



**CEAP-ARMS: Evidence on Conservation Practice  
Adoption from an Integrated National Survey**

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**A presentation at the SWCS workshop “Managing  
Agricultural Landscapes for Environmental Quality:  
Strengthening the Science Base,” Kansas City, KS,  
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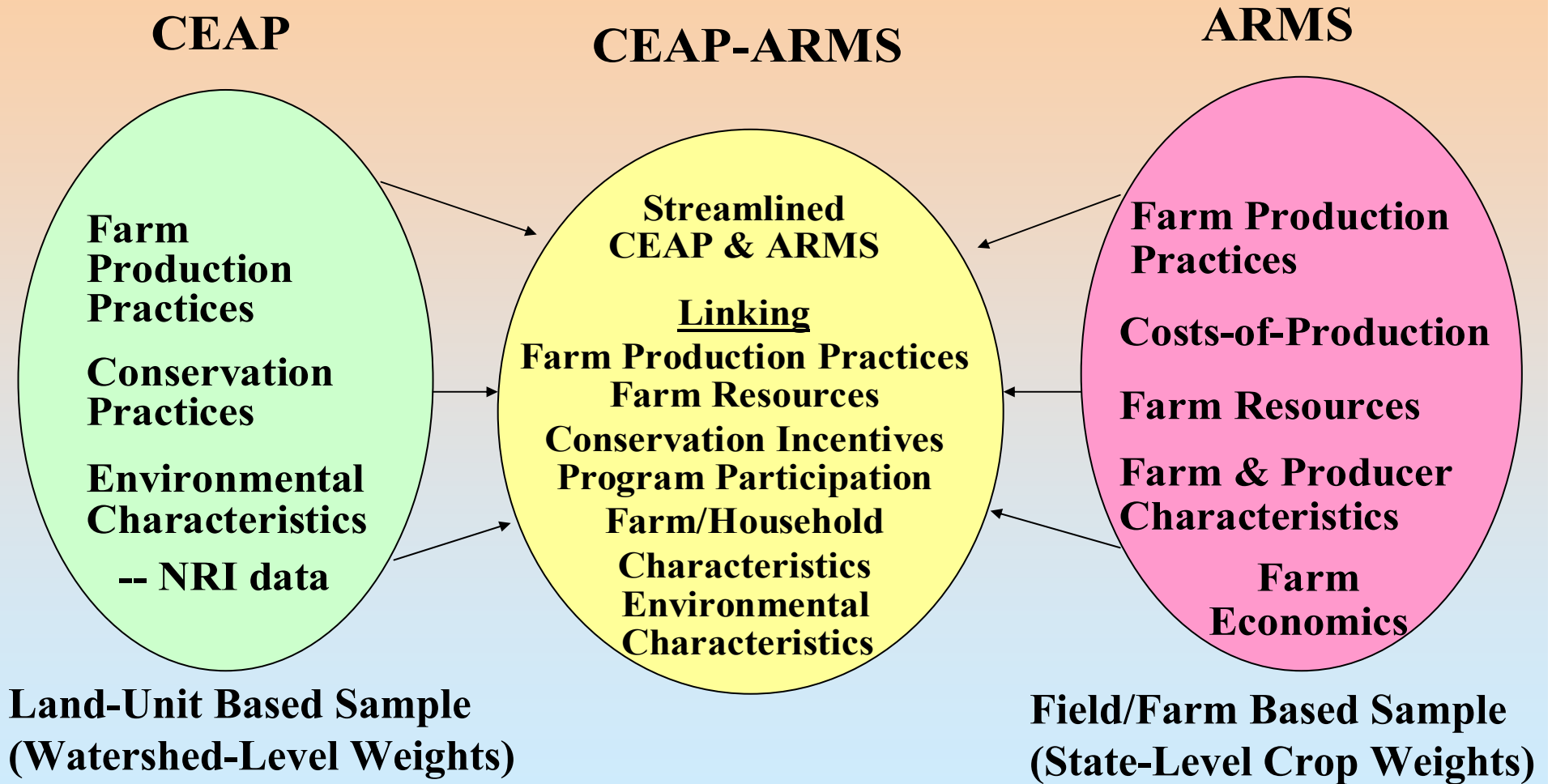
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# Objectives

