CONSERVATION INNOVATION GRANTS
Final Report

I. COVER PAGE

Grantee Name: Agflex, Inc.	
Project Title: Optimizing Net Returns with Nitrogen Efficiency for Corn Production	
Agreement Number: 69-3B19-2-0004	
Project Director: Thomas Green, Ph.D., CCA, TSP	
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Period Covered by Report: September 2010 – February 28, 2014	
Project End Date: September 28, 2013	
Date of Submission: September 24, 2014	

Progress Towards Deliverables

Deliverables Proposed	**Deliverables Progress**
6000 acres in Conservation Tillage or Nutrient Management plans in California	In 2013, 26 acres enrolled in efficient irrigation in broccoli (Table 1). From 2010-2013, 2636 acres enrolled (Table 2).
7000 acres in Conservation Tillage or Nutrient Management plans across U.S, excluding California	In 2013, 2875 acres enrolled in the program (Table 1). From 2010-2013, 10,246 acres enrolled (Table 2).
BMP CHALLENGE expansion into three new crops/cropping practices	• Sweet Corn: The MN sweet corn program completed its third year. The Suffolk County sweet corn program completed its second year. • Potatoes: Suffolk County initiated a potato program. • Broccoli: The efficient nutrient management and irrigation BMP program continues in California. • Manure Incorporation: The Maryland comparisons provided four years of data. • Pre-sidedress nitrate testing: The Virginia comparisons continued to provide two years of data. • Cornell University's Adapt-N tool: Tool implementation expanded in 2013 to 39 fields across four states. • Aerial Imagery: Ten fields in Minnesota used advanced technology in 2012 to make more precise management decisions in 2013.
Attend a NRCS CIG showcase or comparable event	Thomas Green of Agflex, Inc. presented a poster at the USDA Water Quality Conference in January 2011, Washington, DC. Brian Brandt of American Farmland Trust, Ladi Asgill of Sustainable Conservation, Jeff Mitchell of UC-Davis and Steve Schaffer of Environmental Consulting for Agriculture attended World Ag Expo in February 2011 in Tulare, CA. Thomas Green, Brian Brandt and Ladi Asgill attended the SWCS annual meeting in July 2011 in Washington, D.C. Thomas Green presented on the BMP CHALLENGE project. Thomas Green, Brian Brandt and Ladi Asgill attended the SWCS annual meeting in July 2012 in Fort Worth, Texas. Agflex, Inc. coordinated a symposium, "Addressing the Adoption Challenge."
Technical support to BMP CHALLENGE participants	Support of farmers includes a network of crop consultants and project partners. In order to ensure quality comparisons and data collection, Agflex, Inc. increased the frequency of communication and depth of information provided for crop consultants for 2013.
Comprehensive outreach campaign in California	UC-Davis developed a series of conservation tillage and cover cropping videos and wrote an article on the mechanics, and hosted a series of conferences and field days, covering precision irrigation, conservation tillage and controlled traffic.
Assess yield and net returns and document effectiveness	A summary of results through 2013 is available in Table 3.

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III. EXECUTIVE SUMMARY

Farmers enrolled in the BMP CHALLENGE worked with qualified crop advisors to conduct side-by-side comparisons of the farmers' standard practices on a check strip and a nutrient management or reduced-tillage Best Management Practice (BMP) on the balance of the field. Agflex used practice cost and yield data to calculate economic gains or losses as a result of the BMP. Farmers were reimbursed for any net economic loss, eliminating financial risk as a barrier to adoption.

Our primary objectives were to: (1) Accelerate adoption of conservation tillage (CT) acreage for silage corn in California's Central Valley; (2) Expand to include CT in other row crops that exhibit a significant environmental footprint in the San Joaquin Valley (SJV); (3) Implement an outreach and education program to promote the BMP CHALLENGE program to farmers and others about BMPs; (4) Document the effectiveness of the BMP CHALLENGE and the comprehensive outreach campaign in promoting the long-term adoption of CT and nutrient BMPs; and (5) Expand and continue support of the BMP CHALLENGE programs established in Mid-Western and Mid-Atlantic States.

Total enrolled acres were 12,882, just shy of our 13,000 acre overall objective. We failed to enroll 6000 acres in California's SJV, enrolling only 2636 total acres in the state. Project partners in California incurred expenses significantly above budget projections when enrolling acres due in part to higher guarantee costs due to variability in liquid manure performance and inability to control application rates. Agflex negotiated with California partners to reallocate funds to specialty crops, including water conservation practices on processing tomatoes and broccoli, and crops outside of California.

