CHAPTER 9

Linking On-Farm Extension Research Field Trials to Outreach

MICHIGAN'S THUMB AG RESEARCH & EDUCATION CASE STUDY

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Introduction

Farmers want nonbiased information from local sources regarding field crops they grow. While there are many different sources of information, such as seed, chemical, and agribusiness company trials, replicated evidence-based testing trials that are analyzed for significant differences provide a trusted resource they can use to make management decisions.

Michigan State University (MSU) Extension has used organized teams to provide integrated educational outreach, research, and teaching to reach public leaders and groups (Leholm & Vlasin, 2006). One of the MSU Extension teams in agriculture is the Field Crops Team. The team members include MSU specialists and educators who work with commodity crops such as corn , soybeans, wheat, forages, and dry edible beans, as well as farm management. Educator team members have historically been housed in county-based offices throughout the state of Michigan. Each educator covers multiple counties with varying areas of expertise such as forages, corn and soybeans, or wheat.

The goal of the Extension service is not only to conduct unbiased research but also to disseminate the results. For Extension clientele to be satisfied with their service, the research must be relevant to the local famers and the information must be current and accurate. Extension educators must assess and respond to the needs of the farmers as well as evaluate the programs they perform (Terry & Israel, 2004). One way to provide relevant information to farmers is to bring the information to them by providing in-person programs in their county (Galindo-Gonzalez et al., 2008).

Challenges occur on how to diffuse or increase the outreach of MSU Extension programming. Diffusion is the process through which an innovation is communicated through certain channels over time among the members of a social system (Dearing & Kee, 2012). In 2006, MSU Extension Field Crops Team members in the Thumb Region of Michigan (see Figure

9-1) saw an opportunity to collaborate in a new programming effort to increase diffusion.

Figure 9-1. Michigan Thumb regional team brochure.

The program, Thumb Ag Research and Education (TARE) (see Figure 9-2), took place for 10 years. The TARE project focused on generating and disseminating educational information for field crop producers based on locally generated field research and demonstrations. The program enhanced the outreach of MSU Extension, its Field Crops Team, and regional team members by providing results from evidence-based, on-farm research trials and programs to farmers and agribusiness professionals to increase production efficiency and increase profitability. In addition, educators increased technical capacity in their field of expertise by direct experience with growing and harvesting a commodity crop. The self-directed regional team of field crops educators included educators whose areas of expertise each contributed to a diverse cross section of crops from the area. Team members were highly engaged in the generation of information through field research and demonstrations in partnership with agribusinesses and farmer plot cooperators. The educators had expertise in corn, soybeans, wheat, nutrient management, farm resources management, and forages.

The TARE Program became a trusted resource that featured local farmers and agribusinesses in the same area as the farmers. The information was locally disseminated to other farmers, agribusinesses, and government agencies in the region.

To some extent, the project gained more positive response than originally anticipated. In part, this was due to an appreciation for the replicated, evidence-based, technical information that was locally generated. At the same time, it was evident that MSU Extension educators gained valuable technical experience and received positive recognition and acceptance from

farmers and agribusinesses stemming from the high-profile engagement and commitment required for carrying out the project.

In Michigan's Thumb region, agriculture is one of the primary businesses and hosts 21% of the state's farms. Corn, soybeans, wheat, forages, sugar beets, and edible beans represent the majority of crops grown (see Table 9-1) in the Thumb region. These crops also support a thriving livestock industry, primarily dairy, in the region.

Figure 9-2. TARE (Thumb Ag Research & Education) program graphic.

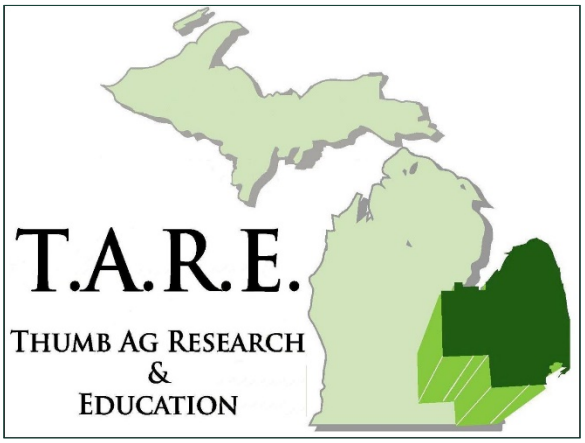


Table 9-1. Hectares of commodity crops harvested in Michigan and its Thumb Region according to the 2017 U.S. Agriculture Census.

