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Nitrogen Decision Making Under Uncertainty: Role of Subjective Beliefs

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*Selected Poster prepared for presentation at the 2015
Agricultural & Applied Economics Association and Western Agricultural
Economics Association Joint Annual Meeting, San Francisco, CA, July 26-28*

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Background

- The 2008 Action Plan of EPA in order to control hypoxia in the Gulf of Mexico has mandated the states along Mississippi River basin to draft a Nutrient Reduction Strategy
- A Nutrient Reduction Policy has been drafted for Iowa in 2013 emphasizing on Best Management Practices
- Effectiveness of voluntary mechanism in this context is questioned
- Whether voluntary or mandatory, the subjective beliefs and heuristics of farmers in nitrogen decision making is at the core of any related policy

Objectives

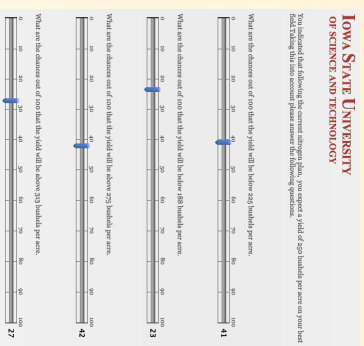
- The objective of this study is an attempt to understand the Nitrogen Decision making process of the farmers
- Subjective Beliefs of farmers surrounding Nitrogen decision making are measured which includes subjective beliefs about Yield Conditional on Nitrogen applied, Crop-Nitrogen response, Rainfall beliefs
- Identify the potential drivers that shape the Nitrogen decision process
- Comparing the farmers subjective beliefs to Objectively held scientific benchmarks and look for evidence of bias or over confidence in their decision making
- Findings from this study will provide a direction to policy making in context of agricultural runoffs by providing a snapshot of the behavioral and psychological aspect of farmer about Nitrogen management on their farm

Why Subjective Beliefs ?

- Dominitz & Manski(1997), Manski (2004)
- Subjective Beliefs can relax and validate restrictive assumptions about expectations based on observed choice.
- Behavioral models based on observed choice data suffer from researcher bias due to the assumption of rational expectation

Data & Methodology

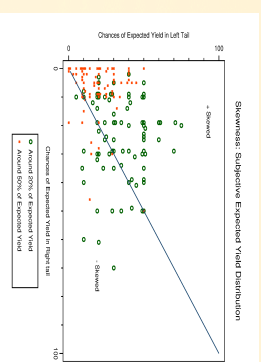
- Subjective Beliefs are measured using tools from Behavioral Economics and Psychology
- Primary data on subjective beliefs regarding farm nitrogen management is collected through a survey in early June 2014 among 75 farmers in central Iowa
- Following Manski (2004) and Delavande & Rohwedder (2008), beliefs are measured using a format "Chances Out of 100"
- A snapshot of the survey page:



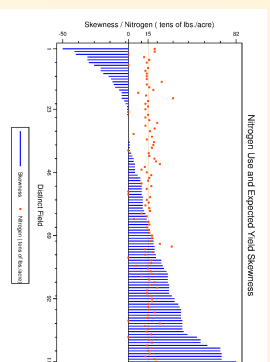
- Measured Subjective Beliefs include Chances about the Expected Yield and Rainfall at different levels, Chances of Rainfall and their perception about change in Expected Yield following different levels of Nitrogen application and varying levels of precipitation during the growing season
- Other filed specific variables included CSR, HEL in acres, Size in acres, Nitrogen requirement and timing and method of Nitrogen application
- Objective benchmark measures are built from Nitrogen trial data from four research farms maintained by Iowa State University*
- Precipitation data for Central Iowa from 1980 to 2013 from NOAA data center

Results

Subjective Yield Skewness

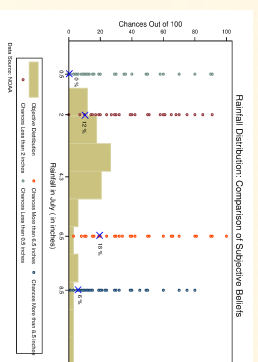


Subjective Yield SkewnessBeliefs and Actual Rainfall Distribution



- In contrast to standard literature on Yield distributions, Day (1965), Babcock (1992) and Du et al. (2012) find evidence of yields to be negatively skewed at high nitrogen levels, the findings do not support them

Subjective Rainfall Beliefs and Actual Rainfall Distribution



Results

Summary statistics reveal the following:

Variables	Expected Yield
CSR	+
Soil Fertility	+
Soil/Plant Test	+
Nitrogen estimate	-
Confidence	-
Planting Date	-
Higher Education	+
Non-Conventional	-
Tillage	-
Nutrient Advice	-
Field Size	+
Number of Fields	+

Conclusions

- Preliminary findings support heterogeneity of farmer's beliefs
- Evidence of Pessimism Bias in the growing season precipitation
- Perception about crop yield being positively skewed at high levels of nitrogen contrast to widely experimented belief of negative skewness

Future Research

- Characterize the Subjective Beliefs about Marginal Product of Nitrogen and Rainfall
- Are farmers potentially biased and miscalibrated about their Nitrogen beliefs ?
- What are the primary factors that shape the underlying nitrogen beliefs

References

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Acknowledgement: *Thanks to Dr. John Sawyer for providing the Nitrogen trial data