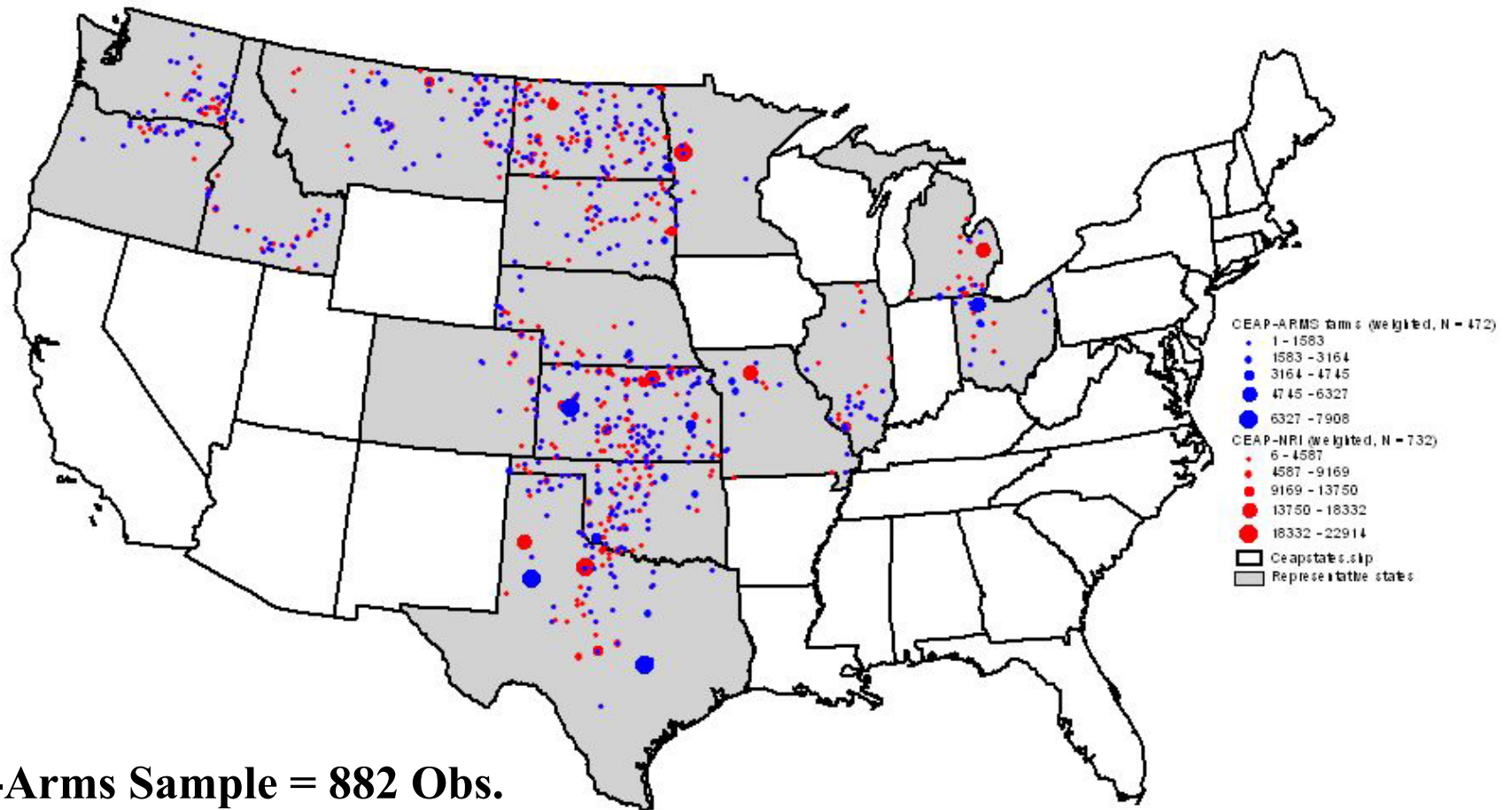
- **Briefly describe the integrated, national field, farm, and environmental survey, CEAP-ARMS.**
  - **Conducted in 2004 for wheat, and in 2005 for corn.**
- **Discuss some research results for two initial ERS studies using the 2004 Ceap-Arms data (for wheat).**
  - Study 1: examined producer decision factors influencing adoption of conservation structural practices; and**
  - Study 2: evaluated the value-added of using onsite environmental data.**
- **Draw some likely policy implications.**

# CEAP-ARMS: Common Ground

[Joint Effort by NRCS, ERS & NASS]



