How Corn Growers Choose Nutrient Management Practices: The Impact of Heterogeneity in Personal Goals

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What Do Farmers Care About?

Farm management is a complex task. Every growing season, crop managers must make decisions about crop mix, seed varieties, pest control, tillage, fertilizer, harvest timing, and an untold number of other farm activities. These choices have important effects on not only their yields, but on the environment as well.

What factors do farmers consider when making these decisions? This question as has been asked by agricultural social scientists for decades. Surveys of the literature suggest that farmers adopt a new practice when the practice is *perceived* to move the farmer closer to their *personal goals*.[1]

In this research, we categorize farmers' personal goals into three categories: **income, environmental,** and **social**. We explore how heterogeneity in farmers' goals affect the adoption of four practices related to nutrient management.

Survey Design

The mail survey of 10,582 corn growers in **Illinois**, **Indiana**, **Michigan**, and **Ohio** in February, 2017, achieved a **31% response rate**. Farmers answered questions about their cropping practices during the 2016 growing season, where they learn about new practices, what values drive their management decisions, and what farm resources they rely upon.

Practices Examined

We examine four practices which help farmers more efficiently use fertilizer on their fields. **Cover cropping** prevents nutrient loss between growing seasons. **Just-in-time nitrogen testing** allows in-seasons nitrogen applications to be made only when needed. **Yield mapping** provides site-specific information on nutrient needs for the following season. **Variable rate application** of phosphorous and potassium can reduce fertilizer use by applying only where nutrients are needed within a field.

Farmer Goals

We group farmer motivations into three broad categories.

Income: A farmer's desire for financial independence and consumption goods.

Environmental: A farmer's desire to protect both their own and shared environmental resources.

Social: A farmer's desire to be perceived in a positive light by their family and peers.

These motivation categories are referred to as **attitudes**.

References

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Acknowledgements

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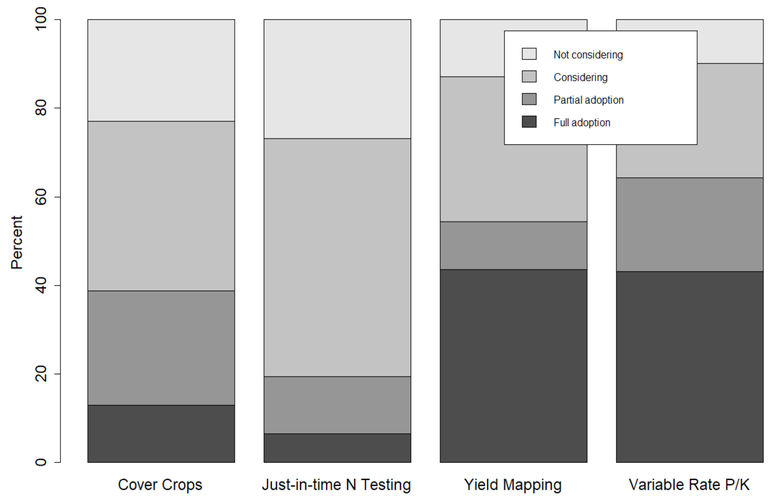

Figure 1: Adoption levels of four nutrient management practices by corn growers in Illinois, Indiana, Michigan, and Ohio.

	Practice:			
	Cover crop	Just-in-time N testing	Yield mapping	Variable rate P/K
Attitudes				
Income	-0.046	**-0.285****	**-0.286****	-0.219*
Environmental	**0.471*****	0.122	-0.265**	-0.072
Social	-0.346*	**0.470****	**0.821*****	**0.373****
***Information Use* (frequency of contact)**				
Extension	0.305***	0.069	-0.033	0.099*
Faculty	-0.078	0.102*	0.165***	0.011
Chemical Dealer	0.002	0.088	-0.008	0.256***
Seed Dealer	-0.124**	0.013	0.092	-0.011
Ind. Consultant	0.183***	0.259***	0.200***	0.130***
Other Farmers	0.078**	0.058	0.066*	-0.110***
Growers Associations	0.159***	0.052	0.107**	-0.05
Web	0.027	0.057**	0.104***	0.083***
Print	0.053	0.005	-0.018	0.062*
Resource Constraints				
Cropland (acres managed)	-0.00001	0.00004	0.001***	0.0001***
Tenure (proportion owned)	0.024	0.022	-0.029	-0.009
Labor (full-time employees)	0.007	0.016	-0.013	-0.008
Livestock (0/1)	0.284***	0.014	-0.284***	-0.135*
CRP Enrollment (0/1)	0.088	0.025	0.061	0.177***
Age	-0.009***	0.001	-0.010***	-0.006**
Education	0.009	0.01	0.208***	-0.042
Obs.	1,435	1,365	1,464	1,456

*Note: *p<0.1; **p<0.05; ***p<0.01*

Table 1: Determinants of adoption of four nutrient management practices using ordered probit models. For variables in the attitudes and information use categories, coefficients can be compared within category and model as relative effect sizes. Coefficients discussed in the Findings & Next Steps box are shown in bold and color, while those that are statistically insignificant are grayed out.

Measuring Attitudes

To measure the relative importance of income, environmental, and social objectives, we use **confirmatory factor analysis** (CFA). Survey respondents reported how important various objectives were when managing their operation on a 5-point Likert scale. CFA weights these responses to generate measures of unobserved attitudes towards each of the three objectives that we hypothesize will drive practice adoption.

Adoption Levels

We used a four-level adoption scale for the examined practices:

1. Not adopted and not considering it
2. Considering adoption, but not adopted as yet
3. Partial adoption
4. Full adoption

Survey respondents self-reported their position on this scale. Adoption levels for each practice are presented in **Figure 1**.

Empirical Methods

We use **ordered probit** statistical models to measure the effects of **attitudes** on progress along the adoption scale. In addition to attitudes, we include controls for **resource constraints** and **information use**. Access to and quality of information on practices is recognized as a consistent factor influencing adoption decisions; including measures of information access controls for these influences.[2,3] Resource constraints account for differences in operation scale and capacity. Survey weights were used, calculated on the basis of USDA – NASS farm counts in each state and size class. Coefficient estimates are presented in **Table 1**.

Findings & Next Steps

The effects of attitudes on the adoption of **just-in-time nitrogen testing**, **yield mapping**, and **variable rate application** of phosphorus and potassium show similar patterns. **Large, positive coefficients for social attitudes indicate that these technologies are more likely to be adopted by farmers concerned with status.** These practices utilize advanced technology which can be considered "cutting edge". Relatively small negative coefficients for **income** attitudes indicate that these practices may not be perceived as profitable for farmers more concerned with their bottom lines.

For **cover crops** a positive coefficient on **environmental** attitudes indicates that **farmers concerned with preserving environmental quality are more likely to adopt.** This result is unsurprising, as cover crops have been shown to provide several ecological benefits both on and off farm, conserving soil health and prevent nutrient loss into water.

Going forward, we hope to further refine our model to explicitly account for possible spatial correlations. We plan to look for spatial dependencies arising from the adoption decisions of nearby farmers as well as spillover effects from nearby farmers' attitudes. We are also in the planning stages for a follow-up survey, which will allow us to measure how farmers' adoption levels change in response to changes in their motivations.