10-2020

Engaging Farmers and the Agriculture Industry Through the Testing Agricultural Performance Solutions Program

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Journal of Extension

Volume 58 | Number 5 Article 13

October 2020

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Journal of Extension
www.joe.org

October 2020
Volume 58
Number 5
Article #v58-5a3
Feature

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Abstract

The University of Nebraska–Lincoln Testing Agricultural Performance Solutions (TAPS) program involves use of farm management competitions to increase engagement across producers, industry, and universities. Participants make several management decisions throughout the growing season in a controlled field trial held at the university research station. Results are analyzed, and awards are presented for most profitable farm, most efficient farm, and farm with the greatest grain yield. The TAPS program involves several techniques for facilitating participatory assistance, including two-way communication and transformational learning. It has resulted in participants' questioning their past management decisions and realizing that they need to improve their marketing skills to improve profitability.

Keywords: farm management, competition, transformational learning

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Introduction

The world is a much different place than when Cooperative Extension began to deliver research-based information to local farmers. Extension began as a top-down process (i.e., one-way communication) wherein scientists developed answers to pertinent questions and Extension staff delivered them to end users (Vanclay & Lawrence, 1994). Shroyer and Sullins (1993) described traditional Extension as on-farm demonstrations. However, an increased desire for two-way communication between Extension and end users was evident through the expansion of on-farm research. Shroyer and Sullins (1993) described this type of study as action research in which farmers' suggestions, observations, and conclusions are incorporated into the management solutions tested by scientists. Norman et al. (1994) described the addition of on-farm research to traditional research as a continuum rather than a substitute. Overall, farmers have evolved into very astute innovators capable of conducting applied research.

Extension programming has developed into a farmer-centered participatory assistance process for determining technical knowledge needed for adoption of an innovation (Lanyon, 1994). Lanyon (1994) described participatory assistance as a series of repetitive experiences by a farmer during research, development, and

implementation. As Vanclay and Lawrence (1994) explained, the lack of adoption of research findings by farmers, what Extension personnel might call best management practices, is part of the disconnect in the traditional Extension programming model. This circumstance is evident in the 2018 Census of Ag Irrigation Survey, which showed that only 31% of Nebraska irrigators used soil moisture monitoring to schedule irrigations whereas 48% used the older and less accurate method of determining hand feel of soil water.

It was these challenges that led to creation of the University of Nebraska–Lincoln (UNL) Testing Agricultural Performance Solutions (TAPS) education and extension program. Faculty at the West Central Research, Extension, and Education Center (WCREEC), including members of our author team, in cooperation with members of the Nebraska Water Balance Alliance conceptualized, planned, and implemented the program.

TAPS Creation and Overview

We established the TAPS program in 2017 at the WCREEC, which is in North Platte, Nebraska. Although the TAPS program is ongoing and expanding, we have chosen to focus herein on the first 2 years of the project. The two primary agricultural production challenges in the area were and continue to be limited water resources and increasing levels of nitrate in the groundwater. In addition, crop prices at the time were at economically challenging levels for agricultural producers. To address the aforementioned issues, our TAPS team focused on profitability and input use efficiency when developing the TAPS program. Primary goals of the program were to

- increase adoption of practices to reduce cost of production,
- increase use of marketing tools to improve profitability, and
- increase adoption of best management practices to improve water and nitrogen efficiency.

With the many challenges related to agricultural production, a deeper level of engagement among stakeholders was needed. Thus, we designed the program to incorporate and engage agricultural researchers, technology providers, and industry personnel along with farmers. UNL's TAPS team and research technicians formed the foundation of the program, and the TAPS program was hosted at UNL facilities. The land-grant structure allowed for the oversight and neutrality needed to maintain a safe environment for producers, researchers, and industry suppliers to innovate, develop, test, learn about, and adopt new technologies; try new management practices and techniques; and make needed adjustments to achieve efficient, environmentally responsible, and profitable production of a crop. Furthermore, inclusion of local businesspersons, technology providers, farmers, and researchers in the program allowed a learning community to develop (Krasney & Doyle, 2002).

