

The Productivity-Water Quality Dilemma: GROWMARK's Response

Michael Boehlje

Distinguished Professor of Agricultural Economics Purdue University

This case was developed for classroom discussion by Michael Boehlje, Distinguished Professor of Agricultural Economics, Purdue University. The author would like to thank Lance Ruppert, GROWMARK and Jean Payne, Illinois Fertilizer and Chemical Association. Editorial support and assistance was provided by Nancy Alexander, Editor, Noblesville, and Betty Jones-Bliss, Center for Food and Agricultural Business, Purdue University. The case is a basis for class discussion and represents the views of the authors, not Purdue University. No part of this publication may be reproduced or transmitted in any form without written permission from Purdue University.

CEO Jim Spradlin and his GROWMARK management team were preparing for the upcoming board meeting, which Jim knew could include some pretty intense discussion. The topic generating it would be recent developments surrounding litigation and public debate on water quality and farming production practices, and in particular, the application and use of nitrogen (N) and phosphorus (P) from both commercial fertilizer and animal waste to enhance crop yields.

This issue was the most recent concern that state and federal regulators as well as environmental groups raised related to modern production agriculture's environmental footprint. The fundamental dilemma is the perceived or real tradeoff between productivity and environmental quality: Do modern production practices to enhance agricultural productivity and, in turn, farmer profitability, and to satisfy the expanding food demands of a growing middle class of consumers, come at the cost of environmental degradation? Of particular concern is the critical water resource needed for public and private uses such as drinking water; fish habitat and the fishing industry; recreational uses and the tourism industry; and aesthetic benefits of clean lakes and streams.

GROWMARK had discussed and debated these issues for almost 10 years. The company designed and implemented new initiatives under its Endure™ label to respond to public and private concerns about nutrient use and management and water quality. However, questions continued to arise about these initiatives and activities in terms of impacts on producer/owner bottom lines as well as company costs; sales and revenues and market share position; return on investment; and environmental footprint metrics.

Recent changes in the regulatory environment, such as proposed restrictions in EPA funding, review of WOTUS regulations, and dismissal of the Des Moines Water Works nitrate-pollution lawsuit, also generated questions about whether the Endure™ programs and related activities should be redirected, downsized, or expanded.

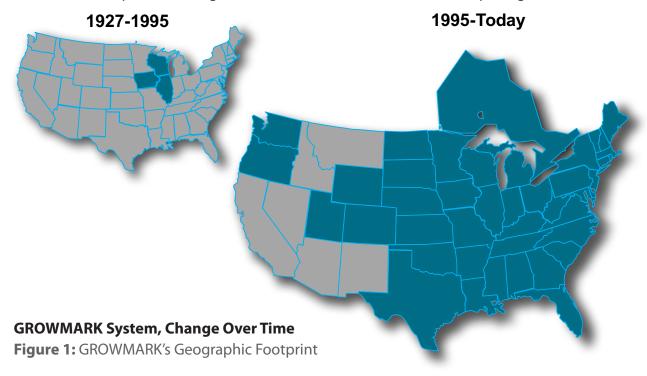
Jim wanted his team to be ready for what he expected to be some hard questions.

The GROWMARK Story

GROWMARK (www.growmark.com) is a farmer-owned cooperative based in Bloomington, Illinois. It is the fourth largest agricultural cooperative in the United States, and provides agronomy, energy, and facility planning and logistics products and services, as well as grain marketing and risk management services, in more than 40 U.S. states and Ontario, Canada. GROWMARK owns the FS trademark. FS cooperatives serve more than 250,000 farm, commercial, and residential customers through member cooperatives and retail operations.

History

The GROWMARK System dates to 1927, when Illinois Farm Bureau members organized local agricultural cooperatives to meet their growing demand for a reliable fuel supply for farmers transitioning to gasoline-powered tractors. Nine such cooperatives formed Illinois Farm Supply Company, which merged with similar organizations in Iowa and Wisconsin to form FS Services, Inc. The new company adopted the FS trademark in 1955. FS Services, Inc. and Illinois Grain Corporation merged in 1980 to form GROWMARK. Subsequent growth occurred



through strategic alliances, joint ventures, mergers and acquisitions. Exhibit A summarizes major events in GROWMARK's growth over time, and Figure 1 summarizes its current geographic footprint.

Structure and business model

Agricultural cooperatives enable producers to achieve economies of scale and realize economic benefits unavailable to them as smaller entities. GROWMARK is one of 2,048 U.S. agricultural (farmer, rancher, fishery) cooperatives (USDA, 2015). Its mission is to improve its members' long-term profitability. Over 200 local member cooperatives own GROWMARK. Through its retail divisions, more than 10,000 farmer members are also owners.

Current operations

GROWMARK employs more than 7,000 people systemwide. It provides products and services in five primary areas:

- Agronomy seed, crop nutrients, crop protection, crop productivity. GROWMARK's
 dominant position in its market in crop nutrients, particularly N products, is detailed
 later.
- **Energy** refined and renewable fuels, lubricants and greases, propane, related energy products. The GROWMARK System is the fourth largest propane marketer in the U.S.
- Facility Planning custom grain drying, handling and storage systems
- Logistics product transport and storage
- Grain administrative support including long-range planning and business development; risk management and grain marketing services

Among GROWMARK's retail brands are AgriVisor, Archer Lubricants, FS InVISION, HiSOY, the FS System, Green Yard, MID-CO, Seedway, STAR Energy, and United Lubricants. GROWMARK also has approximately 230 FAST STOP branded fuel stations and convenience stores in the Midwest.

