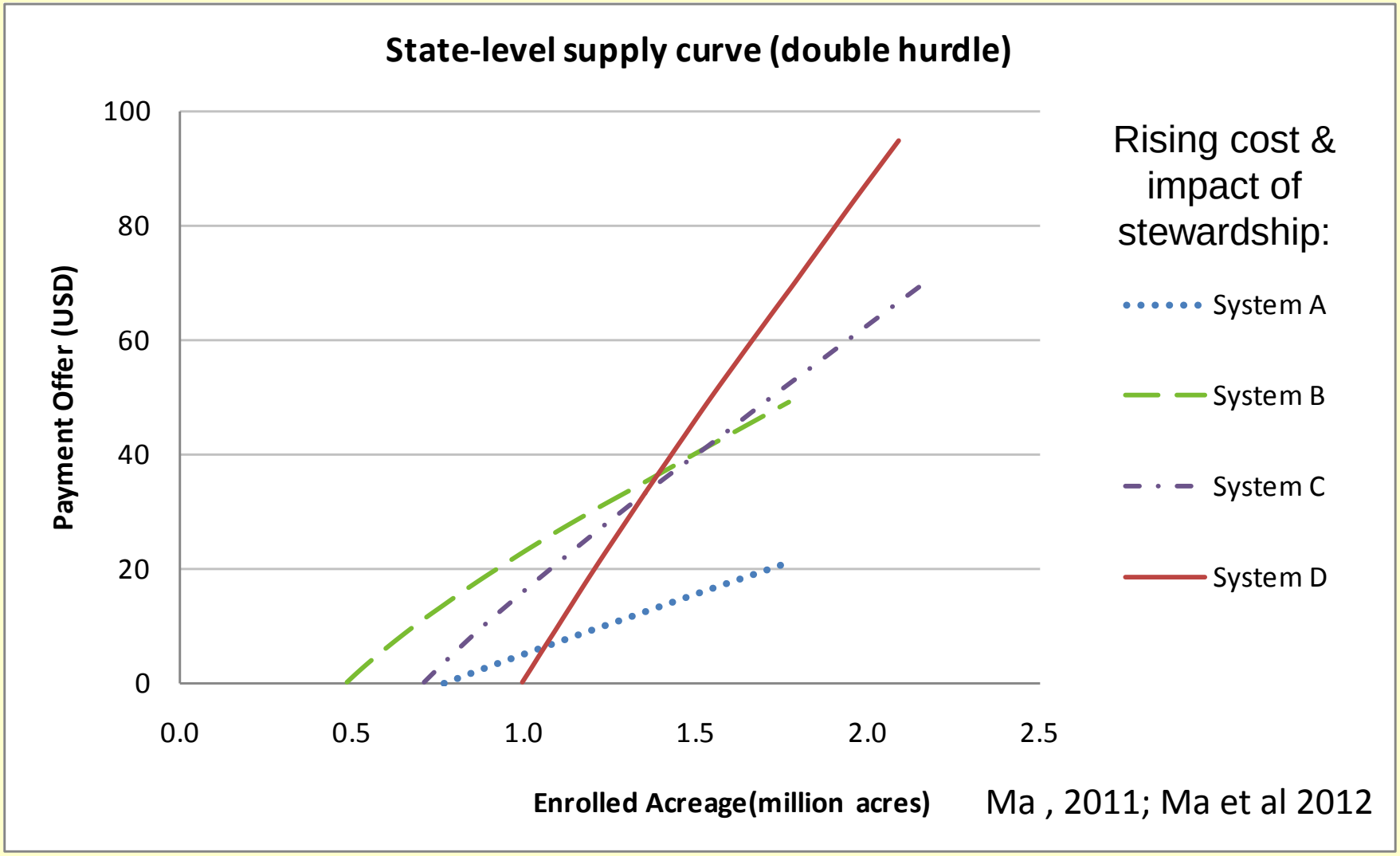
Jolejole 2009; Swinton et al 2015

Attitudes: Farmers more willing to provide ES that have private benefits than public



N=1800 Michigan corn-soy farms. Swinton et al, 2015.