## CEAP-ARMS survey farms 2004 Wheat (16 States)



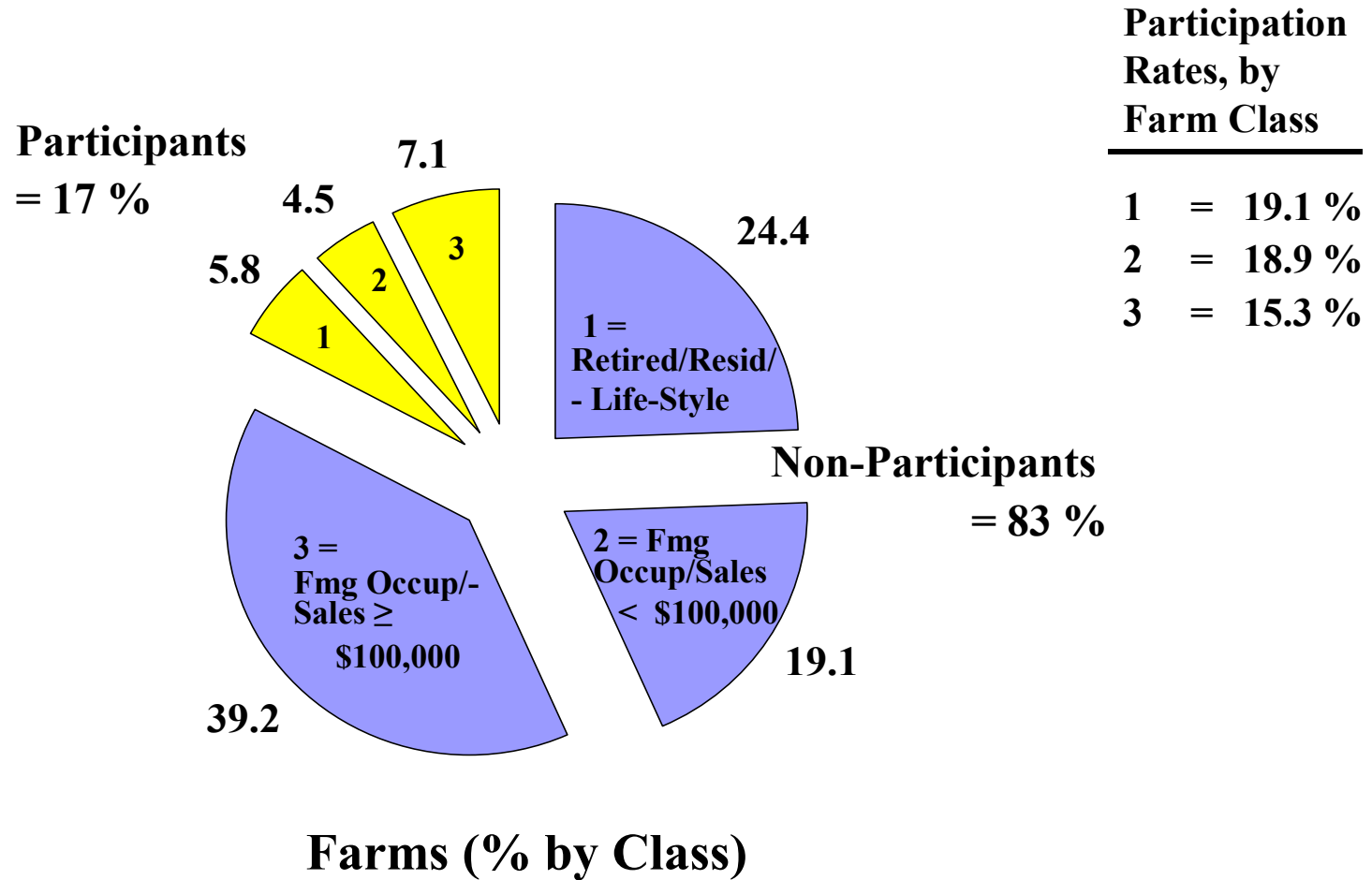
Ceap-Arms Sample = 882 Obs.