Hectares Harvested	Michigan	Thumb Region	Percentage of State Total
Hay and Haylage	408,567	63,035	15
Soybeans	1,006,614	325,847	32
Wheat	197,091	92,074	47
Corn Grain	877,460	228,357	26
Corn Silage	134,008	27,355	20
Total	**2,623,740**	**736,667**	**28**

Note. According to the U.S. Agriculture Census, there were 47,641 farm operations in Michigan in 2017. Of those, 9,971 (21%) were in the state's Thumb Region.

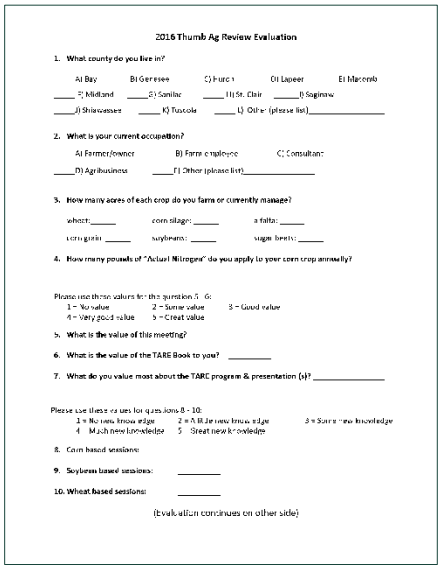
This chapter will discuss the process, funding, opportunities and challenges, results, and lessons learned from the TARE Program. Each element of the discussion has unique facets that helped guide the TARE educators in their decision-making progress and contributed to its success. The process included an annual needs assessment with an advisory committee composed of local field crops producers and agribusiness personnel. The opportunities and challenges of the program were addressed annually, and the advisory board provided guidance that increased the overall effectiveness. The results of the program were distributed and evaluated annually. The outreach efforts included the research trial report and winter meetings in the region for clientele following each growing season. The results were also disseminated through news articles, MSU websites, emails, and printed media (https://www.canr.msu.edu/tare_variety_trials/.)

Educators presented the results of their field research to farmers, agribusiness professionals, and government agency personnel in December at grower programs following harvest at locations in the region, which were convenient for farmers (see Figure 9-3).

Figure 9-3. Thumb Ag Review grower program where TARE (Thumb Ag Research & Education) educators presented growing season results. (Photo by Bob Battel)

Educators used Microsoft PowerPoint presentations referencing the research trials report. Producers were asked to complete a post-session evaluation to document knowledge gained and effectiveness of the materials. They were also asked for suggested areas of future research (see Figure 9-4).

Figure 9-4. Thumbnail views of the 2016 Thumb Ag Review post-session evaluation.



2016 Thumb Ag Review Evaluation

1. What county do you live in?

A) Bay B) Genesee C) Huron D) Lapeer E) Macomb

F) Midland G) Sanilac H) St. Clair I) Saginaw

J) Shiawassee K) Tuscola L) Other (please list)_____

2. What is your current occupation?

A) Farmer/owner B) Farm employee C) Consultant

D) Agribusiness E) Other (please list)_____

3. How many acres of each crop do you farm or currently manage?

wheat:_____ corn silage: _____ alfalfa: _____

corn grain: _____ soybeans: _____ sugar beets: _____

4. How many pounds of "Actual Nitrogen" do you apply to your corn crop annually?

Please use these values for this question 5 - 6:

1 = No value 2 = Some value 3 = Good value

4 = Very good value 5 = Great value

5. What is the value of this meeting?

6. What is the value of the TARE Book to you? _____

7. What do you value most about the TARE program & presentation (s)? _____

Please use these values for questions 8 - 10:

1 = No new knowledge 2 = A little new knowledge 3 = Some new knowledge

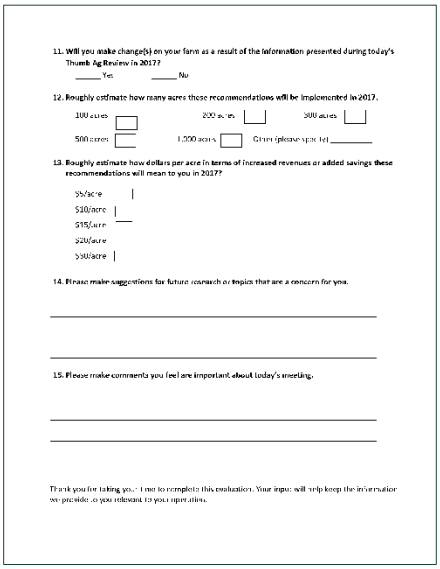
4 = Much new knowledge 5 = Great new knowledge

8. Corn based sessions:

9. Soybean based sessions: _____

10. Wheat based sessions: _____

(Evaluation continues on other side)



11. Will you make change(s) on your farm as a result of the information presented during today's Thumb Ag Review in 2017?

