Farming for Ecosystem Services: Research and Policy to Make it Happen

Scott M. Swinton
Michigan State University

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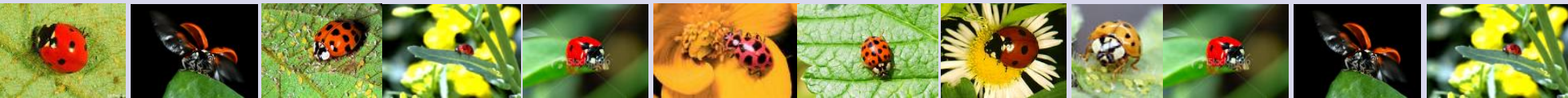
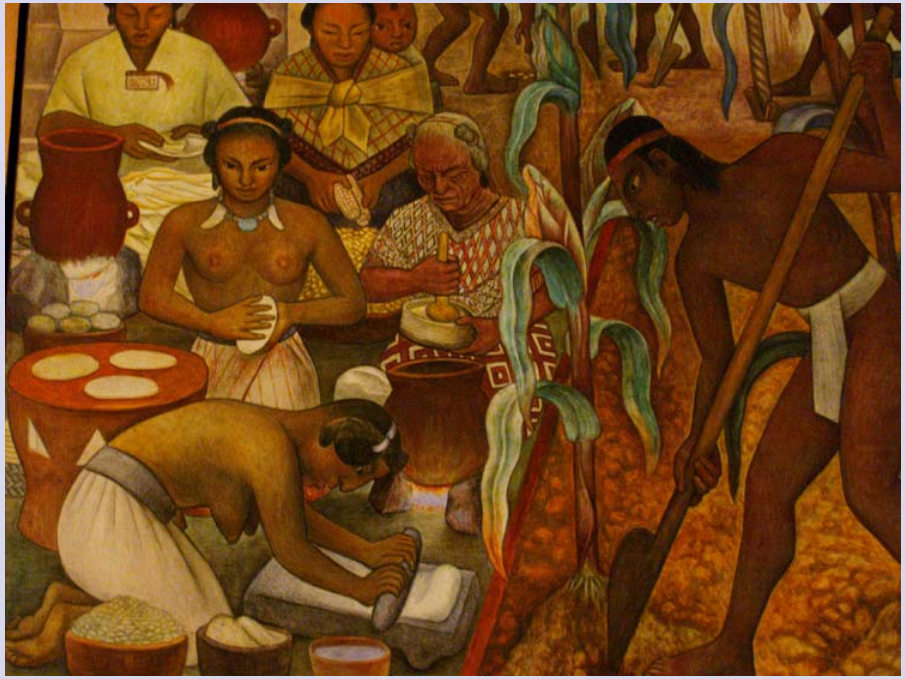