Sales and earnings

GROWMARK annual net sales in FY2016 were \$7 billion, with audited pretax income of \$116 million. GROWMARK leadership called these results "respectable" given lower commodity and grain prices that put significant pressure on net farm income during the year, and declining crop nutrient values that impacted overall income. Strong operating results occurred in Energy, Seed, and Crop Protection. Among its competitors, GROWMARK leads in delivering cash returns to its members and maintaining outstanding stock equity in current status.

Sales by main category of company brand in FY15 were as follows:

- FS: \$4.8 billion (57%)
- GROWMARK Business to Business: \$3.2 billion (37%)
- Other brands \$700 million (12%)

GROWMARK's consolidated financial statements for FY2016 and FY2015 are available at www. growmark.com/company/Documents/2016_Consolidated_GROWMARK_Audit.pdf

The nitrogen (N) market

GROWMARK accounts for about 10 percent of all nitrogen sales in the U.S. That percentage would increase to roughly 25 percent of total nitrogen sales in the states in which it operates.

Overall nitrogen usage in the U.S. is roughly 35 percent ammonia, 35 percent nitrogen solution, and 30 percent urea. The GROWMARK sales book is heavily skewed to ammonia, which accounts for 44 percent of all nitrogen sales. This has declined from as high as 55 percent with the advent of nitrogen-management systems. Urea has trended up as a percentage of total N sales since about 2013, when split applications of nitrogen became more popular. Best estimates are that GROWMARK is in the top five suppliers nationally of nitrogen to the retail sector, not counting producer-direct sales.

The Productivity-Water Quality Dilemma

Despite nutrient management practices improving over the past 30 years and crop yields increasing significantly with less-than-proportionate increases in fertilizer inputs (Figure 2), a number of events have stimulated the most recent debate about the impact of modern farming practices on water quality.

In one of the highest profile instances of water pollution, a half-million people in the Toledo, Ohio, metropolitan area lost drinking water in 2014 due to algae-infested water sourced from Lake Erie. Algae growth is fed by high concentrations of phosphorus from various sources such as runoff from feedlots and farm fields; leaky septic tanks; and municipal, industrial, and urban waste water disposal and runoff. But the prime target of blame was agricultural runoff from farm fields and livestock facilities. A survey of Ohio residents found that an increasing

U.S. Corn Production and Nutrient Use on Corn

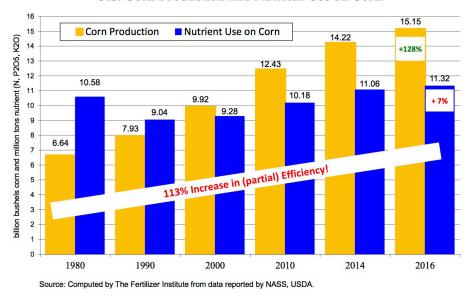


Figure 2: U.S. Corn Production and Nutrient Use on Corn

proportion of respondents attributed blame or the causes of the algae bloom to animal agriculture and crop-production practices as well as the weather, and a reduced proportion to industry, urban sources, and rural septic tanks.1

In 2015, Des Moines Water Works (DMWW) filed a lawsuit against three Iowa county drainage district trustees for violating the federal Clean Water Act. They alleged that increased levels of nitrates from tile drainage systems in these counties polluted the Raccoon and Des Moines rivers, resulting in higher costs to remove these nitrates to supply drinking water to residents of the city of Des Moines, Iowa. The U.S. District Court dismissed the lawsuit in March 2017 on technical grounds that DMWW lacked standing to bring the lawsuit; however, the court did not rule on the substantive issues of whether drainage districts and tiling systems were a point source of pollution and thus subject to the Clean Water Act. This unique and controversial high-profile case in a predominantly agricultural state raised unprecedented public awareness and concern about nutrient loss and water quality, and precipitated further discussions and initiatives to reduce water degradation from agricultural production practices in lowa and surrounding states.

These recent events add to longer-term concern about agriculture's impacts on water quality as evidenced by ongoing discussion and debate about water quality in the Chesapeake Bay and the Gulf of Mexico "dead zone."

Agriculture is the largest source of nutrient and sediment pollution entering the Chesapeake Bay, accounting for 42 percent of nitrogen, 55 percent of phosphorus and 60 percent of sediment.² Since the early 1980s, environmentalists and regulators have been concerned about deteriorating water quality in the Bay and interested in incentivizing and/or mandating changes in management practices to reduce nutrient and sediment pollution and restore the ecosystem.

A full set of best management practices —conservation tillage; cover crops; forest buffers and streamside fencing; nutrition management planning; proper use, application, storage, disposal and transportation of animal waste; and location of livestock production facilities away from streams and wetlands — has resulted in significant improvements. For example, nitrogen inflows into the Bay in 2015 were 35 percent below the long-term average of 335 million pounds per year. But less progress has been made in phosphorus loads. Consequently the debate on agricultural production practices and water quality in the Chesapeake Bay continues.3

The dead zone in the Gulf of Mexico is a result of nitrogen and phosphorus in the water that drains from the Mississippi River, and algae blooms that choke off oxygen in the water and interfere with marine life growth and survival. The National Oceanic and Atmospheric Administration has estimated that the dead zone costs U.S. seafood and tourism industries \$82 million per year.4

The dead-zone phenomenon has been a persistent environmental problem since the 1970s. Again, public perception and scientific evidence place much of the blame on commonly used farming and nutrient-management practices in the Mississippi River basin, which result in surface water runoff and groundwater leaching of nutrients and sediment. And the latest information is that the dead zone this year is the largest ever recorded – 8776 square miles or about the size of New Jersey.⁵

These are recent examples of longer-term concern by environmentalists, government regulators, and the public about water quality. Such concern led to regulations — federal, state, and local — to protect surface water and groundwater from industrial, municipal, urban development, and agricultural pollution/contamination.