_____ Yes _____ No

12. Roughly estimate how many acres these recommendations will be implemented in 2017.

100 acres ☐ 200 acres ☐ 300 acres ☐

500 acres ☐ 1,000 acres ☐ Other (please specify) _____

13. Roughly estimate how dollars per acre in terms of increased revenues or added savings these recommendations will mean to you in 2017?

$5/acre

$10/acre

$15/acre

$20/acre

$30/acre

14. Please make suggestions for future research or topics that are a concern for you.

15. Please make comments you feel are important about today's meeting.

Thank you for taking your time to complete this evaluation. Your input will help keep the information we provide to you relevant to your operations.

Process

During the initial concept meeting held by the TARE educators, there was a unanimous decision to have a multi-county approach for evaluation of corn hybrid and soybean varieties and verify the effectiveness of other production practices and agricultural input products through replicated field trials. Corn and soybeans are the two major commodity crops grown in

Michigan. As part of the planning process, it was determined that a volunteer advisory committee composed of local field crops producers and agribusiness personnel would provide input on the needed research for the program. Great care was taken to ensure the members of the advisory committee represented the major commodity groups in Michigan. This step was important since funding of the program was a major concern of all. Each of the commodities groups administer funds from a mandatory assessment for commodities grown or a checkoff program, used for research, education, market development, and new uses. Corn and soybean checkoff dollars were secured annually through a competitive grant program to support TARE. (The checkoff programs for Michigan will be discussed in the "Funding" section of this chapter.)

Each educator selected two influential producers to serve on the advisory committee for a total of 10 producers from the region. Six additional influential agribusiness representatives from the region were also selected to serve on the committee for a total of 16 in the committee. This committee had a crucial role in ensuring that the TARE educators were meeting stakeholder's research and educational needs.

While corn and soybean growers were the primary audience of this project, an important secondary audience was the agribusiness personnel involved in the sale of seed, fertilizer, pesticides, and general farm supplies. In addition to being an important audience of the project, agribusinesses were critically important partners as they participated in the fee-based variety performance trials and donated supplies or provided special services. This is consistent with university performance fee-based trials where seed companies pay an entry fee for each corn hybrid or soybean variety entered into the trial. The fees are used for operational expenses over and above the cost of any grant monies obtained.

Corn Hybrid & Soybean Trials

The backbone of the TARE Program were the corn hybrid and soybean trials. These two crops are the two largest commodities for the region, and seed represents a major portion in the annual cost of production for each crop. One of the most important management decisions corn growers make each year is selecting corn hybrids (Henninger, 2012). Before the TARE Program, MSU Extension agriculture educators conducted seed variety research and demonstration plots by asking cooperating farmers to plant the seed trials for them. Farmers perceived the seed trials as a cost, in both time and effort, and were hesitant to place a priority on planting the trials. Additional challenges associated with planting seed trials include the ability to plant in a timely manner, proper sizing of equipment, land availability, trial design, statistical analysis, and the ability to be open to all seed companies. Most often, a small cross section of companies and their hybrids and varieties would be selected for testing. Widespread testing of seed company hybrids that included every company that wanted to participate would be overwhelming to the producer. Thus, some seed companies would be excluded, thereby violating one of the core values of the Extension system, which is to be open to all. Additionally, many times early planting of plots was a low priority for farmer cooperators due to weather concerns and wanting to get their own crop planted first, and subsequently, many variety trial plots were planted late. This limited the use of a wide range of maturities and decreased potential yields.

The advisory committee prioritized research trials focusing on corn hybrid and soybean variety moisture, test weight, and yield performance. The performance of the seed combined with the cost of the seed have a large impact on profitability. Seed costs are one of the highest variable costs for farms and therefore, their performance will have a large impact on farm profitability. The seed trials under the direction of the TARE educators were viewed as an unbiased source of information. In the United States, seed companies spend large amounts of their advertising budgets on comparison plots to entice growers to their products. Seed companies have their hybrids and varieties tested in plots across their marketing area. Although the companies see this as a service when they compare corn hybrids or soybean seed, the plots are rarely planted in a design that would allow for statistical analysis. In addition, the companies may or may not include all the data from their plots to put their products in the best position. Without all the facts, farmers find it difficult to make informed decisions. The companies have a stake in their products doing well, and farmers view them as a biased source of information.

