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Practitioner's Perspective

Developments in Midwestern Precision Conservation

Clay Bess

Farmers in Illinois and other states in the Mississippi River valley are facing potential regulation due to excess nutrients and sediments that are lost from agricultural fields and, eventually, flow into the Gulf of Mexico. In 2015, the Illinois Department of Agriculture and the Illinois Environmental Protection Agency, together with a multistakeholder working group, developed the Illinois Nutrient Loss Reduction Strategy (NLRS) to address urban and rural nutrient losses from both point and nonpoint sources within the state (IDA 2015); only five more growing seasons remain to meet the interim goals set by the state's NLRS plan. The final goals of 45% reduction of total nitrogen (N) and total phosphorus are set for 2035. Planting cover crops, reducing tillage, and reassessing fertilizer applications are scenarios backed by NLRS research to reach these goals. Farmers stand at the crossroads, weighing their options—their decisions affecting not just their own destinies, but the lives and livelihoods of farmers who have not even been born yet. Their decisions will literally shape what it means to be a farmer, to work in agriculture, or even to live in a rural community for future generations. *Sustainability*, *regenerative agriculture*, and *soil health* are the current buzzwords used to describe the practices that many in the nonfarming community hope growers will incorporate into their production management practices. From a farmer perspective, however, the most important factors are the most difficult to capture: "What's it going to cost me?" and "When will I see a return?" This farmer focus is the essence of the Illinois Corn Growers program, Precision

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Conservation Management (PCM), which was established to address the NLRS requirements (ICGA 2018).

PCM gathers actual on-farm agronomic data, pairs it with economic analysis from the long-standing farm financial program, Farm Business Farm Management (http://www.fbfm.org/who.asp), and delivers the personalized, individualized results to growers for them to understand how various conservation practices are likely to impact their financial bottom line as well as how they are likely to address the farmer's conservation concerns. The goal of PCM is to increase conservation practices while providing a financial risk understanding for the Midwestern farmer, who has been assigned the unenviable task of protecting local and national water quality, improving soil health, addressing climate change, and maintaining national food security. Now in their fifth year, the PCM team has exceeded their own expectations, along with the expectations of cooperating farmers.

Conventional wisdom has held that producing more crop yield would produce a higher profit. This mindset emphasized smooth fields for the tractor to get across in less time and to maximize the likelihood of plant emergence. It emphasized clean fields to minimize competition of "weeds" (certain cover crop species being lumped in here). Additionally, it emphasized the perceived importance of not letting nutrients (especially N) be the limiting factor for crops—creating the "more is better" paradigm that results in over-application of nutrients and decreasing nutrient use efficiency. When commodity markets were great (only falling behind for small grains, which quickly left the typical farmscape), these ideologies ruled for corn and soybeans. Dad did it that way, just like grandpa, and great-grandpa. Now things have changed, and the son or daughter is stuck between family convention and family legacy. This adherence to convention has created an environment resistant to the kinds of changes required to meet the goals of the NLRS.

The word *sustainability* may refer to the environmental aspect for most, but for farmers, it means staying in business. It means sustaining the financial success of the farm to keep it there for generations to come. That is the driving factor to pinch every penny and assess each trip through the field. Still, just getting by in the comfort zone is more attractive than adding risk when adopting a new conservation practice. But what if conservation could improve the farm's bottom line? And what if, over time, conservation could minimize risk? That is where PCM plays a role.

PCM separates each practice into standards:

- Tillage: no-till, strip-till, 1-pass light/heavy, 2-pass light/medium/heavy, and 2+ passes.

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- Nitrogen application: greater than 40% fall, mostly preplant, mostly sidedress, 50% preplant/50% sidedress, and three-way split.
- Cover crops: over-wintering, winter terminal, and no cover crops.
- Expenses to calculate bottom lines: fertilizer, pesticides, seed, drying, storage, field work, harvesting, and machine hire/application cost.