Agriculture as managed ecosystem

- Agriculture is humankind's oldest and largest engineered ecosystem

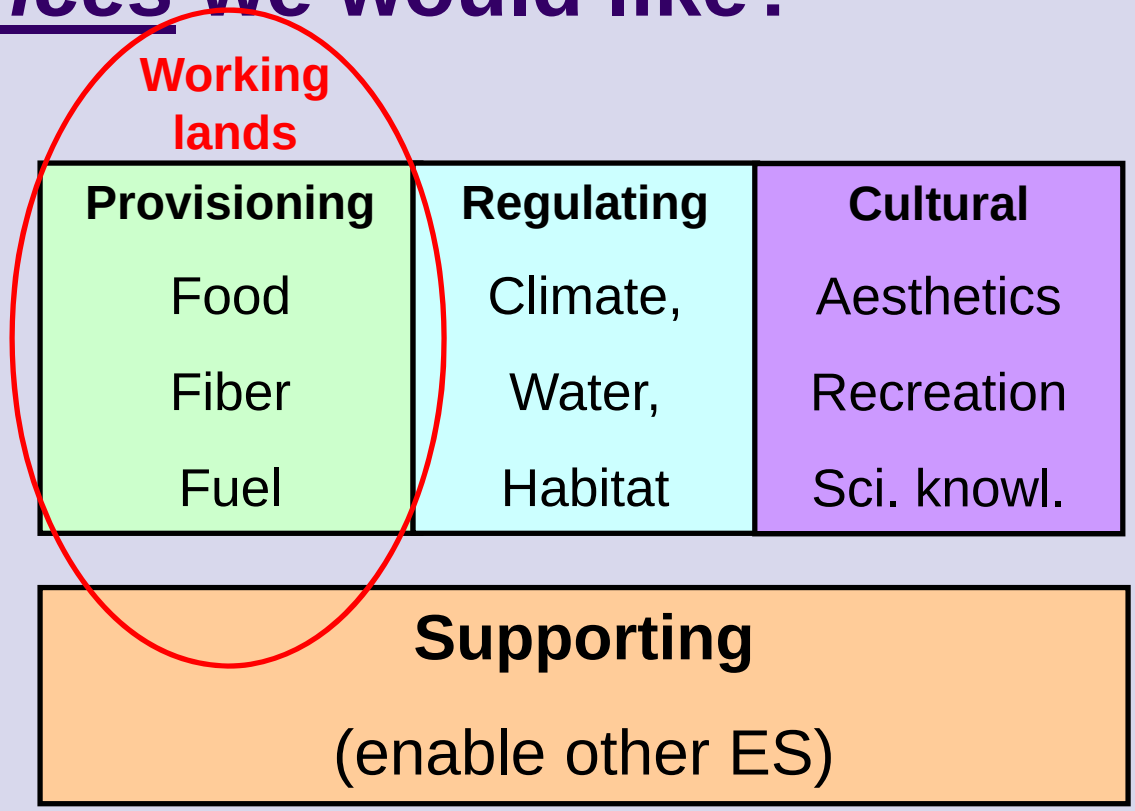


Agriculture has optimized nature for food, fuel & fiber production

- Genetics optimized for marketable products
  - Plant architecture for higher biomass in grain