Methods

The TARE group had their own planting and harvesting equipment, which took the burden of early planting off the farmer cooperator. Educators provided seed for each of the plots that was donated by the seed companies (see Figure 9-5) and had a goal of providing cooperators with the same income per acre as the rest of the field that contained the trials.

Initially, the educators purchased a used six-row planter (see Figure 9-6) and combine. These two pieces of equipment were the most important but proved to be unreliable at times. Newer, more reliable equipment was needed. The Corn Marketing Program of Michigan provided a grant to purchase a 2144 Case IH combine with an attached HarvestMaster weigh system to record grain weight, moisture, and test weight. The cost of the Case IH combine (see Figure 9-7) was $60,000. The project equipment also needed trailers and spray equipment. Case IH, one of the primary tractor manufacturers in the United States, has a program for educational entities to use tractors at a reduced rate. The program provides equipment to the local community and improves visibility of their products. A new tractor was either rented or donated to TARE for $1 per year by the local equipment dealer to promote local research.

Figure 9-5. Inventory of donated corn hybrids by seed companies.

Figure 9-6. Six-row planter for corn and soybeans.

Figure 9-7. TARE (Thumb Ag Research & Education) combine harvesting wheat.

With rapid commercialization and adoption of autosteer technology in agriculture, GPS was purchased and used by the TARE Team. The advantages of the precision agriculture equipment include reduced operator fatigue, elimination of machinery overlaps and skips, and improved efficiency in fuel usage and planting accuracy (Mulla & Khosla, 2016). The program grew and subsequently hired a full-time technician who had skills in equipment operation and repair.

Multiple farmer cooperators agreed to allow educators to use their land to plant the trials. At the height of the program, seven corn locations and five soybean locations were planted, applied pesticides, and harvested by TARE. Seed varieties and hybrids were selected by company representatives and entered into the trials. Companies paid an entry fee for each variety or hybrid and provided enough seed for all plots. For corn, each location had three blocks of corn hybrids (120 total) grouped by maturity (early, mid, and late season). For soybeans, there were four blocks of soybean varieties (98 total) grouped by type (conventional and glyphosate resistant) and maturity (early, mid, full season). Additional agronomic trials researching products and practices to improve yield and profitability were planted within the blocks (see Figures 9-8 and 9-9). The corn (see Figure 9-10) and soybean trials were established in plots 15 feet wide and 75 to 90 feet long (0.013 ha) with four replications in a randomized complete block design. The randomized complete block design (RCBD) is a standard design for agricultural experiments in which similar experimental units are grouped into blocks or replicates. It is used to control variation in an experiment by, for example, accounting for spatial effects in field or greenhouse. The defining feature of the RCBD is that each block sees each treatment exactly once (Clewer & Scarisbrick, 2001). Additional locations were also used for wheat and forage trials.

Figure 9-8. Example of field layout for soybean variety and agronomic trials.

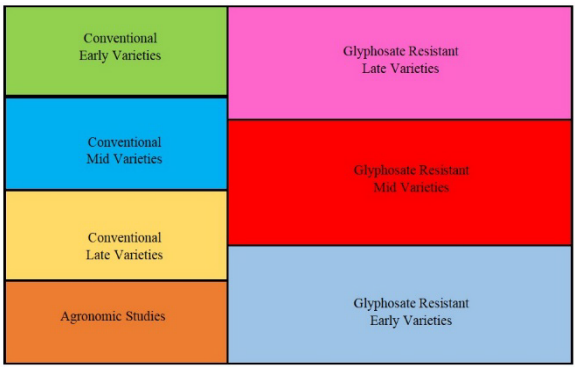


Figure 9-9. A diagram of the TARE corn trial layout.

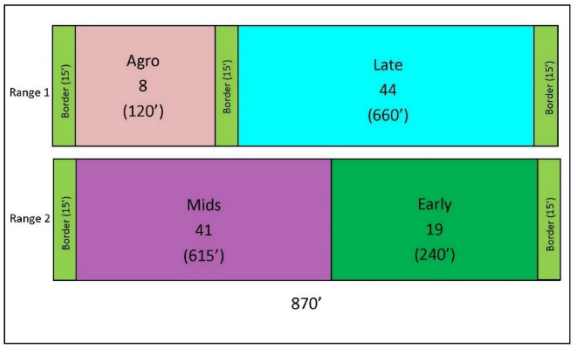


Figure 9-10. Aerial view of TARE corn trials. (Photo by Jim Vincent)

At the completion of harvest, the educators were responsible for providing statistical analysis of the data. The analysis included coefficient of variation (C.V.), a common indicator of the natural variability in an experiment expressed as a percentage. Least Significant Difference was also used to indicate when data values represent treatment differences with 95% certainty. The statistical analysis of yield data has been used by MSU Extension for many years; however, many farmers failed to understand the significance of the analysis, so an emphasis was placed on providing educational information on how to interpret the data.