Arguably the most contentious of these has been WOTUS (Waters Of The United States) regulations, which the Environmental Protection Agency (EPA) promulgated in 2015 to regulate "navigable waters" under the Clean Water Act of 1972. WOTUS was to provide more specificity and functional definitions and guidelines to guide EPA's work under its mandate to "keep navigable waters clean." The definition of "navigable waters" was litigated but not fully resolved in a 2006 Supreme Court decision, which implied the rules should embrace wetlands with a "significant nexus" to navigable waters.

Agricultural groups in particular vehemently opposed WOTUS, arguing that it expanded EPA's authority to include "almost any piece of land that gets wet and puddles," according to Texas Attorney General Ken Paxton. President Trump fulfilled a campaign promise by signing an executive order to review WOTUS to assess its consistency with "promoting economic growth" and "minimizing regulatory uncertainty." However, overturning the rule would require restarting the rule-making process and likely precipitate litigation from environmental and other groups, so is not likely to happen quickly, if at all.

In addition to federal regulations, many states and even counties have enacted water-quality regulations that focus specifically on agricultural runoff and nutrient and sediment pollution. In March 2011, EPA issued a memo (referred to as the Stoner memo) to all EPA regional administrators, directing them to work with states in their respective regions to enact a framework for managing nitrogen and phosphorus pollution in water. The result was development of individual State Nutrient Reduction Strategies. Each state strategy had to address eight criteria in the Stoner memo, which included setting nutrient-reduction goals, prioritizing watersheds, addressing agricultural areas as point source permits, verifying progress toward the goals, and the issuance of annual and biennial public reporting of activities being implemented to meet the goals. EPA also requires states to pursue development of numeric water-quality criteria for nitrogen and phosphorus within three to five years of the plan's implementation.

Regardless of current actions at the federal level to revisit current EPA mandates, most states, including those in the Upper Mississippi River Basin that encompasses the Corn Belt, have developed and implemented plans and made them available to the public and state legislatures. These state plans define specific nutrient-reduction goals in state rivers and streams — in pounds of nitrogen and phosphorus — over time, and include waterquality monitoring programs to access progress toward those goals. Because many state strategies also prioritize local watershed areas for nutrient reductions, local governments and stakeholders become engaged in the process and implementation of activities to reduce nutrient loading.

The state strategies require the point source sector (water treatment and other National Pollutant Discharge Elimination Systems-permitted facilities) to meet nitrogen and phosphorus reductions through new treatment technologies. Agriculture can reduce nutrient losses through voluntary efforts. While the ag community welcomes this voluntary framework for agriculture non-point source nutrient loading, reduction goals equate to millions of pounds of nutrient reductions from the ag sector. For example, the goals of reducing nitrogen losses by 15 percent and phosphorus losses by 25 percent in Illinois by 2025 become hard-line expectations by stakeholders and the public, which challenges agriculture to prove this can be accomplished through voluntary practices implemented by ag retailers and farmers over the next eight years.

Nutrient stakeholders generally understand that if voluntary practices in the ag sector do not achieve these reductions, regulatory approaches may be considered. State Nutrient Reduction Strategies are now defining water-quality priorities, as in lowa, where the state legislature appropriated significant funding to ag cost-share programs to meet goals of the lowa strategy.

These state strategies have engaged all stakeholders at the state and local levels in improving water quality, so expectations to reduce nutrient losses are no longer largely driven by federal regulatory threat but by the expectations of peer groups, fellow business sectors, local communities, and the public. A few states have taken steps beyond their state nutrientreduction strategies and proposed regulations aimed at reducing nutrient losses from the ag sector. Minnesota recently proposed establishing fertilizer-management practices specific to regions within the state. In some regions fall application of nitrogen would be restricted or banned, as would winter spreading of nutrients, based on vulnerability factors in each region.

GROWMARK's Response

GROWMARK introduced a number of initiatives to improve nutrient management over the past decade, but the focus, goals, and strategy have changed.

The emphasis during the earlier part of this decade was on yield enhancement through enhanced and multiple N applications; higher plant populations; fungicide and insecticide use; soil sampling to determine the amount, form and placement of plant available nitrogen, etc. A key objective of these activities was to leverage the full set of nutrient-management practices to enable retailers and growers to apply fertilizer in the fall as well as during the growing season. This allowed for timely planting operations while efficiently using equipment and personnel over a longer application period. Concerns about loss of N because of leaching in particular focused mainly on reduced productivity and profitability issues. Water-quality issues were not ignored, but the primary focus of nutrient stewardship was enhanced farmerowner and GROWMARK profitability.

Industry as well as GROWMARK internal discussions of the environmental impact of nutrient management during this period emphasized the threat to fall-applied N. As noted earlier, GROWMARK and the FS retail distribution system was an industry-leading supplier of anhydrous ammonia (typically fall applied). Water-quality problems in the Chesapeake Bay and Lake Erie, the DMWW lawsuit, and the persistent dead zone in the Gulf of Mexico raised the specter of regulation and litigation, which could dramatically impact operations and agronomic production practices, and significantly increase the costs for both retailers and growers.

Concerns about phosphorus (P) use and applications, particularly on frozen ground in the winter, began to surface for discussion. The industry and GROWMARK response was the 4R nutrient-management program — right source of nutrient, at the right time, at the right rate, and in the right place (see Exhibit D). But producers and retailers were slow to adopt program activities. FS companies and other retailers were hesitant because of increased cost and operational inefficiency as well as concerns that competitors who continued current practices and provided products/services at lower cost would steal customers. And growers were not as informed and aware of the water quality/environmental footprint debate and future challenges they would face in a more regulated environment. Early successes in

nutrient-management practices and technologies (nitrogen stabilizers, multiple applications, etc.) were not as well understood and/or documented, and producers' concerns about cost increases and yield reductions still dominated their nutrient-management decisions.