We successfully completed all aspects of the Nutrient BMP CHALLENGE on 5363 acres in 101 fields from 2010-2013. Nutrient management programs from 2010-2013 reduced nitrogen (N) applications by 228,182 lbs. and mitigated 3586 lbs.N_2O and 467 tons CO_2 generated during fertilizer production. We completed the Reduced Tillage BMP CHALLENGE on 1276 acres in 38 fields between 2010 and 2013. These efforts reduced sediment load losses by an estimated 1913 tons and phosphorus losses by 2551 lbs. (Table 5).

These estimated impacts are conservative; 79 to 87% of participants reported implementing the BMPs or a modified version on additional acres on an ongoing basis as a result of their experience in the program. We did not attempt to estimate these impacts.

On average, farmers who reduced tillage experienced a net yield reduction of 10.6 bu/acre and an average net income loss of $65.14/acre after tillage savings, primarily in the first year. Farmers who adopted a nutrient management BMP experienced an average yield loss of 8.2 bu/acre and an average net income loss of $20.29 after fertilizer savings, again primarily in the first year. The steep learning curve was a primary factor in reduced tillage net income losses. This learning curve applied to both farmers and crop consultants and included learning to operate/adjust/maintain equipment, and weed management in reduced tillage systems. For nutrient management, most recommendation systems were based on the static "X" number of lbs. of N per bushel expected yield, e.g., 1.1 or 1.2 lbs. N per bushel. High variability in both N and corn prices during the course of the project was a factor, including unusually high corn

prices. Recommendation systems included recommendations for timing, placement and N formulation, not just rate. The majority of applications were made in fall or early spring, with a minority of acres receiving split applications with or without pre-sidedress N testing (PSNT). New recommendation systems, including Adapt-N and strip tillage, were used on a minority of acres and have potential to improve net income outcomes for participating farmers.

We encountered quality and technical issues with project implementation in California, particularly with our specifications for establishing representative check and BMP strips. Technical challenges including dealing with nutrients applied through irrigation systems made our protocol difficult or impossible to implement, which resulted in loss of usable data during the 2010 and 2011 seasons, contributing to the overall completion rate of 52%. In response to these challenges, we reduced enrollment in California and allocated acres elsewhere.

Despite these challenges, our California partners report positive experiences on the part of growers and technical advisors who have participated in the program. We are optimistic that our California partners will find additional ways to adapt the BMP CHALLENGE program to meet their needs and contribute valuable knowledge to conservation irrigation techniques in specialty crops.

Other challenges included adverse weather conditions. Excess rainfall and flooding resulting in crops not being harvested was the most common non-technical reason growers cited for not completing the program during a season, especially for CT.

Our one-year, no-cost extension granted through September 2013 allowed us to incorporate results from the 2012 growing season, complete payments to Certified Crop Advisors and growers, and collect contributions from growers who received higher net returns based on their BMP CHALLENGE acres. This extension also allowed for us to more fully develop the specialty crop and liquid manure protocol and accumulate additional data.

Overall, participating BMP CHALLENGE farmers achieved marginally lower net returns to their traditional production systems and learned innovative new practices without financial risk. Crop advisors were trained to implement new BMPs. The nation benefited from reduced greenhouse gas emissions from agricultural fields and improved water and air quality.

A key indicator of long-term success for the BMP CHALLENGE program is continued adoption of BMPs after participation. In our 2011 survey 87% and 79% of Nutrient Management participants from 2003-2009 and 2010, respectively, have continued the practice or a modified version. All CT participants from 2003-2010 continued the practice through at least 2011. Seventy-two percent of 2013 BMP CHALLENGE participants reported they will continue to use the BMP or a modified practice on an average of 67% of their acres. These numbers demonstrate that the BMP CHALLENGE program is highly effective and could be used by any agency or program working to increase adoption of both established and new BMPs for late-adopter farmers who fear loss of income.

Recommendations

Implementation

1. USDA and EPA should invest in a new effort to expand the Nutrient BMP CHALLENGE to help achieve water quality goals. The nation has strong potential to increase adoption of LGU recommendations in key corn-producing regions that are most at risk of N losses, including both new technologies such as Adapt-N as well as older systems that suffer from low adoption including strip tillage and PSNT.
2. New efforts to expand BMP CHALLENGE participation should exploit the program's unique appeal to producers who fail to adopt practices due to fear of yield loss.
3. Retain key BMP CHALLENGE mechanics moving forward with minor modifications including upgrading data collection to include site-specific rainfall amounts, timing and intensity; yield history; soil type and slope; and topographic and location factors needed to allow more extensive data analysis and more precise calculation of N-load reductions.