The TAPS program engages this learning community via farm management competitions held at research sites such as the WCREEC. Unlike with a simple yield contest where competitors' costs and revenues are ignored, the objectives of the TAPS farm management competitions relate directly to real farm management and the relationships of resource allocation to profitability and sustainability. The competitions occur in real time and include information regarding field conditions, market conditions, and regulatory constraints. Also unique to TAPS is the communication among participants, technology providers, and the university. As part of their participation, competitors use a web-based portal to access new and emerging technologies such as aerial imagery and sensor data for their specific plots at the research site. Several opportunities for stakeholders to

meet and discuss outcomes and challenges and to share their experiences are a large part of the program. Communication, learning, and innovation are enhanced through continuous communication and direct yearlong interaction among those involved in the program as well as through sharing of the competition results and findings via publications, presentations, and news media outlets.

The TAPS design used during the program's first 2 years had many benefits:

- University researchers and Extension professionals competed against growers, using UNL recommendations. This scenario provided the opportunity for the university to prove research results and earn credibility.

- Farmers were able to use new and emerging methods and tools. This opportunity provided participants a safe place to familiarize themselves with and test technologies, systems, and methods. Such experience can lead to increased adoption of innovations, reduced risk, and increased productivity.

- Industry personnel became observers of application of their technologies and associated interactions, leading to clearer understanding and further development of their products.

- Other stakeholders, including those involved in regulation or advocacy, were able to participate and observe firsthand grower responses to various issues, such as changes in irrigation water value or availability, nitrogen fertilizer limitation, and so forth.

Participants

The TAPS program is based on a competitive model whereby participants (individuals and/or groups) compete in the management, production, and marketing of a crop. In other words, we host farm management competitions in which teams compete for specific awards and through the process are exposed to new technologies and experiences that will lead to efficient and profitable agricultural production. In the first year of the program, UNL Extension and/or Nebraska Natural Resource Districts personnel recruited participants. In the second year, and subsequent years, prior participants recruited others to compete, or individuals volunteered to compete after learning about the program through various media outlets. Although most participants in those first 2 years were farmers, student groups and state/local agencies also competed. Past TAPS participants are identified at http://taps.unl.edu.

Contest Outline

In the first 2 years, each competition occurred on a single field (i.e., all teams within a competition had plots randomized within the same field at the university research site) to reduce variation in soil and weather conditions across the competitor sites, a factor that is often observed in on-farm research comparisons. In addition, this approach allowed for an experimental environment where statistical inferences were possible. The university's specialists and educators were treated as any other competitor; however, to prevent any claims of favoritism or biased accounting, they were not eligible to win awards. Although the actual land area for the competition was limited to three plots (three replications) per team, each team's plots were amplified on paper to represent a 3,000-ac or 1,000-ac harvested farm depending on the competition. All field operation and equipment costs were held the same for each team within a competition. The farm sizes we used were adequate for showing the impact of minor differences in management and sufficient quantities of grain to

market.

TAPS Competition Management Decisions

Participants in the first and second years had control over six elements of farming operations/decisions:

- **Crop Insurance.** Participants were able to select any of the major types of yield and/or revenue protection crop insurance, including supplemental hail and wind damage insurance. The area covered by crop insurance and/or damage included five fields in close proximity to the competition site. Crop damage reports on these fields were used to determine yield loss and indemnity claims.

- **Hybrid and Seeding Rate.** Soil samples were collected and sent to a commercial laboratory for analysis, with the resulting data provided to participants. Each team selected a hybrid and seeding rate for their farm (plots). A precision planter sowed the seeds at the rate selected by the team. Cost information was obtained from the selected seed companies' district sales managers. A team's cost per acre was determined according to planting population, per-acre equipment costs, and seed costs. Seed costs were adjusted for early season purchase and the appropriate volume discounts based on the size of the simulated farm.

- **Grain Marketing.** Five marketing methods were available for competitors to use to market their grain production from mid-March to mid-November; these were cash sales, forward contract, basis contract, simple hedge to arrive, and futures contracts. All sales or purchases of contracts were required to be time stamped within 24 hr through use of the online form submission portal at the TAPS website (http://taps.unl.edu). This setup provided adequate information for validating each transaction. Any grain not priced by each participant by the marketing deadline (e.g., November 15) was "sold" at the local North Platte, Nebraska, grain elevator at the cash price.