Something had to change to move forward; fear and prospective regulations and litigation weren't working. Experience with the Field to Market "sustainability" activities, along with conversations with colleagues in GROWMARK's Grain Division, suggested potential revenue opportunities from producing crops that had a smaller environmental footprint and "sustainable" attributes. GROWMARK staff read Green to Gold: How Smart Companies Use Environmental Strategy To Innovate, Create Value and Build Competitive Advantage (Esty and Winston, 2009). They saw potential to flip the discussion from fear to opportunity — to differentiate the company to meet increasing demand of at least a segment of consumers for products with "sustainable" attributes.

That approach clearly had risks. Many felt the sustainability discussion was rhetoric and greenwashing without substance. However, even processing companies like ADM and Cargill were positioning to respond to food retailers like Walmart and food companies like General Foods and their stated goals to reduce not just the company's environmental footprint, but also the entire food supply chain's. Maybe here was an opportunity to transform the productivity-water quality dilemma from a tradeoff — you can't have both — to a win-win: more productivity and profit potential for growers and input supply retailers, and enhanced water quality and a reduced environmental footprint.

But many FS farmer-owners and general managers remained concerned about how the topic of sustainability would potentially affect them. Growers were asking, "Will nutrient-reduction strategies on the books at state legislatures force growers to comply with regulation that limits the amount of nutrients applied to their fields?" Jim and Mark Orr, Vice President, Agronomy had been hearing some tough questions from general managers such as, "Will our ability to apply nitrogen in the fall and winter be limited or eliminated in the future, putting extra pressure on our already stressful spring application window?" And the Board was asking, "How does a company that sells fertilizer balance environmental sustainability and staying in business?"

The leadership team went to work to convert a laudable objective — the win-win strategy into action. First, they needed more real data to prove the suggested nutrient management and technology changes really worked both economically and environmentally (water quality). Additional applied research was launched including nitrogen-management trials focused on stabilizers, and N management systems coupled with N watch sampling to quantify and document return on investment and nitrogen management success (Exhibit B).

A new Endure[™] brand and sustainability program messaged the new image and recognized leaders who embrace and implement the program (Exhibit C). New collaborative activities were initiated with Farm Bureau to drive grower awareness and develop a pull-through marketing strategy to move growers and retailers forward (Exhibit D). Four identified metrics to measure progress that are being used include: variable rate P&K application acres, N stabilized acres, N advisor management systems acres, and N&P applied research acres.

The momentum was building, but much was still to be accomplished.

A Broader Perspective

Advances in science and technology, and the resulting increases in productivity, have powered the world's economy and economic progress for centuries. However, along with wealth and prosperity, these advances have caused unintended ecological challenges, including environmental degradation, ozone depletion, concerns about water quality and availability, declining biodiversity, and toxic waste (Shrivastava, 1995).

Agribusinesses that rely heavily on natural resources cannot ignore environmental and social issues prevalent in today's society. Faced with strengthening public opinion and increasing government regulation, food businesses in particular are becoming more accountable for their impacts on society and more transparent in their activities as part of their corporate social responsibility. Agribusinesses are thus increasingly concerned about sustainability. A plethora of definitions of "sustainability" exist, but all share the common rationale as described in "Our Common Future," the 1987 Brundtland Report of the World Council on Environment and Development: "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs."

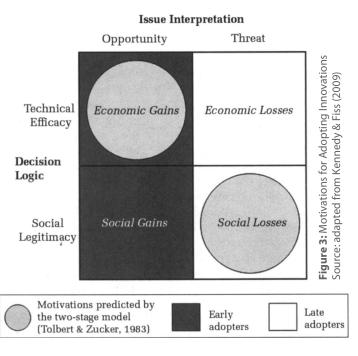
A concern expressed often in the agricultural sector involves potential tradeoffs between environmental and/or social goals and economic goals (e.g., environmental sustainability and productivity). Companies and stakeholders often believe sustainability comes at the expense of productivity and competitiveness within the industry. By taking into account environmental and social concerns, companies must internalize more costs and face additional constraints. Such arguments make it exceedingly difficult for management to receive the support necessary to pursue sustainability initiatives. But today's food production and distribution industry is being challenged to change its production, manufacturing and distribution processes to be more environmentally focused. Such challenges provide new opportunities for implementing sustainable business strategies and entering market niches for environmentally friendly products. Some argue that companies seeing emerging environmental and sustainability issues early and including them in their strategy may be perceived as more innovative and entrepreneurial than their competitors. Consumers concerned with lowering their environmental footprint often distinguish such companies as better prepared to deal with unpredictable market forces and more apt to meet customer needs. The ability to acquire customer loyalty is essential for creating brand value, which in turn drives sales, premiums, and closer relationships with stakeholders (Esty and Winston, 2006).

General Mills has set a goal of sustainably sourcing 100 percent of ingredients such as corn, wheat, and dairy by 2020; it currently is at 70 percent for its top ten ingredients. UK-based retailer TESCO and U.S.-based Walmart have launched carbon footprint initiatives to reduce greenhouse gas emissions. Walmart announced its goal to reduce carbon emissions by 1 billion tons throughout its supply chain by 2030. A critical component of its initiative is to add cover crops and optimize fertilizer applications on 76 million acres of farmland.¹⁰

Technology and innovation in production processes and product development are at the core of both productivity enhancement and environmental performance. Regarding water quality specifically, new technology and cultural practices such as no-till, cover crops, split applications of nitrogen, etc., could potentially increase productivity and grower incomes as well as reduce environmental degradation from nutrient and sediment pollution. Increased pressures on natural resources and the threat of serious potential environmental effects add to the importance of technology's role.

