# Adoption of Phytase by Livestock Farmers

Michael Stahlman[1], Laura M.J. McCann[1], and Haluk Gedikoglu[2]

[1]University of Missouri, Columbia, Department of Agricultural Economics
[2]University of Wisconsin-La Crosse
For further information contact Dr. Laura McCann, e-mail: mccannl@missouri.edu

*"Today, everyone should be feeding phytase because of dical price."*
*- Dr. Marcia C. Shannon*

## Introduction

The grains and oil seeds in animal feed contain nutrients, like calcium and phosphorus, that are bound in a salt called phytate. Unfortunately, non-ruminants, like pigs and poultry, lack the ability to digest phytate. Instead of adding inorganic phosphorus, a farmer could add phytase, an enzyme that breaks up phytate, saving money on feed and reducing phosphorus pollution.

Phytase became commercially available in Europe in 1991 and regulations made phytase use widespread (Institute for Applied Environmental Economics). It was not approved by the FDA until late 1995 (Kornegay). By 1997, two studies concluded that phytase was profitable if the manure was required to be land-applied at agronomic rates (Bosch *et al*). Maryland mandated phytase in 1998 and Virginia followed in 1999. The EPA concluded in 2001 that phytase would only cost 1% more while reducing phosphorus output by 40% (EPA).

Phytase has overcome several technological barriers and production costs have decreased. Increasing dicalcium phosphate prices have also made phytase more profitable. However, to our knowledge, no other studies of the adoption of this new technology have been published.

Image taken from: www.tradekey.com

## Objectives

- To examine social and economic factors that impact the stated adoption of phytase.
- To determine the state of farmer knowledge about this new technology.

## Model

Since a farmer can receive satisfaction from the economic and environmental benefits of phytase, this model is based on utility maximization. The variables relate to relative advantage and compatibility of phytase as well as the socio-economic characteristics of the farmer.

U = f(Profit, Time, Phytase water quality effect, Water quality concern, Species, Animal units per acre, Manure transfers, Outside influence, Off-farm income, Education, Age, State)

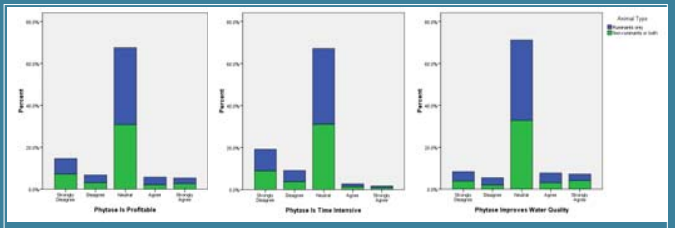
## Methods

- A mail survey was conducted, following Dillman, among 3,014 randomly selected livestock producers in Missouri and Iowa in Spring 2006.
- The effective response rate was 37.4 percent.
- A logit regression was conducted to determine how the farmer's response was influenced by factors relating to the farm and the farmer.
- 437 surveys were used after dropping blank or "Don't Know" responses.