  - Animals for leanness, bigger shares of desired cuts
- Agrochemical innovations have allowed timely, low-cost delivery of needed inputs
- Mechanical innovations allow few people to farm
  - Large crop areas
  - Large livestock herds

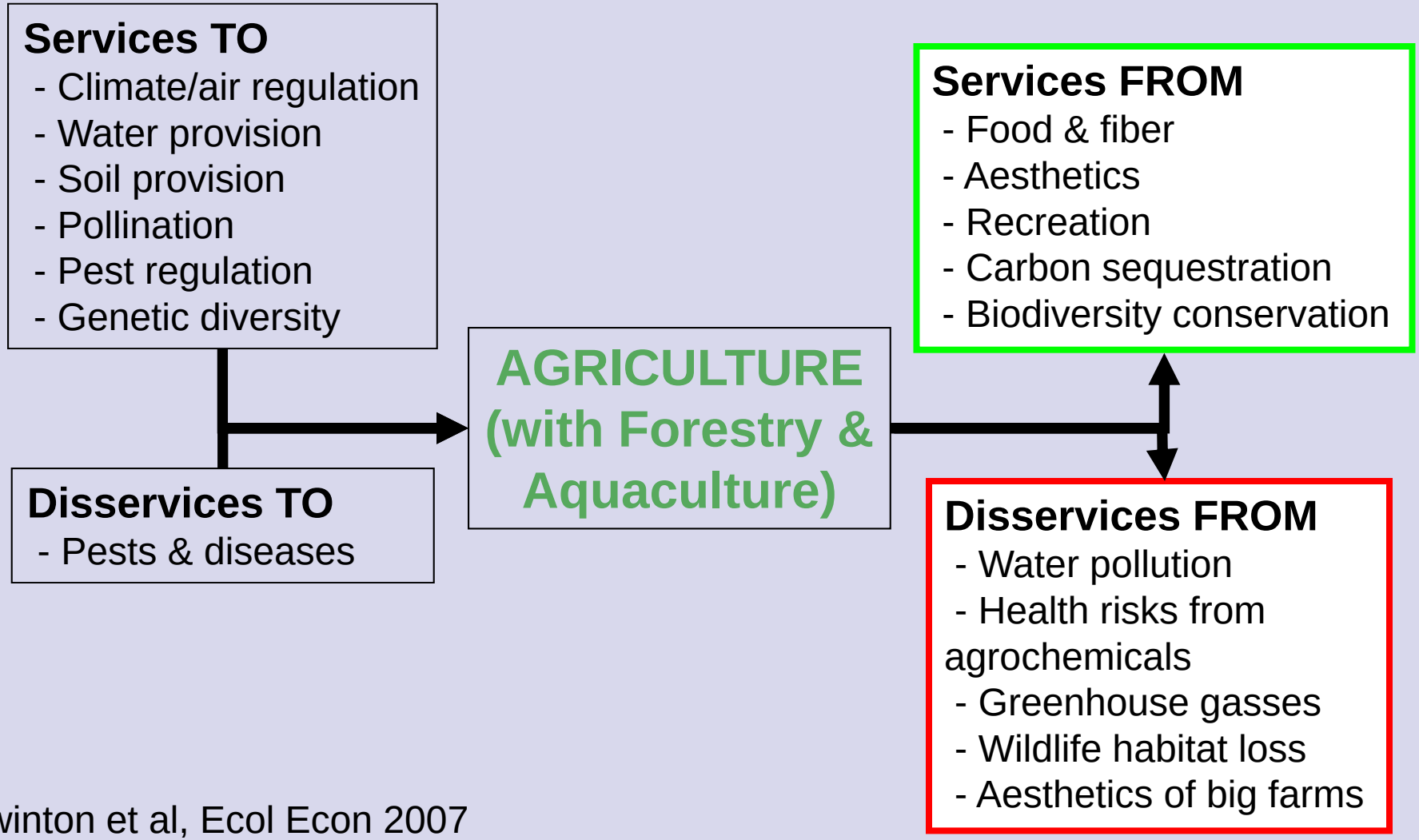
But does agriculture provide the array of *ecosystem services* we would like?