Heterogeneity of farmers:
Some are lower cost providers of ES



Ma , 2011; Ma et al 2012

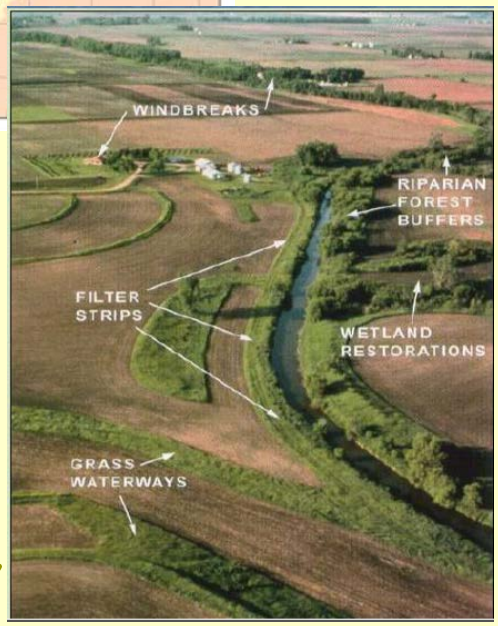
Early lessons: Farmer decisions about choice of practices

- Biology can replace chemicals—but only to a degree
- Unless offered incentives, most MI corn-soy farmers prefer conventional systems. Why?
  - Cover crops are expensive in labor and inputs.
  - Low fertilizer use looks risky.
  - Some rotational crops (e.g., wheat) reduce profits.
- Incentive payments can compensate for costs of providing public goods

Incentives are costly.
How to use them cost-effectively?

- Focus on ecological outcomes
  - Models to simulate outcomes
- For a limited budget, how to get the most environmental benefit per dollar spent?
- What factors influence cost-effectiveness?
- Will farmers cooperate across a landscape?

Case Study: Phosphorus runoff and harmful algal blooms in Lake Erie



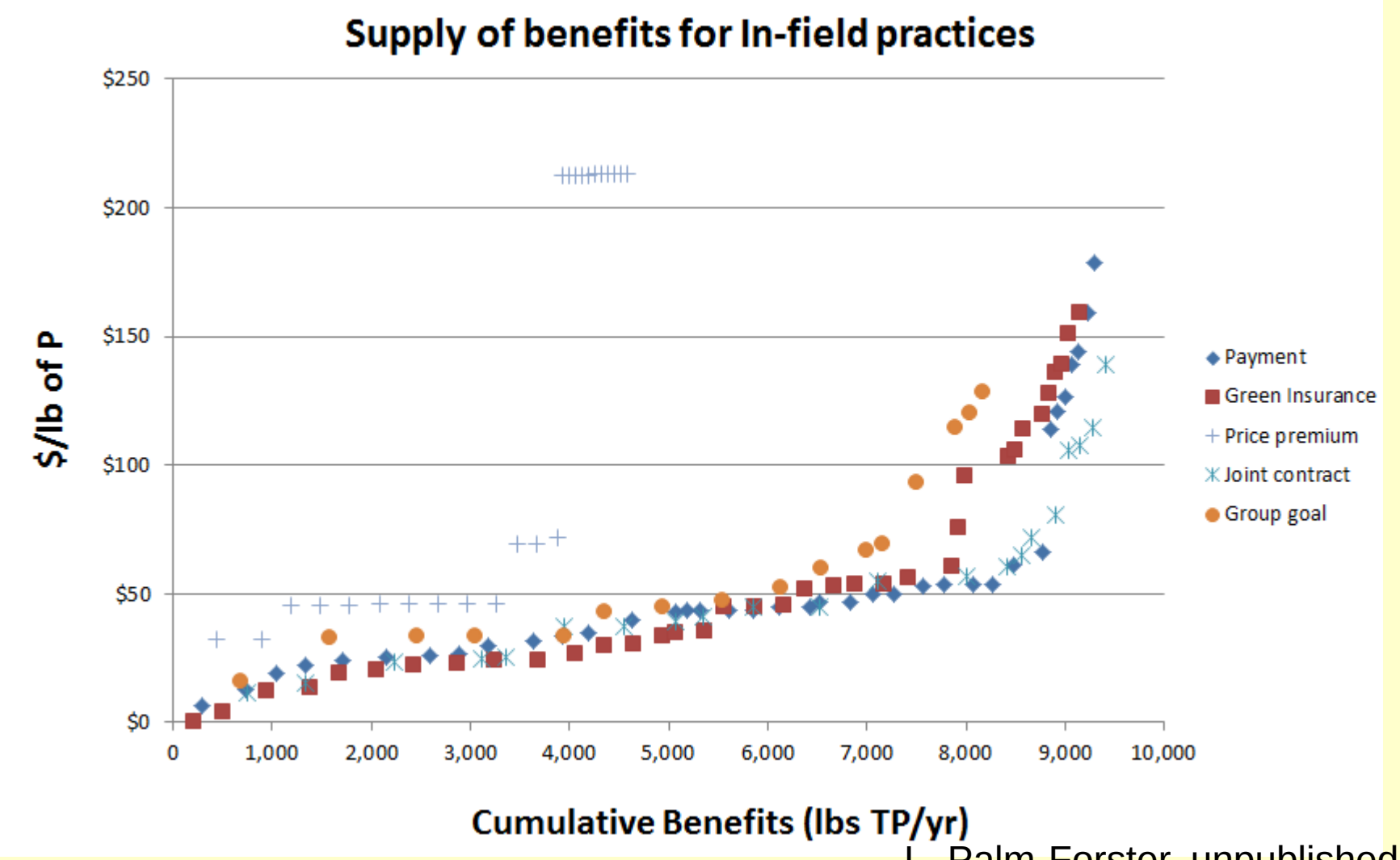
Conservation practices can reduce phosphorus loadings in Lake Erie, but farmers have to be willing to adopt them.