What has been perceived as conflicting goals and a tradeoff dilemma can now be repositioned as complementary goals. A critical issue in responding to the potential economic vs. environmental/social dilemma is thus adoption of new innovations — both the rate/ speed of adoption and the motivations for it. Kennedy and Fiss (2009) suggest that a useful framework for analysis includes issue interpretation and decision logic.¹¹ Issue interpretation is whether an issue (and the change/innovation that responds to that issue) is framed as an opportunity or a threat. Issues interpreted as opportunities imply that gain is possible and control can be exercised, increasing potential to take action and to innovate and implement organizational change. In contrast, issues interpreted as threats imply loss, little control, and resistance to innovation or change.

As to decision logic, Kennedy and Fiss focus on technical efficacy and social legitimacy. They argue that technical efficacy and efficiency gains incent more rapid adoption consistent with the logic of creating value. Social legitimacy is in essence an image or conformance decision logic — the desire to be perceived as "looking good," being "politically correct," or not viewed as lagging — to appear legitimate to both customers and competitors. Their analytical framework is summarized in Figure 3. Early adopters frame the issue as an opportunity and use a combination of technical efficacy (creating value) and social legitimacy decision logic. In contrast, late adopters frame the issue as a threat and use primarily technical efficacy (creating value) decision logic.



The implications of this analytical framework for innovation, and adoption and resolution of the economic vs. environmental/social dilemma, are straightforward: Firms that frame the issue as an opportunity and use both technical efficacy and social legitimacy as decision logics in their strategic decision-making will be more aggressive in innovation and institutional change and thus be leaders in the industry. Those who view the issue as a threat and use primarily technically efficacy as their decision logic will delay innovation and response to the issue.

Next Moves

Repositioning the discussion from fear of regulation/litigation (i.e., freedom to operate) to a win-win opportunity (more productivity and profit for growers and retailers and reducing the environmental footprint and improving water quality) was beginning to show results, but the world was changing and uncertain. Research activity was generating solid and credible data, but sometimes it didn't support the thrusts of the program. Weather is an important determinant of both nutrient productivity and nutrient losses, particularly N losses through leaching resulting from intense rain events, and is difficult to control in field-level research. More and better-designed research was needed.

Growing interest in cover crops — seeding rye or other crops in the fall after corn or soybean harvest — was raising new issues about their role in enhancing soil health by increasing organic matter, texture, and other soil attributes as well as reducing nutrient loss. But management of cover crops was not yet well understood: what species, when to plant, how to reduce competition with the main crop (corn or soybeans), costs, etc. How many resources should we at GROWMARK spend to learn and drive the market on cover crops? What role could and should tillage practices such as no-till or strip-till have in the management plan, and how does it interplay with other cultural practices, soil types and conditions, and weather events to impact productivity and nutrient utilization and losses?

How do we keep retail managers and crop specialists engaged in sustainability initiatives and activities? What should our position be on retail location certification programs now being discussed in states like Ohio? These programs will require additional staff, e.g., a 4R specialty Certified Crop Advisor to make fertility/nutrient recommendations. How do we staff, train, and compensate them? Should we outsource this to a separate consulting entity? Many of these initiatives and activities add costs to doing business. Can we offset those costs with enhanced margins or grower loyalty? Or are they just "table stakes" and a new cost of doing business?

The regulatory and legislative environment might be shifting with prospects for reduced EPA funding, the executive order to review WOTUS, and dismissal of the DMWW nitrate-pollution lawsuit. As discussions begin on the 2018 Farm Bill in an environment of low commodity prices, proposals are surfacing to increase the Conservation Reserve Program. What are the prospects to leverage this interest, combined with growing concerns about long-term soil losses and soil health to reduce erosion as well as nitrogen (N) and phosphorus (P) losses,

to improve water quality and reduce the environmental footprint? More generally, what is GROWMARK's role in conservation? Should we increase staff to provide more assistance to growers, and what is the business case here?

Finally, how might growers and retailers use precision farming and digital agriculture tools and techniques to improve productivity and reduce the environmental footprint of crop farming? How can these help convert knowledge from the applied research to management decisions that will help transform the **productivity-water quality dilemma** to a win-win proposition of **better incomes and a better environment**?

Discussion Questions

- 1. Should GROWMARK expand its Endure[™] program? If so, how should GROWMARK incent growers and member retail cooperatives to participate in the program?
- 2. How should GROWMARK proceed from here? What additional initiatives (including actions and activities) should it take to move forward?
- 3. How might other participants in the value chain be encouraged to collaborate in an expanded program? Who specifically should they have conversations with to move the program from rhetoric to action? Grain originators? Processors? Food manufacturers? Fertilizer and crop protection manufacturers and distributors?
- 4. How might regulatory/government agencies, educational institutions (universities and community colleges), and environmental and special interest groups (Field to Market, Nature Conservancy, etc.) contribute to or impede their movement forward?
- 5. What actions can or should be taken to respond further to the challenge of positioning the productivity-water quality dilemma as an opportunity to innovate, create value, and build competitive advantage?
- 6. How might you leverage the challenges and responses that GROWMARK has and is facing to more effectively position your firm to respond to similar issues concerning economic vs. social/environmental tradeoffs in your industry?