- **"Ecosystem services** are the benefits that people obtain from ecosystems." (Millennium Ecosystem Assessment, 2005, *Ecosystems and Human Wellbeing: Synthesis*)



Source: Millennium Ecosystem Assessment

Ecosystem service flows to and from agriculture



Swinton et al, Ecol Econ 2007

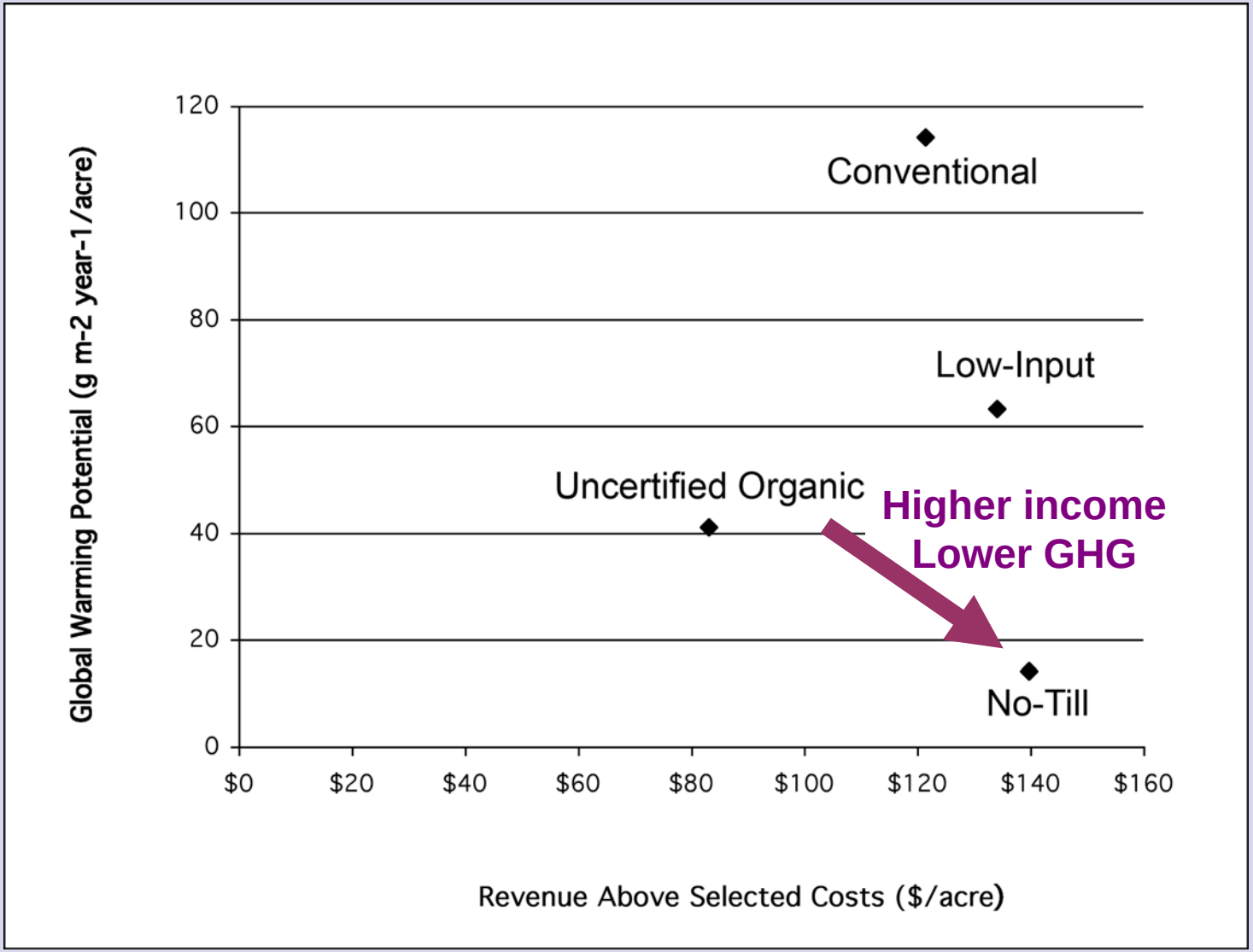
But if we design it, will it fit farmer goals?