PCM farmers are starting to implement conservation based on the financial data that the program provides and the technical assistance that PCM specialists offer to farmers for planning and program enrollment. Of the farmers on highly productive soils in PCM-Illinois (Soil Productivity Rating [SPR] of "high" is a score of 136 or higher [University of Illinois 2000a, 2000b]), the most profitable farmers applied 0.5 kg (1 lb) of N for every 25 kg (1 bu) of corn produced or less (table 1; ICGA 2018). This has been seen consistently every year in the PCM dataset. Another finding regarding N is the timing of application. Those who applied more than 40% of their N in the fall, regardless of type and including N contained in monoammonium phosphate (MAP) and/or diammonium phosphate (DAP), have a nonland net return that is \$32 ha^{-1} (\$13 ac^{-1}) lower than the next closest PCM class (50%/50% sidedress) and \$109 ha^{-1} (\$44 ac^{-1}) below the most profitable class, which is a mostly preplant system (table 1; ICGA 2018). These increased returns with in-season N applications are convincing PCM farmers to move more N application to the spring or summer, even though it sometimes creates challenges logistically. Farmers are accepting the risk of not having fertilizer applied at an exact time or the conventional time because data prove a spring/in-season system is ultimately more profitable. During the individual visit between a conservation specialist and farmer, PCM may frame the conversation as follows: "Field A has consistently been your worst producing corn field for the past four years. Since you have told me that there are no issues like drainage problems, it is time to consider changing the rate of nitrogen to be closer to the one-to-one ratio of nitrogen to yield, since that is the strategy that we are seeing as most profitable throughout the program on ground similar to yours."

These conversations have led to decreased rates of N applications on lower-producing fields and have even led to higher rates of applied N on better-producing fields, but always with the objective of improving N use efficiency. This strategy also forces farmers to become precise in their thinking about management goals and plan each field on its own. PCM understands that cover crops and no-till are not going to work on every acre. However, if we and the farmer can understand which field has the best chance for success, then that becomes the field to use for greater exploration of a new

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Table 1

Economic returns resulting from various nitrogen (N) fertilizer management strategies for corn production in central Illinois from 2015 to 2019 (ICGA 2020).

Illinois corn, 2015 to 2019 high SPR	Mostly fall	Mostly preplant	Mostly sidedress	50% preplant/ 50% sidedress	3-way split
Average NUE (lb N bu^{-1} grain)	1.01	0.93	0.92	0.91	0.94
Yield (bu ac^{-1})	219	218	220	221	230
Fields (*n*)	732	492	612	228	52
Gross revenue ($)	**789**	**785**	**791**	**793**	**827**
N fertilizer($)	84	78	76	84	95
Other direct costs ($)*	320	286	307	311	338
Total direct costs ($)	**404**	**364**	**383**	**395**	**433**
Field work ($)	16	16	16	18	19
Other power costs ($)**	97	89	94	95	93
Total power costs ($)	**113**	**105**	**110**	**113**	**112**
Overhead costs ($)	**37**	**37**	**37**	**37**	**37**
Total nonland costs ($)	**554**	**506**	**529**	**545**	**582**
Operator and land return ($)	**235**	**279**	**261**	**248**	**246**

Notes: SPR = Soil Productivity Rating. NUE = nitrogen use efficiency. Mostly fall = >40% of total N application rate applied in fall. Mostly preplant = more than 50% of total N applied at or before planting in spring. Mostly sidedress = more than 50% of total N applied after planting. 50% preplant/50% sidedress = total N application is split roughly evenly between preplant and sidedress. 3-way split = <40% total N is fall-applied and balance is roughly evenly applied between preplant/sidedress.

***Direct costs include fertilizers, pesticides, cover crop seed, drying, storage, and crop insurance.**

****Other power costs include fall fertilizer application, spraying, planting, cover crop planting, spring/in-season fertilizer application, harvesting, and grain hauling.**

technology while accepting the least risk possible. That is how PCM is delivering precision conservation.