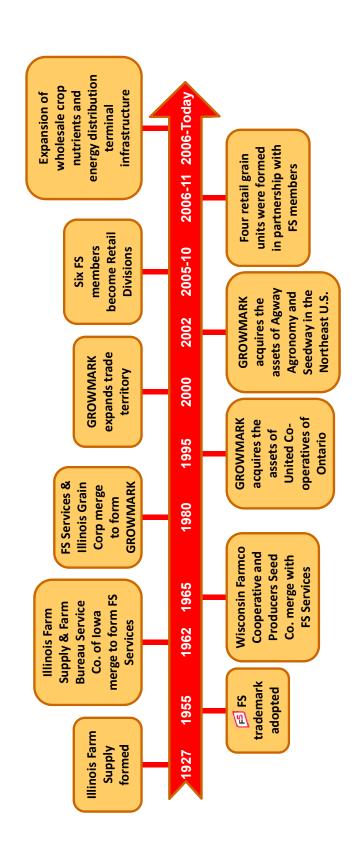


Exhibit B





2016 Yield Trial Reports

Conducted in partnership with **FS Member Companies**



TABLE OF CONTENTS

Introduction	1
N-WATCH™	9
Nitrogen as a System	18
Nitrogen Rate	27
Y-DROPS	31
Corn Fungicide	36
Soybean Fungicide	45
Micronutrients	50
Sulfur	56
Starters	60
Seed Treatments	62
Ask Me How	66

For Internal Use Only

The aggregated data presented throughout this reference was pulled from the United States Midwest regions of the FS System. It must be emphasized that in order to make this information available for public consumption, every trial that contributes to an aggregated data set must be accompanied by a data use agreement (DUA) signed by the participating farmer and the local Member Cooperative sales representative implementing the protocols. At the time of publication, some DUAs were not executed and submitted for inclusion.

Do not distribute this book beyond FS employees. All the focus trials reported in this book are published with the consent of the host farmers and their Member Cooperative partner, and are available via PDF for public distribution.

Trials in this book are provided for informational use; GROWMARK and FS Companies make no specific recommendation based on these trial results, or provide statistical analysis of the results.





MiField by FS is a research and analysis tool that offers so much more than some distant field trial. Applying findings from your farm, MiField helps your Crop Specialist deliver ongoing recommendations, more customized than ever. From crop health inputs to nutrient management to new methods, MiField by FS can discover what fits best on your farm. In practice, MiField by FS focuses on helping growers better understand their cropping practices by delivering research based data and recommendations that help them be more profitable on their fields.





Testing toward profitability

FS assists growers in conducting real-field trials using practical testing methods to discover how agronomic practices will optimize their profit-per-acre. This approach provides for side-by-side applied research of a single agronomic practice or of a single $system, comparing \ how\ performance\ and/or\ efficacy\ affect\ yield\ and\ profit.$

This publication is a compilation of yield trial projects conducted throughout the FS System service territory. Each category and trial is summarized with aggregate data backed by independent testing to gain insights into trends that increase profitability for farmers. Focus trial reports are analyzed in various ways to gain the best understanding of factors affecting yield and profitability.

Find specific yield trials in your area. Visit www.fssystem.com to search for MiField Applied Research trials in your geography. Conduct your search by year, state, county, crop, and trial type to find the information that relates best to the farm(s) near you.





2016 Focused Yield Trials. During the 2016 growing season, seven types of trials were conducted across the FS System. Within the chapters of this book, you'll find aggregated values of the individual trials. On www.fssystem.com, you will also find yield results for more individual trials conducted in the FS System Midwest geography.

Aggregating Data to Net Winning Decisions. MiField Applied Research utilizes specific protocols for conducting various cropping practices. This consistency across trials that follow proctocols allows for aggregation of data. By aggregating data, we are able to expose trends which may have otherwise remained hidden within stand alone data. These trends can help advisors and producers better understand factors that influence yield and profitability in their geography. Your FS Crop Specialist will help you leverage these trending insights to increase your chances of making winning cropping decisions.

CORN - Ask me how to reach 300	Corn Foliar Fungicide	Nitrogen as a management system
SOYBEANS – Ask me how to 100	Soybean Foliar Fungicide	N-Serve and slowing nitrification
	Soybean ILeVO vs Clariva	

Trials in this book are provided for informational use; GROWMARK and FS Companies make no specific recommendation based on these trial results, or provide statistical analysis of the results. Contact your local FS Crops Specialist to gain further insight into specific trials that can answer..."What's next for my field?"

Why do trends matter? Applied to your unique farming situation, trends can help you better understand how agronomic practices and environmental variables are affecting, or can affect, crop performance.

Through aggregated farm data, you can identify and analyze trends of specific situations to better predict outcomes and increase the chances of higher profitability. For example, reasonable yield predictions can be made by looking at thousands of pooled data points.

- Planting date
- Nitrogen rates and management
- Genetics and traits
- ▶ Fungicide treatment
- ▶ Planting rates

Soil type

Rainfall

More Data, Better Analysis

The relative value of data increases when additional data points are added to the pool.

What can I expect from aggregated farm data? The short answer is better decision making. So many aspects of our lives are touched by decisions based on aggregated data analysis, that we may not recognize the influences. A general comparison to America's pastime serves to demonstrate the power of aggregated data. Let's look at farm data in the same way a baseball manager looks at player statistics – or data points – to fine tune the team roster and coaching decisions.

Baseball and corn have more in common than a great movie made in lowa.





Single **Box Score Data Set**

Players Positions At Bats Hits Runs Walks Strikeout

A single game box score gives the team manager performance data points that occurred in one particular game this season.

