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Assessing the Impact of Cap-and-Trade Climate Legislation on Agriculture in the Northern Plains: A Policy Simulation with Farmer Preference and Adaption

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Research Objective

- Investigate farmer preference to carbon sequestration potential under cap-and-trade.
- Examine the production cost impact of carbon pricing due to cap-and-trade.
- Simulate acreage enrollment in carbon sequestration, carbon supply, and the impact of cap-and-trade on farm income and its distributional effect.

Policy Background and Motivation

- Pending cap-and-trade climate legislation – The American Clean Energy and Security Act of 2009.
- Co-existence of both opportunity and challenge for agriculture.
- Divided view and debate on the net impact of cap-and-trade on farm income.

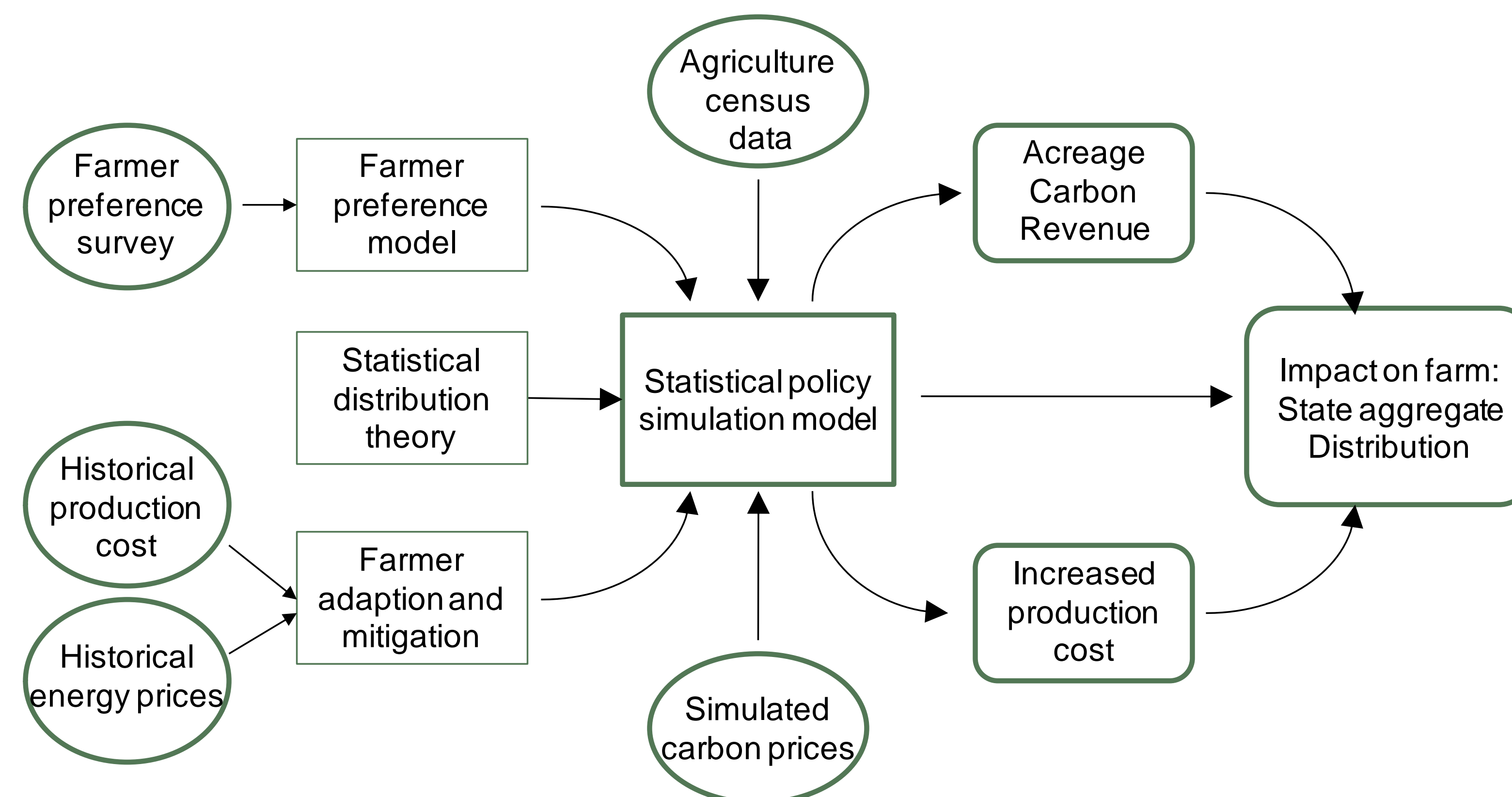
Research Challenges and Issues

- Farmer production behavior
 - Farmers might not be willing to tradeoff the potential revenue from carbon sequestration with restrictions on production management over a 5 year period and transaction costs.
- Farmer capacity of adaption
 - While cap-and-trade can increase prices for energy-intensive inputs, farmers may adjust production practice to mitigate the production cost impact.
- Heterogeneity in farmer and distribution effect of cap-and-trade
 - Some farmers may gain and others may lose, depending on farming attributes.