- Maumee Watershed
  - 80% agric. land use
  - Water drains into Lake Erie.
- Multiple private landowners
  - Different costs
  - Sites very in potential environmental impacts due to slope, soil texture, proximity to streams

Experimental auctions: Lowest bid to adopt P-reducing practices

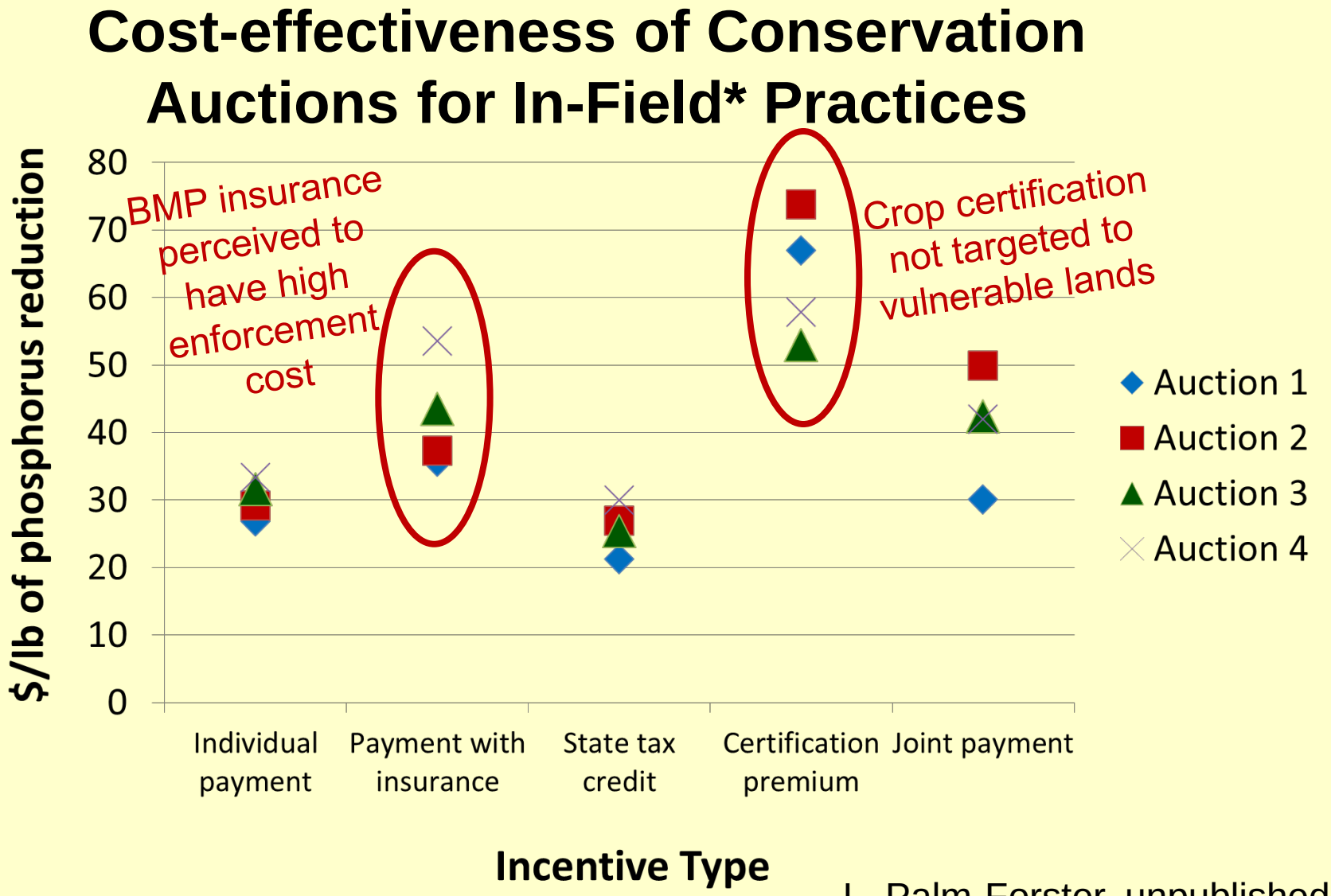
- **Type of incentive**
  - Direct payment
  - Green insurance
  - Tax credit
  - Price premium tied to certification
- **Practices offered**
  - Cover crop
  - Reduced tillage
  - No fall fertilization
  - Filter strips

Cost-effectiveness: Some sites give <u>much</u> better value for money



L. Palm-Forster, unpublished

Inefficient use of funds when 1) poor site targeting or 2) farmers see high costs



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Broader lessons from real conservation auction in 2014

- Low participation undermines cost-effectiveness
  - Only 1% of landowners participated—not unusual.
  - Few fields → Very few high-impact sites
- Additionality: Hard to attract new adopters
  - Stewardship-loving farmers already do BMPs
  - Higher cost to induce profit-oriented farmers to adopt
- Auctions are costly to operate
  - Costly for farmers to participate
  - Costly to simulate field-level outcomes

Palm-Forster, in prep.

Next steps: How to shape the decisions that shape agro-ecological outcomes?

Incentives for voluntary change

- Payments for Ecosystem Services: Redesign to:
  - Reduce transaction costs
  - Target high-impact zones
  - Focus on outcomes
- Policy experiments to test cost-effectiveness and cost incidence of:
  - Conservation auctions
  - Fixed payments in vulnerable zones
  - Mandated change of practices

Info technology to shape decisions

- Decision tools with targeted, field-level info
  - KBS-LTER data to build ecological parameters and validate models
- Site-specific simulation of practice outcomes
  - Profitability
  - Environmental effects
- Producer can do “what-if” simulations
  - (So can members of the public)

Acknowledgments

A Few Key People

- Farmers, landowners & residents in Michigan, Ohio & Wisconsin
  - Focus groups
  - Mail surveys
  - Auctions
- Research collaborators

A Few Key Funders

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  - Human & Social Dynamics
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- Dept of Energy
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- Great Lakes Protection Fund (w/ Nature Conservancy & LimnoTech)