Multiple Environmental Externalities Of Conservation Tillage: Empirical Assessment of Practice And Performance Based Targeting

Luba Kurkalova, Catherine Kling, and Jinhua Zhao

Center for Agricultural and Rural Development

Iowa State University

Presented at 2nd World Congress of Environmental and Resource Economics, Monterey, CA

June 24-27, 2002

Research questions

- If a policy that targets **conservation tillage** is implemented, how much less **environmental benefits** are obtained than if the benefits were targeted?
- If **only one** environmental benefits is targeted, what are the associated **other** environmental benefits?

Data and models

- Data: Some13,000 NRI points located in Iowa
- Benefits: Physical processes simulation model EPIC
  - Carbon sequestration
  - Soil erosion
  - Nitrogen runoff
- Costs: Model of conservation tillage adoption
  - Econometrically estimated
  - Predicts subsidy needed for adoption

Model of conservation tillage adoption

Traditional approach

$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = \Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr[\delta x \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr\left[\frac{\delta}{\sigma_\varepsilon} x \geq \varepsilon\right]$$

Approach of Pautsch, Kurkalova, Babcock, Kling (CEP, 2001)

$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = \Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr[\beta x - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr\left[\frac{\beta}{\sigma_\varepsilon} x - \frac{1}{\sigma_\varepsilon} \pi_0 \geq \varepsilon\right]$$

Model of conservation tillage adoption (continued)

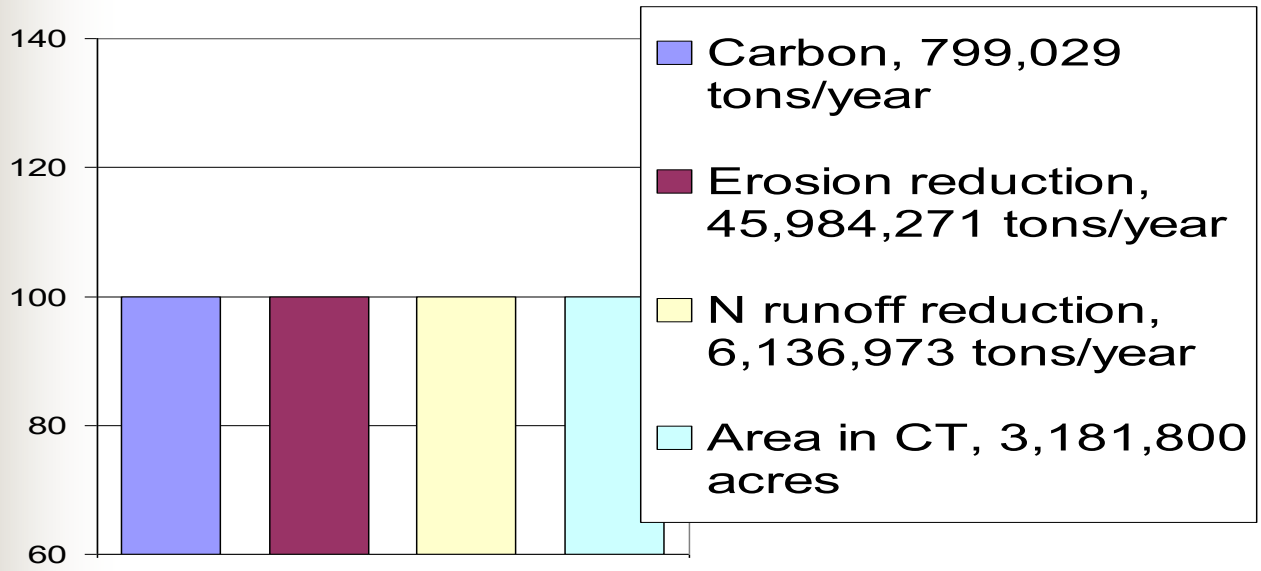
$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + \boldsymbol{P} + \sigma_\varepsilon \varepsilon]$$

$$= \Pr\left[\beta x \geq \pi_0 + \boldsymbol{\alpha\sigma_{profit}} + \sigma_\varepsilon \varepsilon\right]$$