	Farm profit UP ↑	Farm Profit DOWN ↓
Ecosystem services UP ↑	Win-win	Trade-off

Win-win Opportunities

- Targeting inputs in time & space
  - Examples:
    - Fertilization - Just-in-time and site-specific
    - Threshold-based pest control (IPM econ threshold)
    - Plant breeding to fit ecosystem niches
  - Effects
    - Boosts production of food, fiber, fuel
    - Cuts wastes – water pollution, N_2O emissions
- Optimize natural services to agriculture

No-till cropping can cut greenhouse gas emissions while being profitable



Trade-offs: When environmental benefits come at a cost

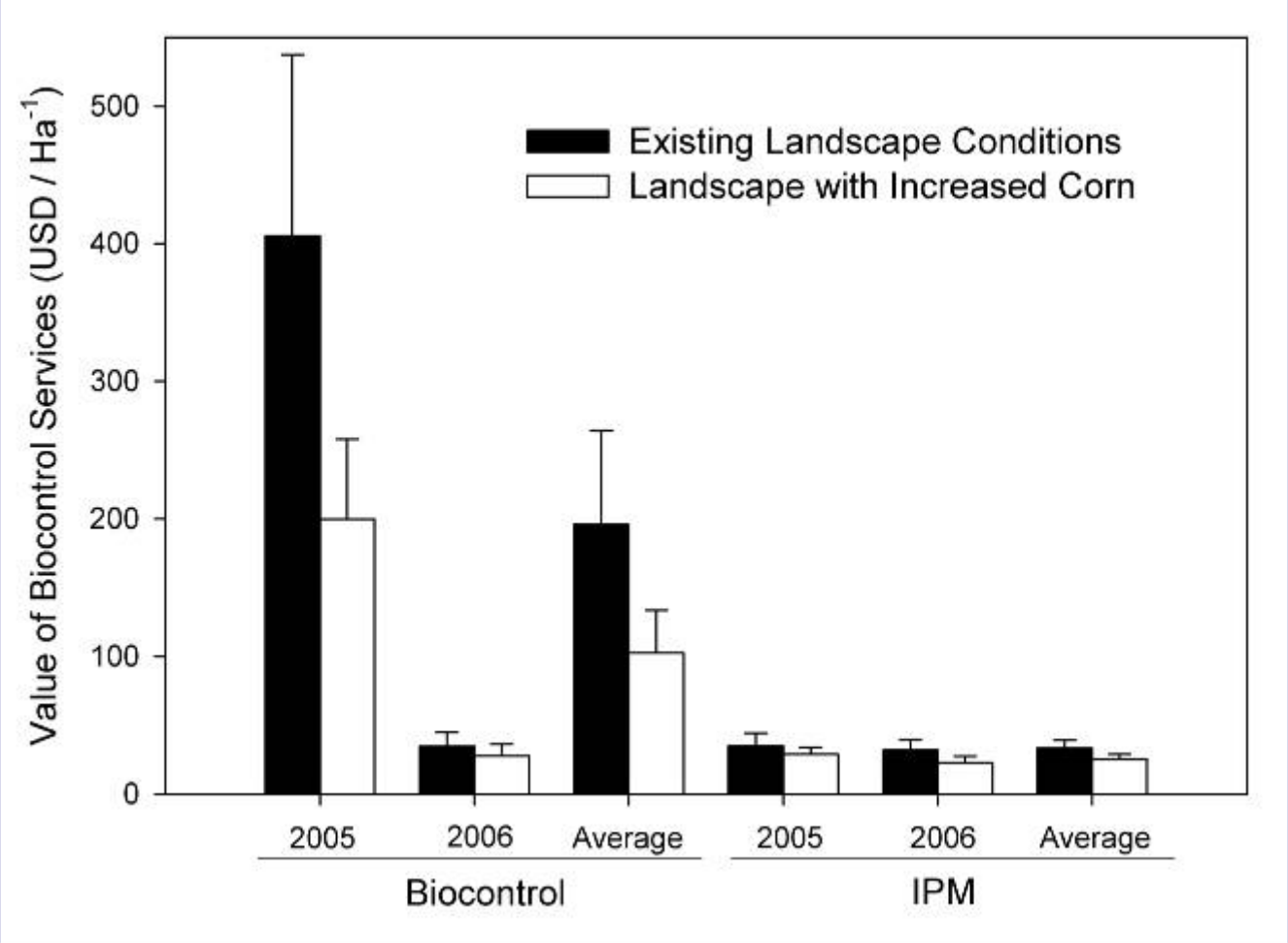
- Direct costs …
  - Example: Cover crop seed & planting for reduced erosion & N loss
- Opportunity costs from reduced income …
  - Setting aside productive land for wildlife habitat
  - Giving up crop yield by lowering N fertilizer rates to cut N_2O emissions