- **Irrigation Scheduling.** Each team had the opportunity to apply 0 to 1 in. of water twice a week throughout the growing season. Doing so required accessing a form through the TAPS website and submitting it by 10 a.m. Monday and/or Thursday prior to the requested irrigation application. A proportional amount of irrigation water was applied during scheduled fertigation operations at a maximum rate of 0.30 in. with 30 lb of nitrogen in the form of urea ammonium nitrate (UAN) 32%. The variable cost to pump an acre-inch of water was $7.80.

- **Nitrogen Application.** Participants were given the opportunity to decide on nitrogen application scheduling and amounts. Nitrogen fertilizer was applied in the form of UAN 32% with opportunities for application using three methods: (a) preplant, (b) side-dress, and (c) fertigation. Participants could choose to apply nitrogen using any number of applications and could choose the amount applied during each application. Preplant and side-dress applications allowed up to 120 lb of nitrogen per acre. The four fertigation application options (V9, V12, VT/R1, and R2 growth stages) allowed up to 30 lb per acre per application.

All other production and management decisions (i.e., those related to pesticide use, tillage, residue management) were the same for all plots. WCREEC staff and employees conducted physical management of the plots, including machinery and irrigation system operation, application of chemicals, and harvesting. Participants were provided soil water data from a capacitance probe installed in one of their three replicated plots. In addition, aerial and satellite imagery, weather station data, plant growth parameters, and other data

sources/information were provided to all participants to help in the management of their plots.

Description of Awards

The participants competed for three awards:

- most profitable farm,
- highest input use efficiency, and
- greatest grain yield.

The most significant award was established for the most profitable farm to emphasize that profit is one of the primary drivers in the business of farming and that without it, sustainability is unlikely. The TAPS team determined profitability by calculating the difference of revenue (income) minus costs (expenses). Revenue was determined according to each team's grain sales, quantity of production, and insurance indemnity payments. The Nebraska Crop Budgets for irrigated corn production were used to estimate a typical machinery complement, a set of crop inputs, and land expenses (rent or return on investment) in the calculation of profitability. However, costs for harvest, irrigation, grain drying, hauling, and fertilizer were adjusted to yields and use in the competition.

For the highest input use efficiency award, we used the Water × Nitrogen Intensification Performance Index (Lo et al., 2019).

The award for greatest grain yield was initially called into question in that yield should not be a primary goal of crop production. However, further discussion revealed that greatest grain yield was too important to ignore and that the opportunity to discover and learn about the yield-to-profit and yield-to-efficiency relationships was too great to neglect.

Timeline

During the first 2 years, the TAPS farm management competitions began with a kickoff meeting in March of the respective year. Participants were provided a project description and introduced to the TAPS webpage. Participants were required to submit their crop insurance decision by the end of March and their hybrid selection, seeding rate, and preplant nitrogen decisions by mid-April. Subsequent nitrogen, irrigation, and marketing decisions were made throughout the growing season. Marketing was closed mid-November, and the awards banquet occurred in mid-December. Two major education and engagement events occurred during the growing season. The first was a field tour held in June, where participants could view their plots and reflect on their management decisions to date. The second was the annual August Water and Crops Field Day, which included a TAPS update, a participant panel discussion, and an industry fair of the latest technology and services in crop production.

Results and Impact

TAPS Competition Results

Selected results from the 2018 corn farm management competition held at the WCREEC are shown in Table 1.

The wide range in profitability showed that there were improvements to be made by reducing input costs and improving marketing strategies. Furthermore, the results showed that several contestants had similar yields with varying levels of irrigation and nitrogen fertilizer amounts, highlighting the importance of efficiency and cost of production concepts. Farm 12 served as a control plot with no irrigation or nitrogen applied. Several key takeaways have resulted from the competitions. The winners of the award for highest input use efficiency in the first 2 years (2017 and 2018) had the highest and second highest yields, respectively. Price received and marketing proved to be one of the key drivers of profitability. Most teams that achieved a significant profit did some forward contracting or sold on the futures market during the growing season.

Table 1.