The yield and moisture data provided farmers with gross income per acre that could assist them in making buying decisions for the next growing season. For example, in 2011 when comparing full season corn hybrids, the magnitude of difference between the highest and lowest corn hybrids was 59.1 bushels per acre. When you consider the average price for corn in 2011

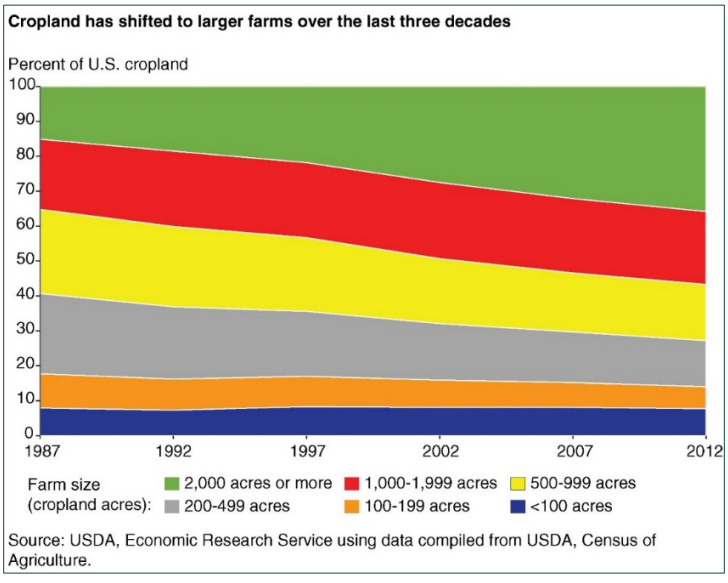
was $6.20 per bushel for the marketing year, gross income differences could have been $366.42 per acre of corn grown. These are not typical prices for corn in the United States, but show how great the value can be for picking the correct hybrid for planting.

Funding

To pay for the program, TARE was dependent on soft dollars from outside sources. The educators secured grants from the Michigan corn and soybean commodity groups. The Corn Marketing Program of Michigan is a checkoff program established by Public Act 232, 1965 as amended. Public Act 232 allows for the establishment of checkoff programs for commodities grown in Michigan and sold. Commodity checkoff programs collect funding from agricultural commodity producers and then use the money for market development, promotion, and research that will stimulate the demand for that commodity. The Michigan Soybean Promotion Committee directs the soybean checkoff. These commodity groups supplied annual funding for the duration of the program, and supplemental funding was used to purchase or update necessary equipment and hire personnel to coordinate a large-scale testing program.

Support by the seed companies was a critical component of the trials. When the seed company with the largest market share in the region withdrew from TARE, other major seed suppliers followed suit, lessening the perceived impact of the corn and soybean trials. The consequences of having a voluntary program funded by registration fees made sense to the planners of the program since there had been great support by the seed companies in the past. According to the United States Department of Agriculture, agricultural production has shifted to larger farms over the last three decades (see Figure 9-11). Additionally, technology has been the primary driver of this shift, which has been large and widespread across crop and livestock commodities. This shift in production has led to agriculture supply companies being able to capture a larger proportion of market share with fewer farms (MacDonald & Hoppe, 2017).

Figure 9-11. Percentage of U.S. cropland and farm size comparison.



The seed suppliers also have consolidated and are relying on their own research data rather than the unbiased university data from programs such as the TARE Program or university variety trials. Farms will increasingly expect and demand total solutions to their unique business problems. The fundamental issue will be whether a particular supplier provides a total system solution or only selected components of that solution (Langemeier & Boehlje, 2017).

Opportunities & Challenges

During the initial planning stages of the program, the Thumb area had five field crops educators housed in the region. Each educator had been involved with field trials in their local county or counties and had participated in a year-end program to highlight the results of their local trials. With TARE, the idea of a joint educational program brought a sense of excitement to the work. Synergism between the educators was at an all-time high and helped the group to develop new approaches and thinking in their work. We had anticipated some inherent challenges. However, many more obstacles were hidden underneath the excitement.