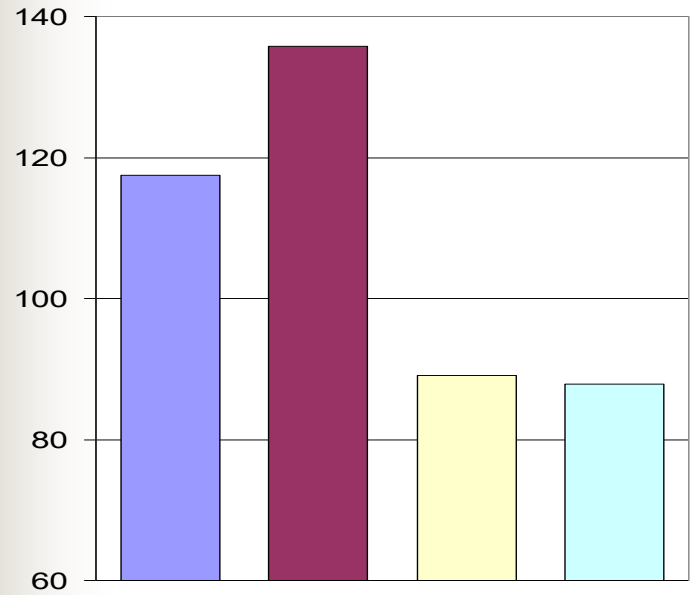
$$= \Pr\left[\frac{\beta x}{\sigma_\varepsilon} - \frac{\pi_0}{\sigma_\varepsilon} - \frac{\boldsymbol{\alpha\sigma_{profit}}}{\sigma_\varepsilon} \geq \varepsilon\right]$$