Sample Results and Selected Inputs for the 2018 Testing Agricultural Performance Solutions (TAPS) Corn Farm Management Competition

Farm #	Nitrogen, lb/ac	Irrigation, in.	Yield, bu/ac	Efficiency rank	Profit, $/ac
1	210	11.7	275	16	179
2	200	8.0	256	14	227
3	190	9.2	262	12	185
4	215	5.6	249	15	205
5	180	9.0	247	18	149
6	165	5.1	234	13	159
7	200	9.6	289	6	276
8	205	6.0	241	19	133
9	225	6.6	270	11	201
10	195	8.2	274	8	215
11	180	6.6	257	9	186
12	0	0.0	138	N/A	N/A
13	140	6.2	258	2	278
14	190	4.6	261	5	217
15	195	4.7	279	1	261
16	155	9.1	240	17	161
17	130	1.1	222	3	138
18	175	9.7	264	10	232
19	190	5.0	256	7	176
20	200	5.3	272	4	195

Note. The TAPS competition was held at the University of Nebraska–Lincoln West Central Research, Extension, and Education Center in North Platte, Nebraska.

Several journalists attended the TAPS educational events and provided positive feedback and media coverage. One media outlet represented was a regional publication, *Nebraska Farmer*, which printed several stories after staff interviewed participants and contest award winners. In addition to these media releases, social media

posts and stories, including in UNL's *CropWatch* newsletter and Cornhusker Economics website, were completed, all of which contributed to sharing the successes of the TAPS program.

Participant Survey Results

Preliminary impacts were documented through two tools: a follow-up survey with the participants after competing and an awards banquet participant survey.

Follow-Up Survey

After the competition, participants were given a written survey to complete. The survey focused on the TAPS program in general and on possible changes in thinking or behavior. The survey results indicated that 39% of the participants were recruited by UNL, 33% by a friend, and the remaining 28% in some other way. Thirty-four percent of the participants joined TAPS to learn from other competitors, 31% to test new technology, 14% to help someone who asked them to participate, and the remaining 21% for other reasons. Seventy-seven percent of participants found that TAPS met or exceeded their expectations. Seventy-four percent of the competitors indicated that if asked by a neighbor about TAPS they would rate it as being a great program, and 26% indicated that they would rate it as good. The remaining portion of the survey documented changes in thinking or behaviors. Findings regarding respondents' greater likelihood of taking certain actions are as follows:

- 73.5% were more likely to look for more early or preharvest sales of their crops;
- 73.5% were more likely to use the futures market in some way;
- 67.6% were more likely to use soil water status as measured by technology to schedule irrigation; and
- 67.6% were more likely to use soil analysis for determining the amount of nitrogen fertilizer to apply.

Respondents also provided additional comments. Examples are as follows:

- On participant said, "I've really learned a lot by participating in the UNL-TAPS competition. There were a lot of really cool tools at our disposal and we had the opportunity to see if they can add value to our operation without risk."
- Another participant stated that looking at the results had made him "question every management decision" he had ever made on his own operation.
- A 2017 participant who admitted having conducted no marketing during the growing season on his own operation proclaimed that he had already forward contracted grain for his operation for 2018.

Banquet Participant Survey

Among banquet participant survey respondents, 89% indicated high agreement with the statement that they

had been rewarded for their invested efforts and participation in the program. Additionally, 89% indicated high agreement with the statement that having ag technology and service providers involved in the competition added positively to the experience. Overall, findings suggested that the TAPS program increased stakeholder engagement and interest, making it another tool in the university's arsenal for fulfilling its land-grant objectives.

Growth of Program

The TAPS competition began with 15 teams comprising 18 contestants in a single competition in 2017. The program expanded, not only with other competitions, but also in number of participants. In 2019, the TAPS program hosted five competitions in two states, using three crops and two irrigation application methods. Fifty-eight teams comprising 160 individuals competed in those events.

Conclusion

We submit the TAPS model of hosting farm management competitions as a new method of Extension programming. The TAPS farm management competition model included several of the 10 steps outlined by Franz (2007) and originally referenced by Mezirow (2000) in the process of transformative learning. Notably, several participants experienced a disorienting dilemma when they realized that their performance was less than expected compared to their peers. This caused them to undergo a self-examination of their decisions and has caused them to look more critically at how they are running their own operations. The process of engaging with other participants and university and industry partners further encouraged them to consider potential changes in their management strategies. Complete results can be found at the TAPS website: http://taps.unl.edu.

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