## Logit Regression Results

| Variable | Description | Coef. | Marginal Effect |
|---|---|---|---|
| Phytase Not Profitable (1-2) | Indicator Variables, Based on Likert Scale (1 - 5), Base "3" | -0.437 | -0.010 |
| Phytase Profitable (4-5) | | 1.897*** | 0.101 |
| Not Time Intensive (1-2) | | 1.115*** | 0.036 |
| Time Intensive (4-5) | | -0.821 | -0.015 |
| Doesn't Improve Water (1-2) | | -0.294 | -0.007 |
| Improves Water (4-5) | | 1.424*** | 0.059 |
| Not Concerned about Water Quality (1-2) | | -0.562 | -0.012 |
| Water Quality Concern (4-5) | | -1.635** | -0.074 |
| Dairy | Indicator, 1 if Species is ≥¼ of all animal units on the farm, Base "Swine (>55 lbs)" | -2.244*** | -0.038 |
| Beef Cattle | | -1.639*** | -0.034 |
| Beef Cow | | -2.596** | -0.044 |
| Swine (<55 lbs) | | 0.460 | 0.015 |
| Turkey | | -0.871 | -0.017 |
| Animal units per acre | | 0.009 | 0.000 |
| Sell Manure | Indicator, 1 if farmers sell (give) manure, Base "no" | -1.492* | -0.025 |
| Give Manure | | 1.621*** | 0.081 |
| Contractor (Low, 1-2) | Indicator, Based on Likert Scale from 1, no influence, to 5, very high influence, Base "3" | 0.179 | 0.004 |
| Contractor (High, 4-5) | | -0.741 | -0.015 |
| Other Farmers (Low, 1-2) | | -0.340 | -0.008 |
| Other Farmers (High, 4-5) | | -0.531 | -0.012 |
| NRCS (Low, 1-2) | | -0.058 | -0.001 |
| NRCS (High, 4-5) | | 0.359 | 0.010 |
| $0 - $9,999 | Indicator, Base: "No off-farm income" | -0.717 | -0.015 |
| $10K - $24,999 | | -1.197* | -0.022 |
| $25K - $49,999 | | -0.602 | -0.014 |
| $50K - $99,999 | | -1.893** | -0.028 |
| $100K + | | -0.904 | -0.016 |
| High School Diploma | Indicator, Base "Less than High School" | 0.292 | 0.008 |
| Some College or Vocational School | | 0.743 | 0.022 |
| Bachelor's Degree | | 1.241 | 0.048 |
| Age | In years | 0.015 | 0.000 |
| Iowa | Indicator, Base = Missouri | 2.206*** | 0.061 |

Pseudo R-Square= 0.5273 Overall Correct= 90.8% LR Chi-Squared (32 d.f.)= 206.35




## Results

- People are more likely to say they use phytase if they think it is profitable, not time intensive, and improves water quality.
- They are less likely to indicate they use it if they are concerned about water quality, have ruminants, or have off farm income.
- They are also more likely to say they use it if they give their manure away and are from Iowa.
- The stated adoption rate for the survey was 7.7%, among farmers with non-ruminants the adoption rate was 17.2%.
- 355 of 951 farmers surveyed did not know whether they used phytase.
- The majority of responses concerning phytase attributes were neutral.
- 78% of farmers stated they were concerned about water quality.
- 71 of 79 phytase users came from Iowa.
- There were no broiler farmers that indicated they used phytase.

## Implications

- Since most premixes for non-ruminants include phytase (Shannon) the fact that no broiler farmers, only 5% of turkey farmers, and less than half of swine farmers reported using phytase suggests there is an information disconnect between farmers and feed-manufacturers/contractors.
- While the stated adoption rate for non-ruminants was only 17%, the actual rate is much higher so we are measuring knowledge rather than adoption.
- Centralized decision-making by feed-manufacturers/contractors to reduce dical costs has probably had environmental benefits.
- This is a success story based in part on induced innovation. Further research needs to be conducted to develop other win/win technologies.

Partially funded through USDA Water Quality 406 Grant 2005-51130-02365

References:
- Dillman, D. A. (2000). *Mail and Internet Surveys: The Tailored Design Method. 2nd ed.* John Wiley & Sons, Inc. New York.
- Institute for Applied Environmental Economics. (2007). "Case Study 227." *International Cleaner Production Information Clearinghouse.* http://www.p2pays.org/ref/11/10841.htm (9-14-07).
- Kornegay, E. T. (1996). "Nutritional, Environmental, and Economic Considerations for Using Phytase in Pig and Poultry Diets." *Nutrient Management of Food Animals to Enhance and Protect the Environment.* Lewis Publishers, Boca Raton.
- Bosch, D. J., Zhu, M., Kornegay, E. T. (1997). "Economic Returns from Reducing Poultry Litter Phosphorus with Microbial Phytase." *Journal of Agricultural and Applied Economics.* http://ageconsearch.umn.edu/bitstream/123456789/21054/1/29020255.pdf. (10-18-07).
- U. S. Environmental Protection Agency. (2001). "Final Cost Methodology Report for Swine and Poultry Sectors." *Cost Methodology Report for Swine and Poultry Sectors.* http://www.epa.gov/waterscience/guide/cafo/pdf/PPCostReport.pdf (12-12-07).
- Shannon, M. C. Personal Communication. (07-08-08).