Practice and performance based targeting, same budget, $5.7 M

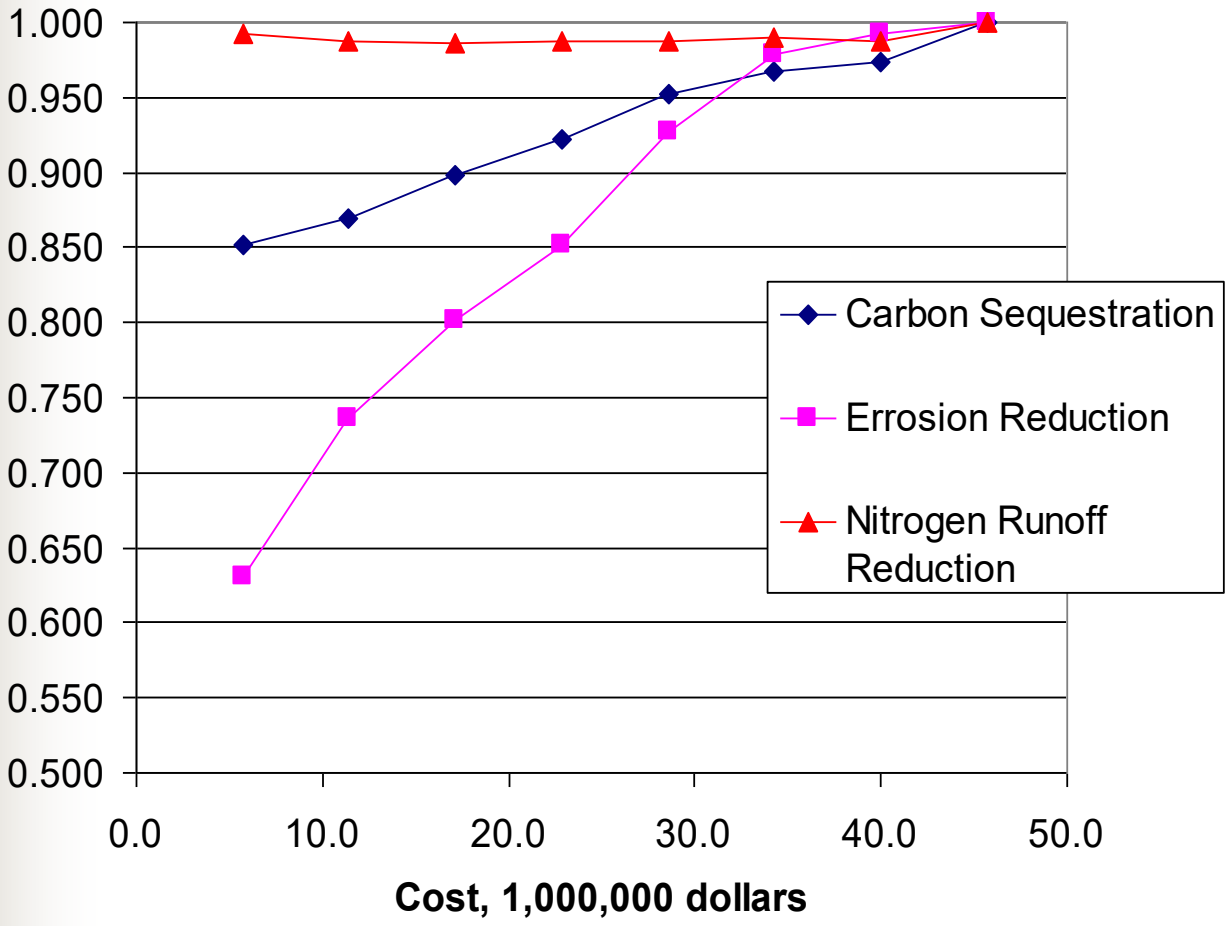
Target conservation tillage



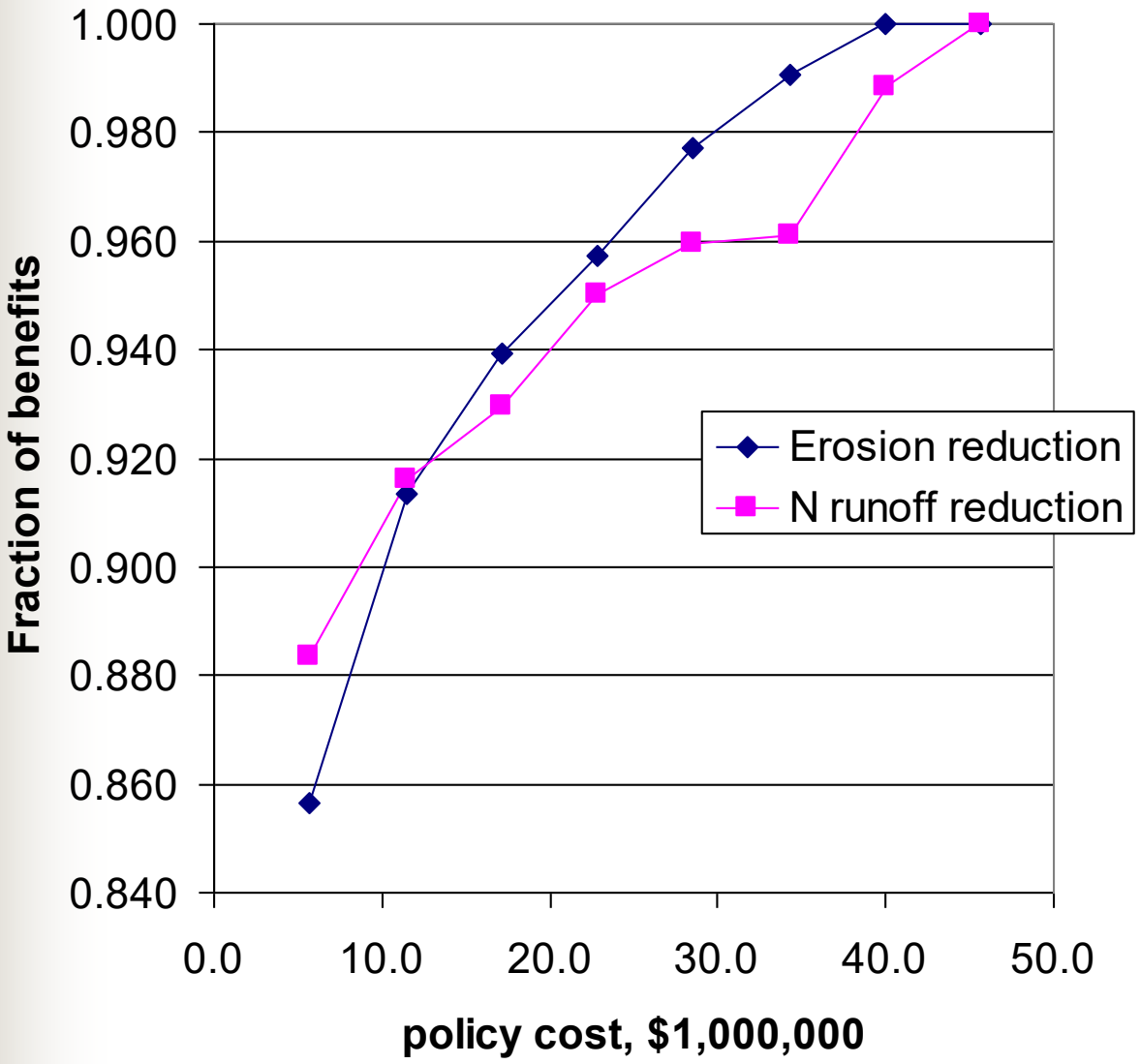
Target carbon



Fraction of maximum possible benefits obtainable under conservation tillage targeting



Fraction of maximum possible benefits obtainable under carbon targeting



Conclusions

- The proposed methodology allows for **comparison of alternative benefit targeting schemes**
- Targeting **conservation tillage** provides high fractions of the maximum possible amounts of the 3 environmental benefits in Iowa
- Targeting a **single benefit** is estimated to provide high fractions of other associated benefits