Habitat managed for biological pest control

- Soybean aphid = new pest that cuts yields
- Asian lady beetle is predator

Photos: Christine DiFonzo, MSU

Measuring value of soybean aphid biocontrol



Biocontrol

$196 +/- 68
$103 +/- 31

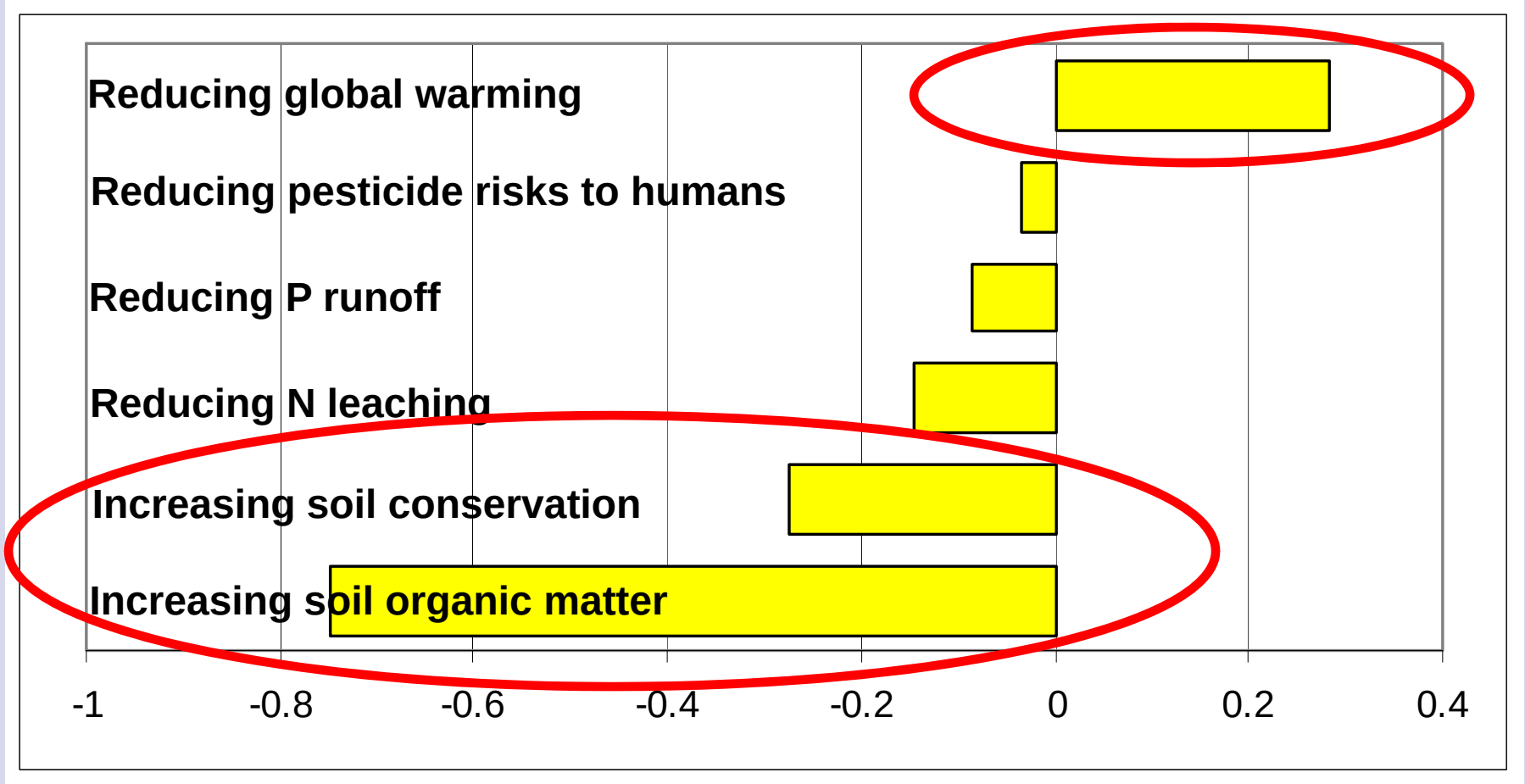
IPM

$33 +/- 6
$25 +/- 3

Soybean price: 2007-08 USDA price projection $380 Mg^{-1} = $10.40 Bu^{-1}

(Landis, Gardiner, van der Werf, and Swinton, PNAS, *2008*)

Farm focus groups & survey: Global warming seen as less important “to Me” than “to Society”



Costs to farmers of providing environmental benefits in 2008 survey of Mich corn-soy growers: 2 options

- A: Corn-soybean

- Reduced tillage
- Nitrogen fertilizer just-in-time based on tests

- D: Corn-soybean-wheat

- Reduced tillage
- Nitrogen fertilizer just-in-time based on tests
- Winter cover crop
- 1/3 cut in fertilizers by applying only over row

Added costs compared to typical corn-soybean production

Crop system D	Added costs
• D: Corn-soybean-wheat	• Wheat often lower revenue than corn-soy
• Reduced tillage • Nitrogen fertilizer just-in-time based on tests • Winter cover crop • 1/3 cut in fertilizers by applying only over row	• OK • Soil testing during season causes delays • Costly seed & labor • Equipment to “band apply” fertilizers