**Integrated Ph. II / NRI (field level) = 732 Obs.**

**Integrated Ph. II / NRI / Ph. III (field/farm level) = 472 Obs.**

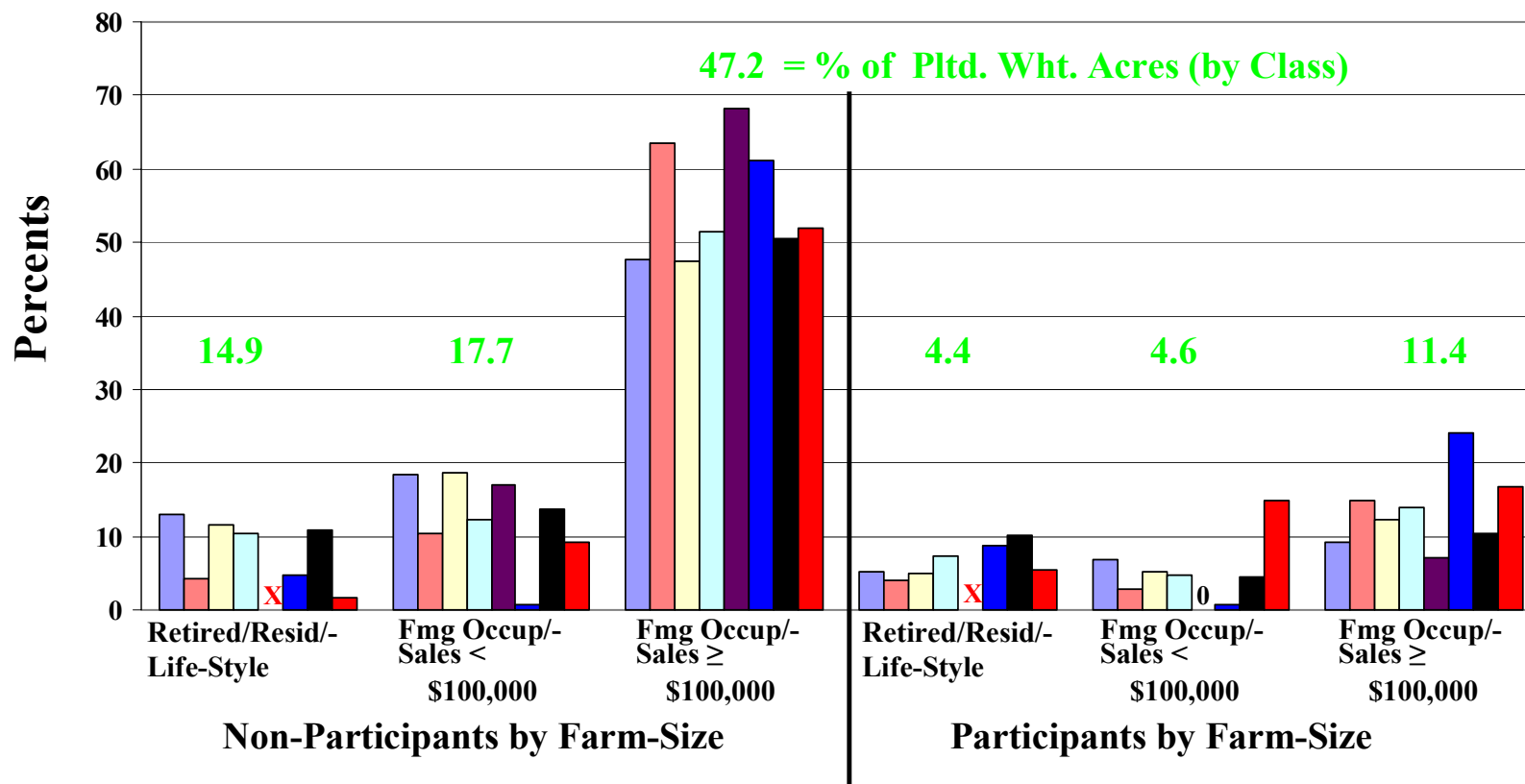
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# Percent Distribution of the 2004 CEAP-ARMS for Wheat Conservation Program Participants vs. Non-Participants by Farm-Size Class



# Land-Management & Structural Conservation Practices for 2004 Wheat

## Percent of Practice Acres (by Participation & Farm Class)



X = insufficient data for this item



# Research Study I

- **Examined the adoption of infield & perimeter-field conservation structural practices on wheat fields using a Cost-Function Approach.**
  - decision factors: farm economic, farm structure, field-crop management, and field environmental attributes
- **Research Questions Addressed:**  
Whether differences exist in: (1) the relative importance of economic decision factors used in the adoption of conservation structural practices between conservation program participants and non-participants; and (2) how important are other socio-environmental factors in the adoption decision.
- **Theoretical Economic Framework:**  
**A Generalized, Cost-Function Based Model of Producer Crop-Specific Production Technology Choices (from Kim, et al., CJAE, 2005).**
  - assumes near-perfect competitive nature of farm sector
  - assumes that program participants and non-participants recognize the changes in output and costs associated with shifting field acres from crop production to conservation structural practices.

# Model Estimation

## Model I : Wheat Field Acres With

EQ. 1: No Conservation Structures

EQ. 2: Only Infield Structures

EQ. 3: Only Perimeter Structures

EQ. 4: Both Structures

[Jointly estimated for:

Participants and Non-Participants]

$$\left. \begin{array}{l} \text{EQ. 1: No Conservation Structures} \\ \text{EQ. 2: Only Infield Structures} \\ \text{EQ. 3: Only Perimeter Structures} \\ \text{EQ. 4: Both Structures} \end{array} \right\} = \mathbf{f} \left[ \begin{array}{l} \text{normalized input prices for:} \\ \text{nitrogen (N),} \\ \text{agricultural wages (W), \&} \\ \text{diesel fuel (D);} \\ \text{3 technology-class variables} \\ \text{3 installation time-period variables} \end{array} \right]$$

## Installation time-period Variables:

(1) Installed in 2004; (2) Installed within last 10 years; (3) Installed prior to 1990

## Technology class Variables:

(1) Only Infield Structures; (2) Only Perimeter-field Structures; (3) Both Structures

## Model II: Similar to Model I, but with:

$(\text{Wheat Field Acres})_{j,p} = \mathbf{f}[\text{Model I variables} + \text{seven socio-environmental covariates}]$

Model II Additional Covariates: farm tenure rate, farm cropland acres, crop rotations, gully erosion on the field, field next to a water body, surface drainage system, and improved wildlife habitat as a producer objective.