TARE was similar to large-scale farming. This may not seem like an issue to someone that has not been involved with a modern agriculture business. Successful farmers in the region are business people with many enterprises that need to be managed successfully. Farmers use remarkable skill when managing their time and resources to plan, develop, and execute their cropping plans. The TARE Team required the same set of skills to be successful. There was a need for securing capital, procuring land and equipment, managing additional labor needs, handling logistics for getting the work done over a large geographic area, marketing, and managing data, and the TARE Team needed to be excellent Extension educators as well. Each of the educators had a full-time job prior to taking on the responsibility of this project, and at times were overwhelmed. None of the educators were "real" farmers with all the expertise or time needed to do the needed work; therefore, a technician was necessary for the project. With additional labor, additional funds were required. The initial technician worked for a wage far below what was warranted by the work. However, he was part of the initial planning committee and donated much of his time to help the program get started.

The turnover with technicians was unanticipated and so additional funding was sought and obtained, for a time. Since the time needed for this job involved blocks of full-time work, and at other times, part-time work, keeping a technician busy and employed full-time during the year was a great challenge. They needed to be able to use modern up-to-date equipment, service and troubleshoot machinery repairs, and use computer-based programs.

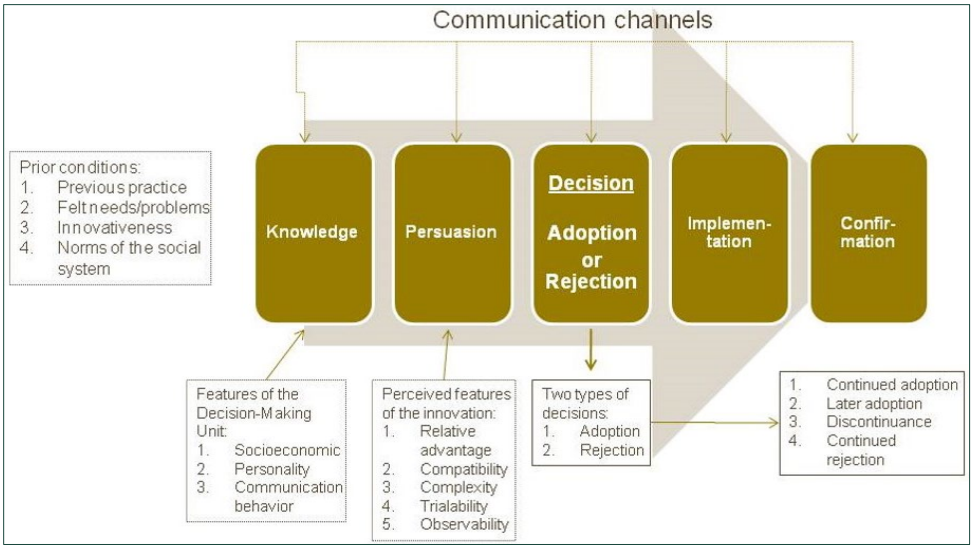
The geographic area of the Thumb is roughly 730,000 hectares, so transferring machinery from plot to plot was difficult. As much time was spent moving long distances from site to site as was spent in actual planting time. The farthest distance between locations was approximately 115 kilometers.

Another challenge for the educators was the ability to disseminate the information to all the producers in the region. The Thumb area has nearly 10,000 farms (see note following Table 9-1). The largest number of TARE

Variety Trial reports printed was 2,000, so there were approximately 80% of the farms not receiving the printed yield information. This opportunity for the target audience to view unbiased information was a continuous concern. Dissemination through the MSU Extension website, email, social media, and delivery through agribusinesses were all used during the years of the program.