Methodology

- Approach:
 - benefit-cost analysis
 - stated preference approach
 - reduced production cost function
 - statistical simulation
- Modeling tool: Matlab programming

Assessing the Agricultural Impact of Cap-and-Trade: Research Framework



Farmer Behavior Model

Preference to Carbon Sequestration

- Assumption:** farmers tend to maximize their profits
- Derived Kuhn-Tucker condition:** farmers would participate in carbon sequestration only if the benefit is greater than farmer perceived costs.
- Empirical Specification:**
 - Probability (carbon sequestration) = binomial logit
- Data for Empirical Estimation:** farmer stated preference survey

Adaption to Manage Production Cost

- Economic Production Theory:**
 - Production cost function: production cost is a function of output quantity and input prices.
 - Farmer adaption: profit-maximizing farmers will adjust production to reduce their production costs as relative input prices change.
- Hypothesis:**
 - Variable production costs are an implicit function of energy prices (given that agriculture production is energy intensive in terms of input).
 - Variable production costs are a non-linear function of energy prices (due to farmer adaption).
- Empirical Specification:** Variable production costs per unit land are a quadratic function of energy prices.
- Data for Empirical Estimation:** state level variable production costs, acreage of cropland in active production, and energy prices (1945-2008).

Farmer Preference to Carbon Sequestration Survey

Survey Design:

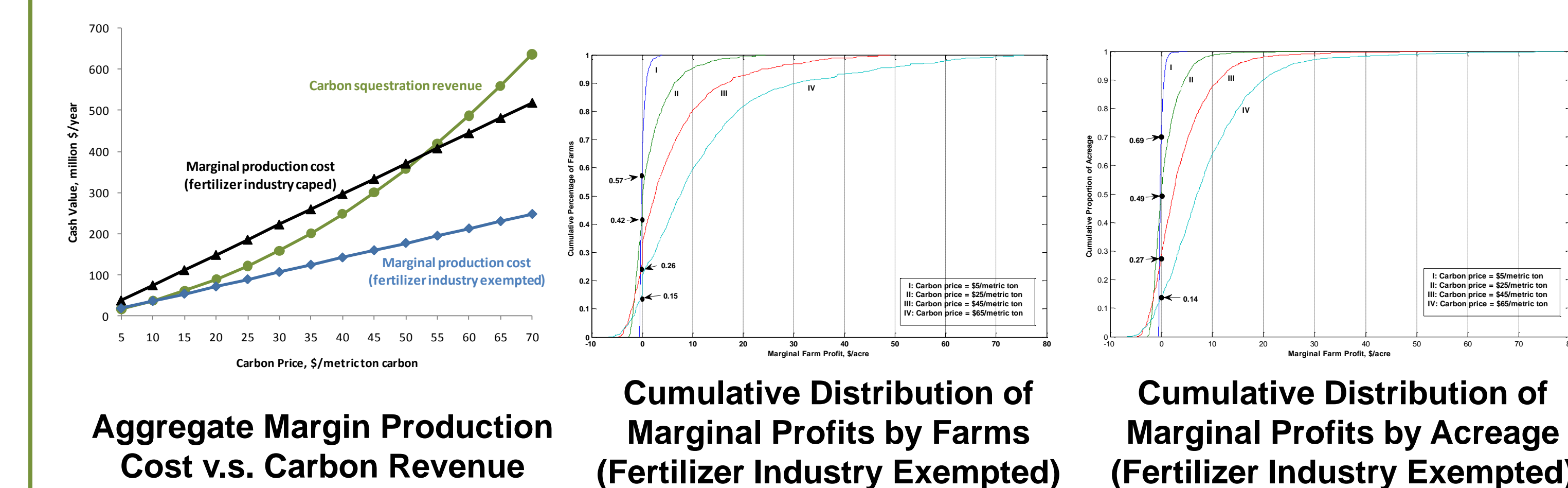
- Structure of survey questionnaire: preference to participate in carbon sequestration, socio-economic background and attitude to climate legislation, and current production practice.
- Versions of survey questionnaire: 6 different versions corresponding to 6 levels of carbon prices ranging from \$5 to \$70 per metric ton.
- Sample sizes: 500 for each version of questionnaire with a given carbon price
- Survey administration: a random sample of 3000 farmers in the USDA ND Agricultural Statistic Service database selected

Survey Result:

- No. of usable returned survey = 281
- farmer distributions by attributes between participation and not participation



Simulated Agricultural Impact of Cap-and-Trade Climate Legislation



Note: Marginal production costs were estimated based on 2009 ND production cost for different carbon prices and may vary depending on the base year production cost.

Some Caveats

- The study did not consider the effects of higher commodity prices and increased demand for bio-energy feedstock.
- Simulated ex ante carbon revenue based on farmer stated preference might underestimate ex post actual carbon revenue after cap-and-trade climate legislation becomes effective.
- Production cost impact of cap-and-trade might be underestimated as well since the effect of GHG emission regulation on prices for non-energy intensive input was not considered.