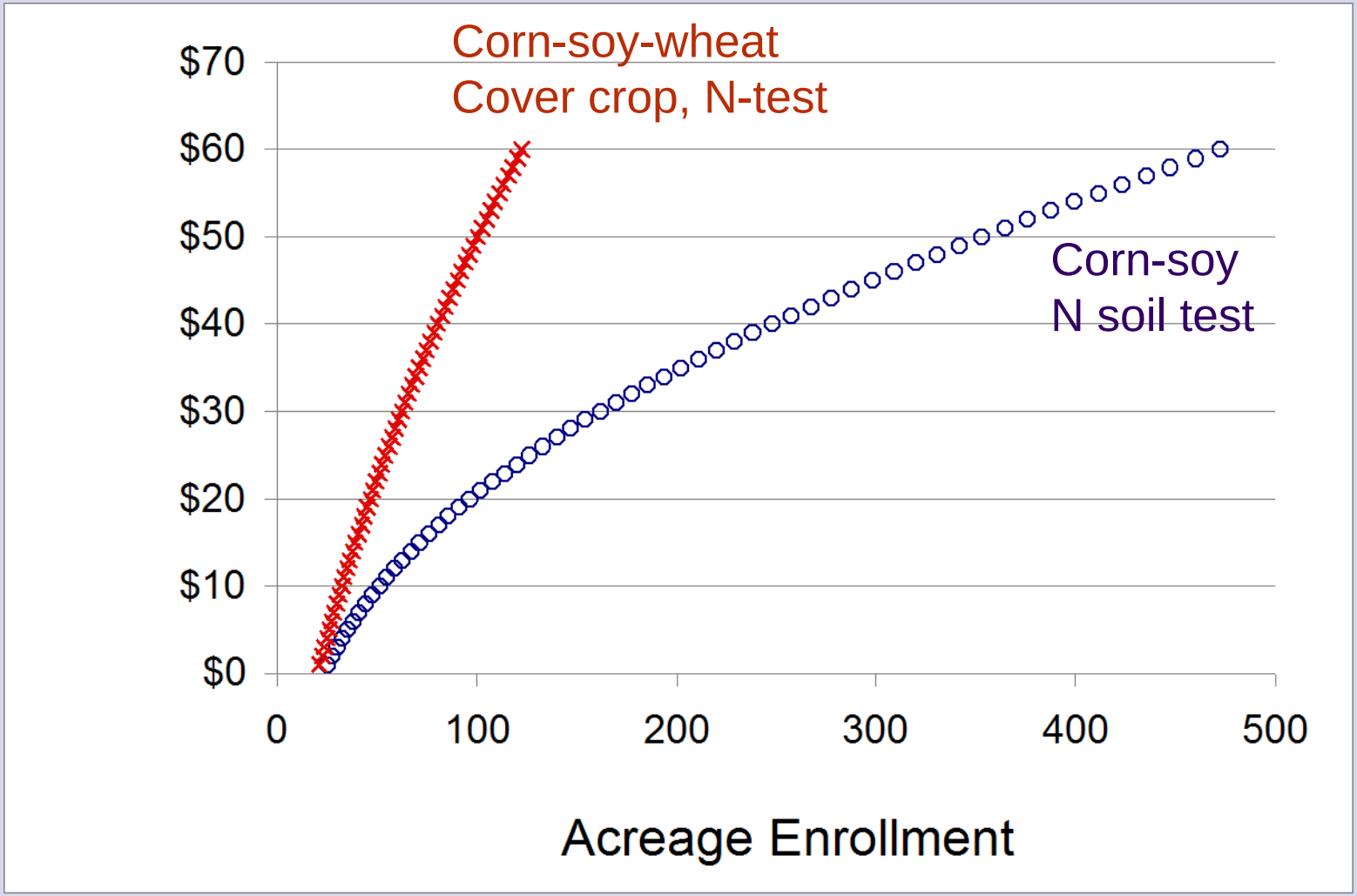
Payment for Environmental Services: Farmer willingness to change

- If a program run by the federal government would pay you $X per acre each year for 5 years for using this cropping system, would you enroll in this program? (Yes) (No)