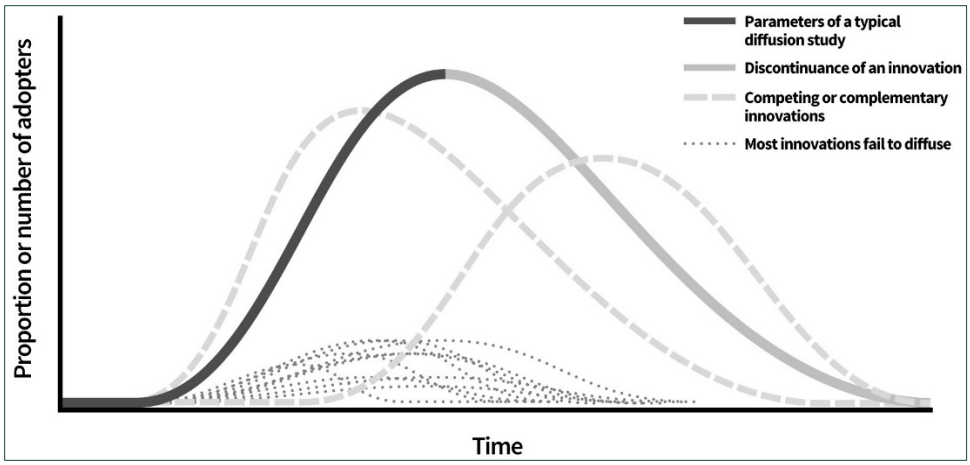
The farmers and agribusiness representatives chosen to serve on the advisory committee were invaluable partners to the program. Educators expected the committee to help with adoption of the information and disseminate the results. The individuals chosen by the MSU Extension TARE educators were perceived as leaders in their respective communities and opinion leaders for agriculture policy. These leaders understand what it takes to be successful in farming. They felt all the right pieces were in place for the TARE Program to be successful. When you consider the classic innovation attributes of cost, effectiveness, simplicity, compatibility, observability, and trialability (Dearing & Kee, 2012), there was anticipation the program would thrive in the region with a strong group. In hindsight, the model worked in many ways to provide farmers and agribusinesses the knowledge to improve profitability by following the progression outlined in figures 9-12 and 9-13. Farmers considered the research information and if they chose to implement a concept, validation of the practice and profitability would be done using the management system they use for their farms.

Figure 9-12. Innovation adoption process.



Source: *Diffusion of Innovations: From Rogers to Today*, by J. W. Dearing, 2019 (Presentation at University of Wisconsin, Madison).

Figure 9-13. Diffusion in context.



Source: *Diffusion of Innovations: From Rogers to Today*, by J. W. Dearing, 2019 (Presentation at University of Wisconsin, Madison).

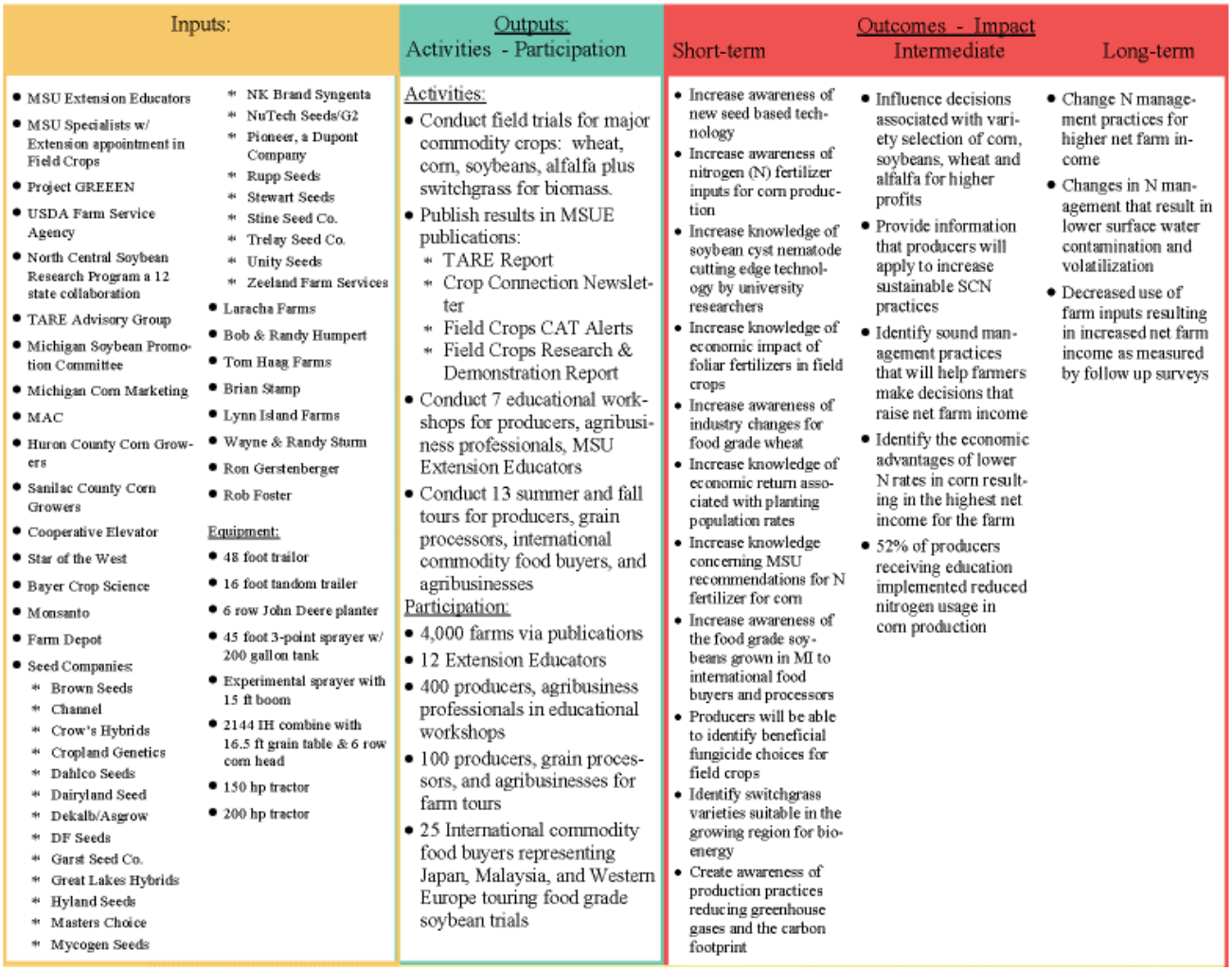
Many of the farmers and agribusiness representatives served on the committee the entire tenure of the program.