Another PCM practice standard, tillage, demonstrates the most profitable classes of tillage prior to planting corn and soybeans on high SPR soil (figure

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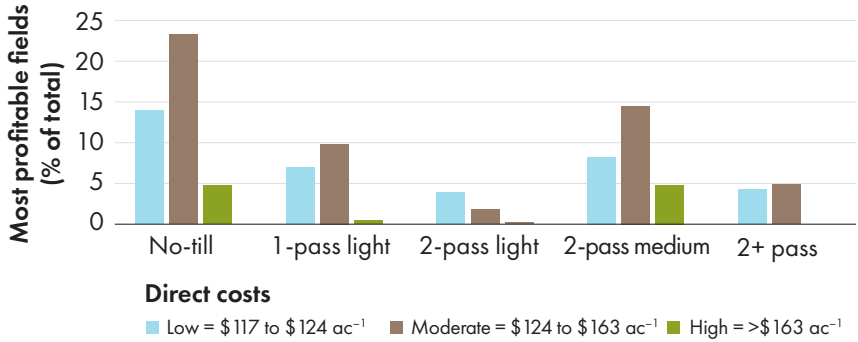
Figure 1

Most profitable soybean, high Soil Productivity Rating (SPR), tillage and direct cost classes, 2015 to 2019 (ICGA 2020).



1). Of the most profitable corn fields grown between 2015 and 2019, 1-pass light was the tillage system used on 35% of those fields (ICGA 2018). For the most profitable soybean fields in the same timeframe, no-till was the most common tillage practice on nearly 41% of fields. The other interesting metric regarding this breakdown of soybean fields was that farmers who were able to keep their direct costs between $306 and $403 ha^{-1} ($124 and $163 ac^{-1}) were the most profitable for all tillage systems. Using this data, PCM specialists helped influence and build the confidence of farmers to back down from a conventional tillage system. Given the supporting data, farmers are revising tillage systems toward less-intensive, more conservation focused practices.

A dataset on using cover crops is still being built. In the east-central region of Illinois (Champaign, Coles, Douglas, Edgar, Ford, and Vermilion counties), cover crops ahead of soybeans on low SPR soils produced a better soybean yield in 2019 and only fell a few dollars short on the bottom line relative to soybean crops produced without a cover crop. In all other instances, however, the nonland net financial return for a cover crop system fell far short of a system without cover crops (high SPR, low SPR for soybeans, over-wintering, and winter-kill), even though corn following a winter-kill species (i.e. oats, radishes) resulted in a better yield.

Partnership has become a catch phrase thrown around almost as frequently as *sustainable* and *regenerative* in today's socially tuned vernacular. Whether it be farmer-to-farmer networks; farmers participating in ecosystem service markets; or corporations, conservation groups, and agriculture programs teaming together, the prospect of diverse groups sitting at the same table engaging support from around the web offers exciting new possibilities to increase conservation practices and avoid agricultural regulation. When

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effective conservation practices, such as cover crops, do not result in a bottom line that breaks even, it may be partnerships that can provide the incentive to put the practice on-farm without burying the farmer in risk.

In this way, when PepsiCo offered a \$24 ha^{-1} (\$10 ac^{-1}) cover crop cost-share and PCM consulted their supply chain growers, 63 farmers planted 5,232 ha (12,929 ac) of cover crops (9% of total area farmed), which is triple what the cost-share could cover. When strip-till ahead of corn has consistently been financially reliable in most PCM regions, but the cost of the equipment and additional labor has increased risk, PCM was able to provide a custom strip-till operator who would provide the service for farmers to simply test the practice on their land. PCM partners with Field-to-Market to provide sustainability metrics for farmers to gauge where they rank compared to their neighbors and make improvements on topics such as soil conservation and energy use. A similar metric, carbon sequestration, has provided the incentive for a new pilot partnership between PCM and the Ecosystem Services Marketing Consortium to be unveiled this year. State and local programs are offered through the US Department of Agriculture Natural Resources Conservation Service and county soil and water conservation districts, both of which partner with PCM to identify farmers interested in taking advantage of opportunities to address natural resource concerns or try out new conservation practices at reduced costs. These programs and partnerships are how the agriculture community will move forward. The data from multiple on-farm sites and one-on-one consultation are how PCM is successfully delivering precision conservation.

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