## Estimation Procedure and Data

- **Generalized Estimating Equations (GEE) procedure**  
**[Liang and Zeger, 1986]**
- **GEE is a flexible procedure that accounts for the correlation between adoption decisions measured as a continuous variable, while maintaining the integrity of the discrete choice model.**
  - “subject” effect (farmer)
  - “within subject” effects (crop acres with no structural practices, with only infield structures, with only perimeter-field structures, and with both infield and perimeter-field structures)
- **GENMOD (SAS Version 9)**
- **Used the Integrated Phase II / NRI Wheat Data (732 field/farm observations)**
  - representing 1.1 million farms and 53 million wheat acres across 16 States.

# Summary: Research Study I Results

- For both models, results for normalized input price covariates across the acreage response equations demonstrate that:
  - producers do recognize the productivity/profitability and field cost structure differences when making structural-practice adoption decisions.
- Both models demonstrate that conservation program participants and non-participants respond differently to alternative conservation structural practice options (i.e., infield vs. perimeter-field structures).

## Specifically:

1. Program non-participants place greater emphasis on the adoption of infield structural practices, while conservation program participants emphasize perimeter-field structural practices.
2. The more direct productivity/profitability benefits of infield structures seem to suffice for non-participants (i.e., adoption without program incentives).

## **Summary: Research Study I Results (Continued)**

- 3. Perimeter structures seem to require a program incentive for adoption.**
  - likely because benefits for these structures are perceived as being mostly off-site.**
- 4. Producers do recognize non-program factors when making conservation practice decisions (including field, farm, economic, and/or environmental factors).**
  - From Model II: 3 of the 7 added covariates were consistently statistically significant.**
    - farm cropland acres; gully erosion on the field; and the field being adjacent to a water body.**
- 5. Not accounting for additional socio-environmental decision factors will likely result in under- or over-estimates of conservation practice acreage response elasticities.**
  - for program participants and/or non-participants**
  - and potentially under- or over-estimates of conservation policy response for any particular policy analysis.**

## Research Study II

- **Examined the *Value-Added* of Integrating On-Site Field-Specific Environmental Data with Farm Enterprise, Resource, Operator, And HH Economic Data.**
  - **When evaluating Production Practice Decisions and Conservation Program Participation.**
  
- **Research Question Addressed:**

**Whether inferences and forecasts drawn from behavioral models estimated using on-site environmental data differ from those obtained using aggregated data.**

  - **Environmental data of focus: the NRI USLE estimate (t/ac./yr.) at site-specific (sample point) values, OR aggregated to the HUC or county-level.**

## Model Estimation (for 2004 Wheat Fields)

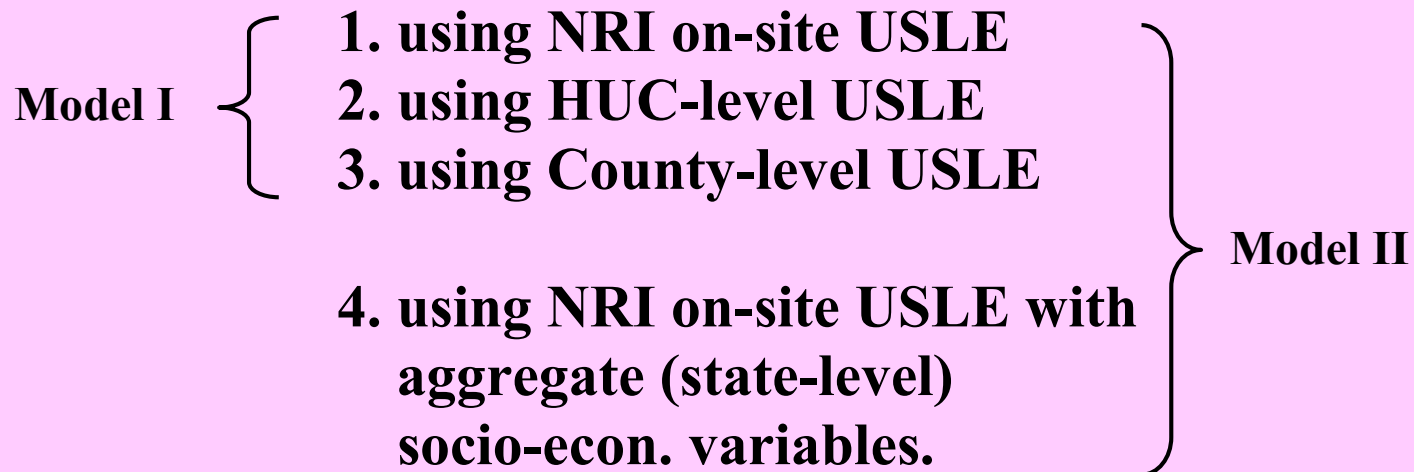
- **Model I: Acreage Supply (for Veg. Conserv. Structures)**  
= f(HH-Oper., Fm. Res./Econ., Fld. Envir., Soil Loss, & Reg. Vars.)