Hitters	AB	R	H	RBI	BB	50	LOB	AVG
D Eckstein SS	5	1	4	2	0	0	0	.333
C Duncan RF	2	0	0	0	1	0	1	.167
b-S Taquchi PH-LF-RF	1	1	0	0	0	0	2	.125
A Pujols 1B	2	0	0	0	2	1	2	.167
J Edmonds CF	4	0	0	0	0	3	3	.308
S Rolen 3B	4	1	2	0	0	1	2	.438
P Wilson LF	3	0	1	1	0	0	0	.200
A Wainwright P	0	0	0	0	0	0	0	.000
Y Molina C	2	0	1	1	2	0	0	.308
A Miles 2B	3	2	1	0	1	1	3	.167
J Suppan P	2	0	0	0	0	1	3	.000
a-J Rodriguez PH	1	0	0	0	0	1	2	.000
J Kinney P	0	0	0	0	0	0	0	.000
<u>T Johnson</u> P	0	0	0	0	0	0	0	.000
B Looper P	0	0	0	0	0	0	0	.000
J Encarnacion RF	1	0	0	0	0	1	1	.000
Totals	30	5	9		6	9	19	
a-struck out swinging for J b-reached on error (credite 7th				O1		P	can ir	the

BOX SCORE

tracks one game within one playing season at one point in time

view of how variables affect a player's performance potential and value to the team's overall success.

Provides a limited

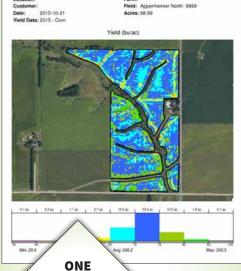
Single **Yield Map Data Set**

A single yield map, much like a single box score, gives you performance data point from one particular field farmed in one year.

M Field

Hybrid/Variety Planting Date Harvest Date Moisture Yield

Data Analysis Report



YIELD MAP

tracks one field within one growing season at one point in time

Provides a limited view of how variables affect the field's performance potential and overall success over space and time.



Bringing you what's next.™

Trending Now...Data Aggregation

Aggregated data starts to reveal trends, which give baseball managers, and farmers, a better prediction of overall success. Baseball experts have found that the value of data increases when more data points are added to the statistics pool.

Situational Baseball Data

2015 BATTING SPLITS

Baseball managers tally players' data over multiple games and multiple seasons. Those numbers begin to reveal trends, and give managers a better prediction of player performance in specific situations - therefore increasing the team's chance of winning.

Analyzing a player's hitting performance

Against left- or right-handed pitcher In day or night games

At home or away games

Overall	AB	R	н	2B	3B	HR	RBI	ВВ	НВР	5	Wit	th bas	es emp	ty or run	ners	OPS
Total	521	118	172	38	1	42	99	124	5	131		in s	coring p	osition		1.109
By Breakdown	AB	R	Н	2B	3B	HR	RBI	BB	HBP	SO	Sh				LG	OPS
vs. Left	154	32	49	15	0	7	25	32	1	34	0				.552	.986
vs. Right	367	86	123	23	1	35	74	92	4	97	6	1			.689	1.160
Home	255	64	88	17	0	23	53	70	2	60	3	1		88	.682	1.170
Away	266	54	84	21	1	19	46	54	3	71	3	3	.2	.433	.617	1.050
Day	183	36	62	14	1	17	39	30	2	42	2	0	.339	.435	.705	1.140
Night	338	82	110	24	0	25	60	94	3	89	4	4	.325	.473	.618	1.091
By Situation	AB	R	Н	2B	3B	HR	RBI	BB	HBP	50	SB	CS	AVG	OBP	SLG	OPS
None On	289	25	94	23	1	25	25	54	1	75	0	0	.325	.433	.671	1.104
Runners On	232	93	78	15	0	17	74	70	4	56	6	4	.336	.490	.621	1.111
Scoring Position	113	72	34	4	0	8	55	40	1	32	2	0	.301	.475	.549	1.024
Bases Loaded	6	18	4	1	0	0	10	1	0	0	0	0	.667	.625	.833	1.458
Lead Off Inning	120	12	/38	10	1	12	12	18	0	30	0	0	.317	.406	.717	1.123

Situational Farm Data

Farm data tallied over multiple seasons, over multiple fields allows growers to better understand how agronomic practices and other variables affect performance in specific situations. As in baseball, the numbers begin to reveal trends. And in analyzing what may be influencing a trend, growers can better predict outcomes - and increase the chances of meeting yield goals and profitability.

Analyzing a field's yield performance by Earlier or later planting dates

Genetic mix and traits Planting rates Soil types Varied nitrogen rates and management practices Fungicide treatment or none Rainfall measures





PURPOSE

To recognize FS System Crop Specialists who engage growers in Sustainable Best Management Farming practices.

REQUIRED ACTIVITIES OF SUSTAINABLE BEST FARMING PRACTICES

- ▶ Demonstrate knowledge of the 4R principles as defined by The Fertilizer Institute
- ▶ Provide at least one example of how you assisted a grower implement the 4Rs on his/her farm
- ▶ Utilize N Watch™ nitrogen tracking program
- Demonstrate knowledge of the principles of a Nitrogen Management System
- Sell or promote use of nitrogen stabilizers
- Conduct at least one MiField™ Applied Research project (trial) on a customer farm

PROGRAM

- ▶ FS Member Company Sales or General Managers can nominate Crop Specialists from January 1 March 31, 2017 by submitting a nomination form to GROWMARK Agronomy Marketing via the Strategic Agronomy Marketing Manager
- ▶ All submissions will be evaluated by committee, who will select up to 5 winners annually.
- The selection committee will consist of 5 people from the agriculture industry, non-governmental organizations , and ${\sf GROWMARK}.$
- Individuals are eligible to win once, though may be nominated multiple years.