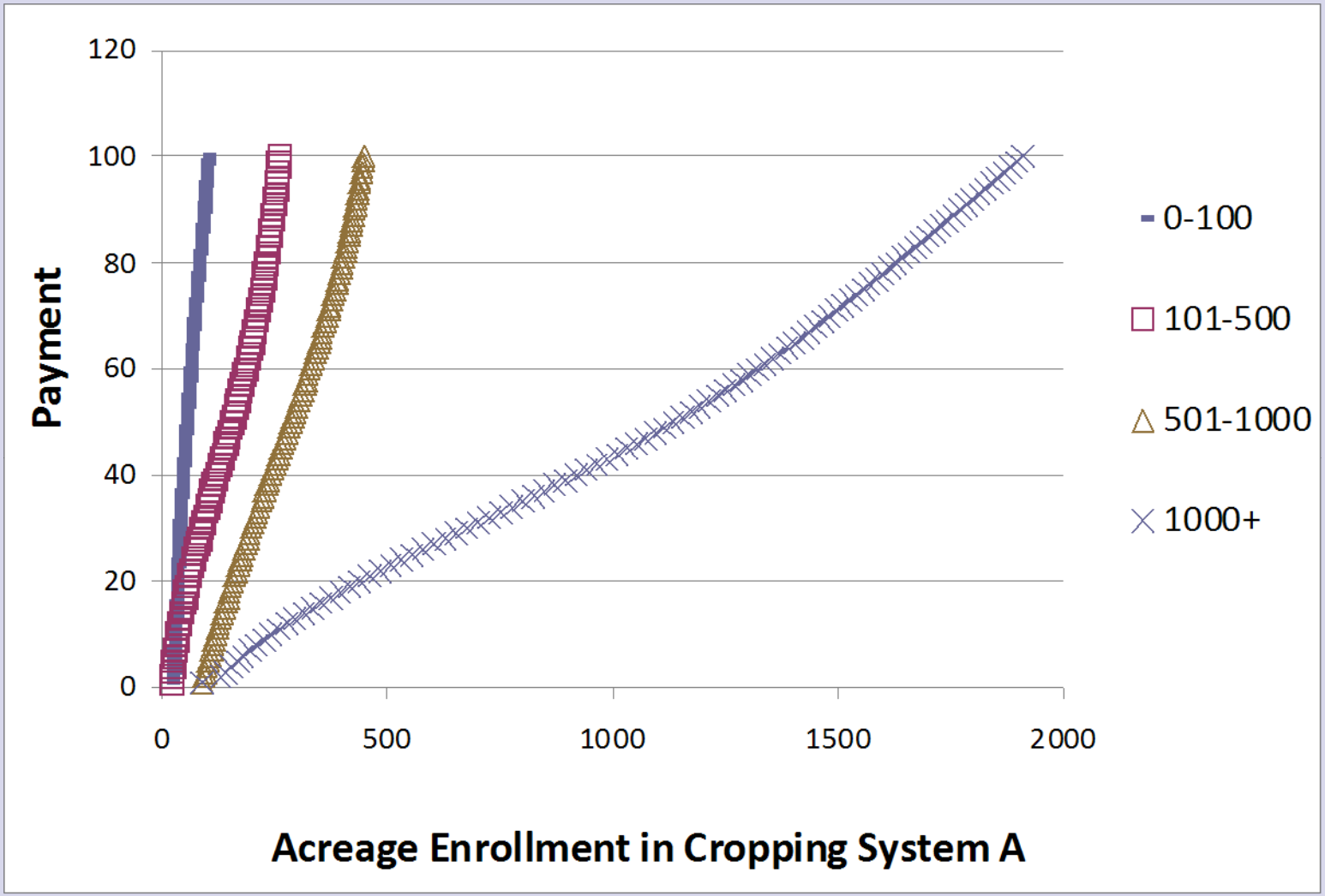
- If Yes, how many acres would you enroll in this program? _____

Farmers at focus group, 2007

Small changes cost less to supply, so more land offered



Large farms offer more acreage



To cultivate ecosystem services: Understand the cultivators, Create incentives

- Farming can supply enhanced ecosystem services
- Farming is both ***life style*** and ***livelihood***
  - Environmental stewardship matters
  - Income matters too
- Win-win technologies are easy if farmers aware
  - → Educate
- Trade-offs (there are many) require incentives
  - Should farmers bear costs if society benefits?
  - → Payment for environmental services
    - Emerging markets for greenhouse gasses
    - Government programs for soil & water conservation

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