**Data: Integrated Ceap-Arms Phase 2, NRI and Arms Phase 3 Farm Res./Econ. Data (472 Obs.).**

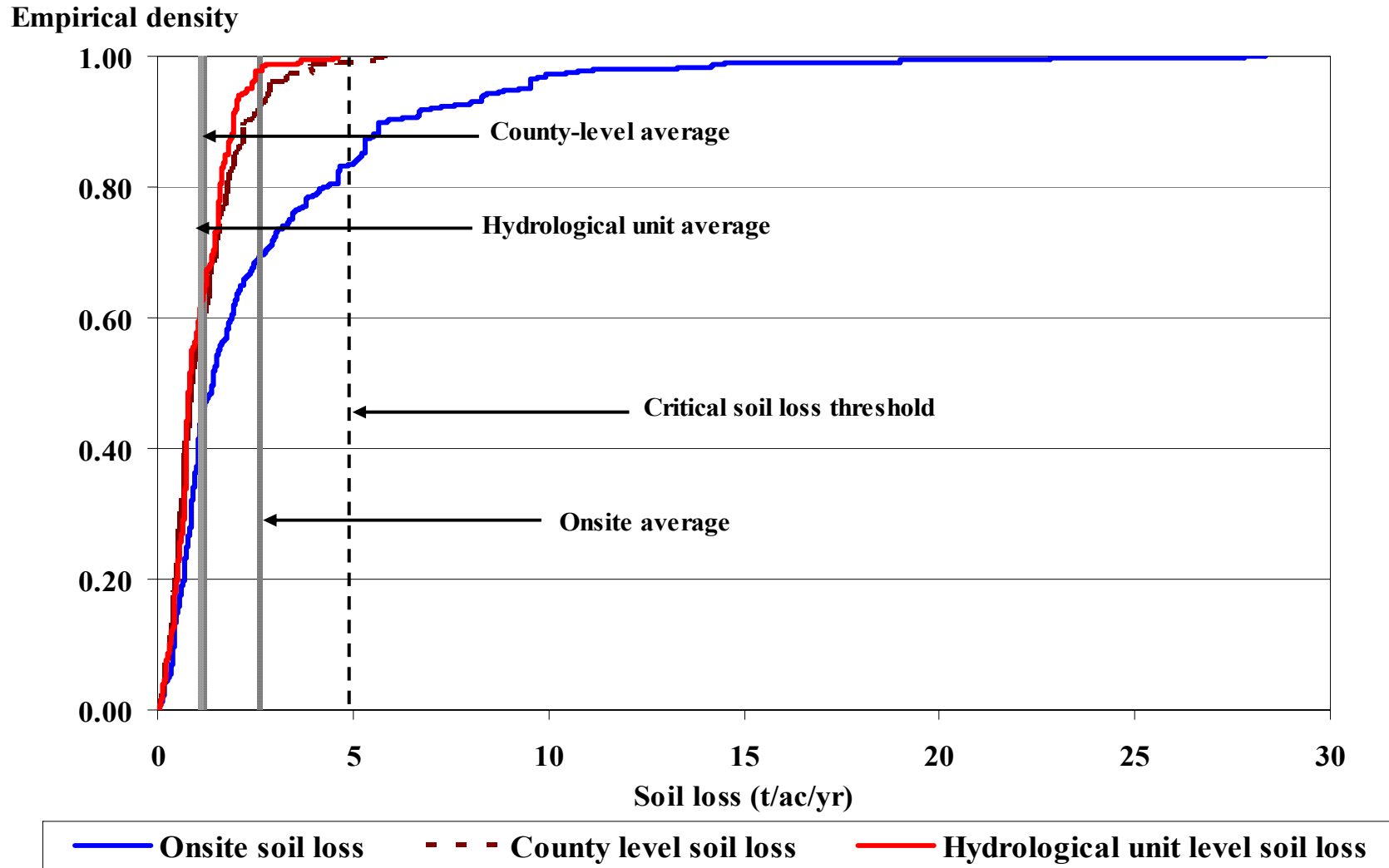
- **Model II: Probability of having a Soil Erosion Plan (for the field)**  
= f(on-site physical char.; cropping practices; farm size, use of new tech.; soil productivity; & Reg. Vars.)