RECOGNITION

- ▶ Winners and their spouses will be invited to and recognized at the GROWMARK Annual Meeting and Agri-business Symposium where they will receive the Endure Advocate Award.
- ▶ Winners will be profiled in the *SOURCE* magazine.



Enduring Farm

The purpose of the *Enduring Farm* is to preserve and improve the land and natural resources for future generations by utilizing proven best management practices. The *Enduring Farm* Program recognizes FS customers who implement these best management practices for nutrient utilization that lead to long-term soil and water quality, while enhancing profitability.

Growers that earn a combined score of 150 points or greater for these nutrient management activities will be designated as an Enduring Farm.

Nominations can be submitted annually September 1 – December 31 with announcements and awards given in February. The initial nomination period will be in the fall of 2017 with the first awards given out in February 2018.

Enduring Farms will receive:

- Two N-WATCH sites utilizing 3 samples for a MiField Applied Research Nutrient Management trial to be used in the next crop season on a field of their choice.
- A press release to communicate their farm's activities and achievements.

Grower Benefits

- Opportunity for collaboration and knowledge development providing better understanding of Nutrient Management practices and their relationship to improved nutrient utilization and profitability
- Participation in new programs, technology and tools to enhance farm profitability and nutrient utilization.
- Documentation and communication of agronomic practices with stakeholders, landlords and community members.
- Potential for qualifying for unique grain markets linked to sustainable farming practices.





PURPOSE

Program allowing FS Member Companies and the GROWMARK system the opportunity to demonstrate their support of pollinator health and sustainability.

FS Companies can set aside ground at their facilities or on trial plots to plant habitat havens for bees. Plots should be planted with Green Yard™ Honey Bee Wildflower Mix, donated by GROWMARK Inc., which is a combination of annual and perennial flowers that provide nectar and pollen to honey bees.

- ▶ Seed should be planted in a visible area.
- ▶ Member Companies should participate in promotional efforts by putting up signs.
- Member Companies should assist **GROWMARK Corporate Relations in** building public relation efforts by submitting photos, videos or providing interviews.

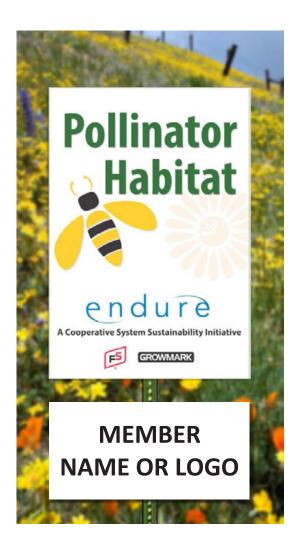


Exhibit D

A field demonstration partnership



Nutrient management works when we work together.





The 4R4U Field Demonstration Partnership is a statewide collaboration between Illinois Farm Bureau, FS ag suppliers and GROWMARK focused on highlighting on-farm nutrient management practices, and data that shows how 4R nutrient stewardship optimizes crop yield while reducing environmental impact. This partnership is locally led by host farmers, County Farm Bureaus and FS Member Companies as they work together to find local answers to issues surrounding nutrient management and the protection of water quality in our state.

About GROWMARK:

GROWMARK is an agricultural cooperative with annual sales of \$8.7 billion (FY 2015 data) providing agronomy, energy, facility planning, and logistics products and services, as well as grain marketing and risk management services in more than 40 states and Ontario, Canada. GROWMARK owns the FS trademark, which is used by affiliated member cooperatives. More information is available at <u>www.fssystem.com</u> or <u>www.growmark.com</u>.

About Illinois Farm Bureau:

The Illinois Farm Bureau is a member of the American Farm Bureau Federation, a national organization of farmers and ranchers. Founded in 1916, IFB is a non-profit, membership organization directed by farmers who join through their county Farm Bureau. IFB has a total membership of more than 400,000 and a voting membership of more than 82,000. IFB represents three out of four Illinois farmers.

Endnotes

- 1. Brian Roe, "Lake Erie Algae: Views of Ohioans on Causes and Solutions Pre- and Post-Toledo," news release, The Ohio State University, January 22, 2015.
- 2. http://chesapeakebay.net/issues/agriculture
- 3. "Chesapeake Bay Water Quality Improving," press release, Chesapeake Bay Program, September 21, 2016.
- 4. "The Floods' Lingering Effects: New Study Shows Gulf'Dead Zone' One of the Largest On Record," The Nature Conservancy, August 2015.
- 5. National Oceanic and Atmospheric Administration, "Gulf of Mexico 'dead zone' is the largest ever measured," http:// www.noaa.gov, August 2, 2017 press release, accessed August, 2017
- 6. "The Waters of the United States (WOTUS) Rule: What It Is and Why It's Important," Audubon Society, March 1, 2017.
- 7. Joel Pollack, Breibart.com, March 2, 2017.
- 8. "The Concept of Sustainable Development" in http://www.un-documents.net/ocf-02.htm#l, accessed April, 2017.
- 9. General Mills, Global Responsibility 2017, http://www.globalresponsibility.generalmills.com, accessed July, 2017.
- 10. Walmart "Walmart Launches Project Gigaton to Reduce Emissions in Company's Supply Chain", http://www.news. walmart.com, accessed July, 2017.
- M.T. Kennedy, and C.F.Fiss, "Institutionalization, Framing and Diffusion: The Logic of TQM Adoption and 11. Implementation Decisions Among U.S. Hospitals," Academy of Management Journal 52 (2009): 897-918.