Farms numbers continue to consolidate according to the United States Department of Agriculture Census of Agriculture (https://bit.ly/35iFNyd). Agribusiness suppliers also continued to consolidate into larger entities with multiple locations within the area. This limited the ability of the TARE educators to have a rotation of representatives. This was both a positive, and in some cases, a negative connotation. There was a sense of ownership and pride of the program by all who served on the committee. It also provided more opportunity for influence over the program. Although the outputs were considered unbiased and served to provide an impartial depiction of results, some representatives would question the validity of the results if their products performed poorly. The farmers also began to question the results when the two largest seed suppliers withdrew from the trials. The company with the largest market share in the area never provided a reason for withdrawing from the program; however, there was a companywide shift away from unbiased university seed trials to company-based trials. The company with the second largest market share then withdrew from the TARE trials the following year, citing that their primary competition in the market had withdrawn.

Lessons Learned

Within MSU Extension, there is great diversity in programming and personnel. However, one of the core guiding principles of the TARE educators was a unified vision for excellence of the program and the unbiased validity of the data produced each year. The logic model (see Figure 9-14) prepared for the 2009–2010 season served as a blueprint for the team. Each member strived to reach short, medium, and long-term impacts for the program. The first lesson learned from the TARE Program was that farming and the factors that affect growing crops will vary year to year. These factors may make it difficult to get the type of consistent data needed, but the goal is to seek the best possible outcome, even in difficult conditions.

Figure 9-14. TARE (Thumb Ag Research & Education) logic model for 2009–2010.



Note. Adapted from Taylor-Powell & Henert, 2008.

There were originally seven educators when the plan for TARE was developed. As discussed earlier, the consolidation of agriculture for both producers and agribusiness affected the program. The consolidation also affected the educator staff. At the end of the program in 2016, there were three educators with the program. From the initial group, four educators either had left Extension or had elected to shift their responsibilities to other programming areas. This highlights the second lesson learned. When planning a major program, plan for change. It is inevitable! The ability to stay flexible and maneuver around shifting influences will be important for long-term success. Continuity of a program is a thing of beauty when you have consistency in personnel, funding, sound leadership with a shared vision for excellence, industry, and organizational and community support. The current political landscape often affects how programs are funded, thereby affecting how programs will operate. This leads to the third lesson learned. It is imperative to maintain your local, regional, and state support. They control aspects of funding. It is important to keep your legislators, clientele, and influential opinion leaders well informed and satisfied of the work being done.

The reasons for keeping stakeholders well informed is tied to the funding of a program such as TARE. The average projected project income, which

included grants, entry fees, and donated materials, for 2010–2014 was $52,000 U.S. The educators were convinced there was a need to have a contingency fund available in the event of a major expense such as a combine breakdown or in grant funding shortages. Even with the best of intentions and annual budgeting, there were simply not enough dollars to build a contingency fund. We learned programs are expensive and funds will be used quickly as operational dollars for any annual initiative. The funds may seem to be a large amount. However, like a typical U.S. farm, the expenses generated annually were used in operational expenses of labor, fuel, rent, and printing of the annual report.

The TARE Program was successful because there were committed farmers (plot cooperators). They allowed the educators the opportunity to do large-scale field trials on excellent farms. Each farm chosen had the proper drainage, improved soil fertility based on soil testing, and growing conditions to achieve maximum yields with our equipment. The farmers were the recipients of the crop grown and typically had similar income compared to their normal rate of return. Without great cooperators, the educators believed there would be a low probability for a successful program. With great cooperators, you have the opportunity for a great program.

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