**Data: Integrated Ceap-Arms Phase 2 and NRI data (732 Obs.)**

- **Scenario Analysis:**

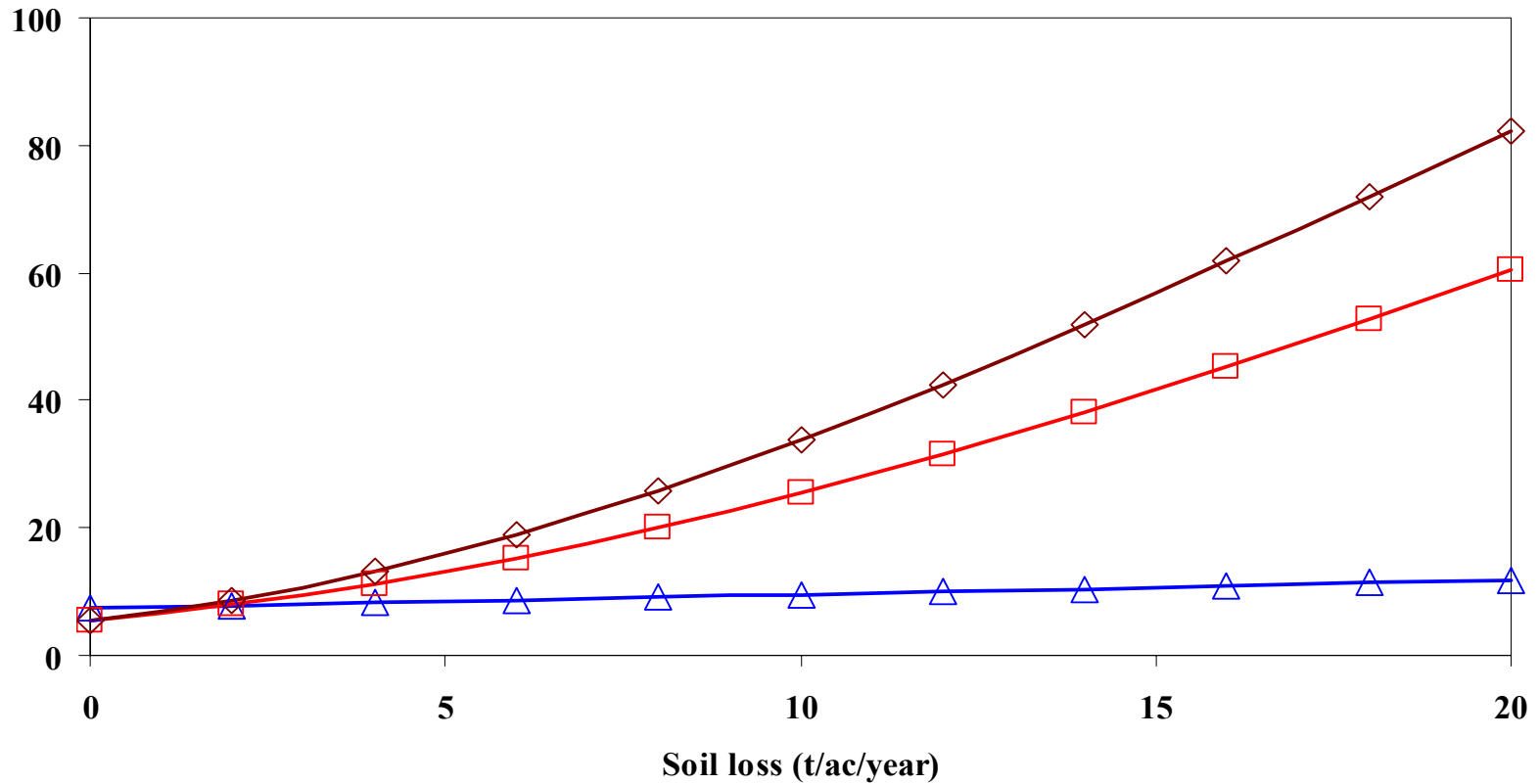


# Empirical densities of aggregated and on-site field-specific 1997 NRI Universal Soil Loss Equation Readings



# Model I values of predicted acres under vegetative conservation structures as influenced by USLE data resolution.

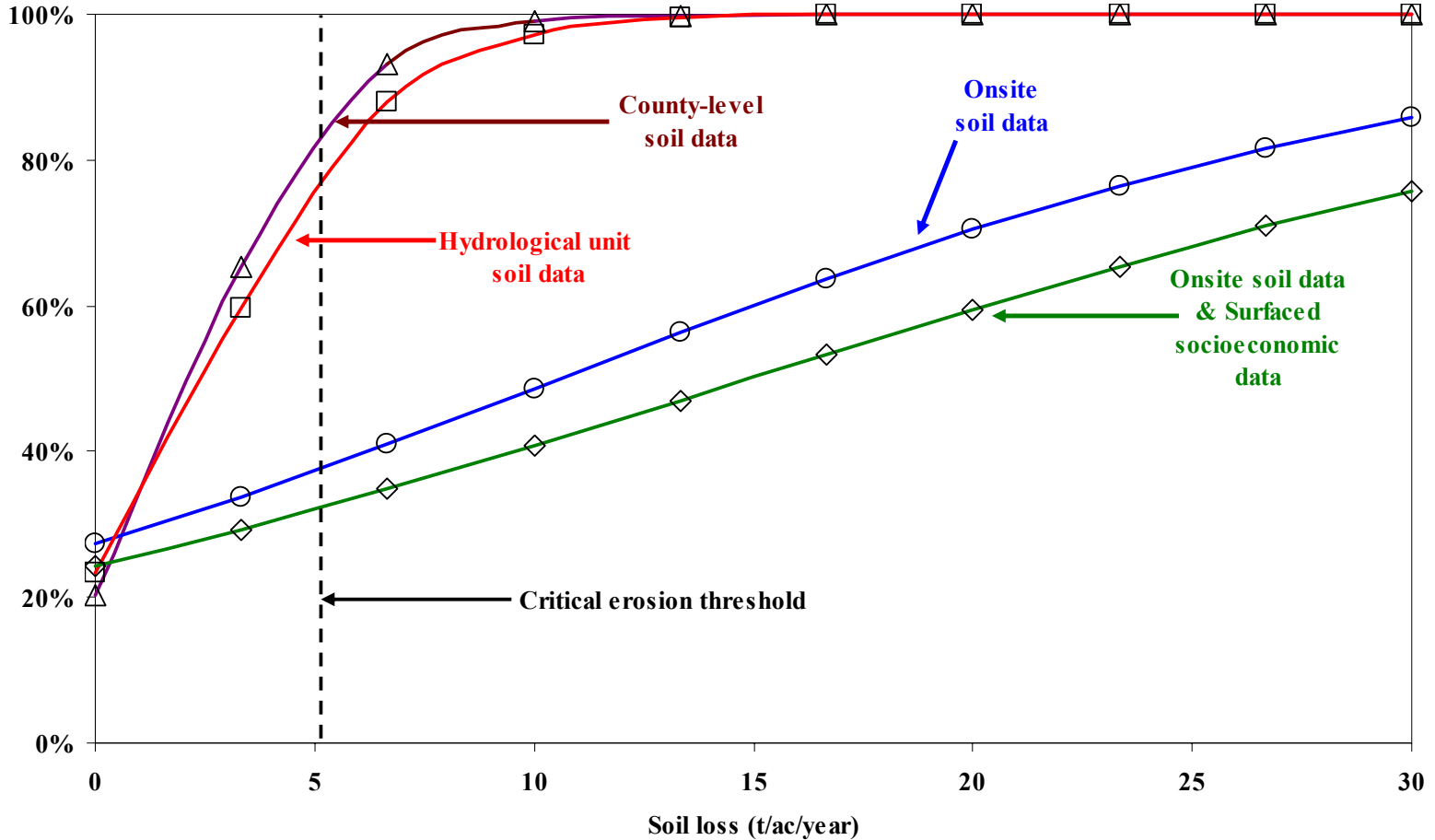
Predicted acres of conservation structure



—△— Onsite soil information    —□— Hydrological unit soil information    —◇— County-level soil information

# Model II predicted probabilities of having an erosion plan as influence by USLE and socio-economic data resolutions

Probability of having an erosion plan



# Summary and Conclusions

## (from Initial Studies using 2004 CEAP-ARMS for Wheat)

- Many decision factors (field/farm/economic/environmental) account for the significant characteristic differences in producer conservation practice adoption between program participants and non-participants.
- Higher-sales non-participant wheat farms have adopted conservation land-management practices much more intensively than have other farm types, including higher-sales participant farms.
- Program non-participants tend to place greater emphasis on adoption of infield structural practices, while participants emphasize perimeter-field structural practices.
- Perimeter structures seem to require a program incentive for adoption, likely because benefits are perceived as being mostly off-site.
- Not accounting for socio-environmental decision factors will likely result in either under- or over-estimates of acreage response elasticities, and thereby, under- or over-estimate conservation policy response.

## Summary and Conclusions (Continued)

- **There is significant “value-added” associated with using onsite (higher-resolution) environmental data when evaluating producer conservation-practice behavior.**
- **Use of aggregate (rather than onsite) soil-loss information will significantly over-estimate policy-relevant variables when using such information with producer-based behavioral data.**

**Example 1: over-estimate predicted acres of conservation structures, and**

**Example 2: over-estimate the influence of soil-loss information when predicting the probability of adoption of an erosion plan.**

An aerial photograph of a vast agricultural landscape. In the foreground, there is a field of tall, golden-brown grain. In the middle ground, a tractor is plowing a curved furrow through a lighter-colored field. The background shows rolling hills under a clear blue sky.

**Thanks for the Opportunity**

**Forward Comments to:  
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