Policy

1. In collaboration with partners, build support for the guarantee approach in the next Farm Bill.
2. PNR, a system for compensating growers who apply less-than-recommended amounts of nutrients remains a cost-effective practice for keeping agriculture in place while reducing N losses on a substantial number of acres at high risk for N losses in comparison to other options and should be considered for corn for grain grown on those acres.

Research

1. Data are needed on current adoption rates of N BMPs and potential to rapidly accelerate adoption of Adapt-N using the net income guarantee approach.
2. Additional investments should be made to identify the most cost-effective practices that still suffer low adoption due to lack of technical support and income protection.
3. Further develop and test an alternate adjustment system that would reimburse forgone income based on county-average net returns rather than an individual field. Use of county data would reduce the cost of implementing a check strip and would allow application on a larger scale.

NRCS Priorities Addressed

This project addresses the following NRCS National CIG Nutrient Management Priorities (USDA NRCS 2014):

1. NRCS High Priority: Demonstrate and quantify the optimal combinations of nutrient source, application rate, placement and application timing (4Rs), as measured by impact on nutrient use efficiency and yield for one or more of the following: corn, soybeans, wheat, vegetables, hay/pasture, cotton and/or rice. Demonstrations are encouraged that show how these optimal combinations change for one or more of the following comparisons: irrigated vs. non-irrigated management, tillage vs. reduced tillage systems, manure-amended vs. non manure-amended systems and/or organic vs. conventional production systems.
2. Demonstrate the applicability and utility of in-season N management tools for determining additional nutrient needs for a range of soils, climates and/or cropping systems.

3. Demonstrate innovative techniques for keeping liquid manure applied via irrigation, surface application, or injection from entering subsurface drainage systems through macro pores.
4. Demonstrate new alternatives to manure application to frozen or saturated soils.

It also addresses the following NRCS National CIG Economics and Sociology Priorities:

1. NRCS High Priority: Demonstrate the impacts of conservation practices and suites of conservation practices on net revenue, net cost, and yield variability (or other measures of economic risk). Methods to demonstrate these impacts may include both case studies and enterprise budgets.
2. Develop tool for measuring economic returns of conservation for landowners. The tool should be useful for analyzing and demonstrating the financial costs and potential returns of alternative conservation practices, taking into account such factors as land characteristics and production potential. The tool should adhere to the Agricultural and Applied Economics Association standards for estimating farm costs and returns, including estimating opportunity costs for operator labor and management, be easy to use and understand and provide transparent calculations.
3. Develop tool for assessing the economics of conservation that includes a defensible and acceptable valuation of environmental benefits and identification of knowledge gaps.

Finally, this project addresses the NRCS National CIG Soil Health Priority:

1. NRCS High Priority: Demonstrate and quantify impacts of soil health promoting practices (e.g., reduced tillage, cover crops and crop rotations) on yield, yield variability and economics of crop production across a range of soils, cropping systems and climates. Methodologies for demonstration may include case studies and enterprise budgets.

IV. INTRODUCTION

Our project was designed to significantly increase the adoption of CT systems in California's SJV through the use of the voluntary risk mitigation program, the BMP CHALLENGE. Initial emphasis was placed on silage corn. The project later expanded to include other row crops that exhibit a significant environmental impact in the SJV. Implementation of these practices occurred through a comprehensive outreach and education campaign, spearheaded by project partners including Sustainable Conservation, American Farmland Trust and the University of California – Davis. In addition to our California operation, we expanded our other BMP CHALLENGE programs across the US, focusing on documenting effectiveness and long term impacts of the program.

Goals and Objectives

Building on the success that we have had in helping farmers adopt BMPs in the Midwest and Mid-Atlantic regions using our innovative BMP CHALLENGE program, the primary objectives of the project were to:

(1) Accelerate the adoption of CT in silage corn in California's SJV by providing financial guarantees against the risk of crop losses associated with the transition to a new tillage practice.

(2) Expand the BMP CHALLENGE to include CT in other row crops that exhibit a significant environmental footprint in the SJV.

(3) Implement a comprehensive outreach and education program to promote the BMP CHALLENGE program to engage and educate farmers and others about appropriate BMPs including CT and nutrient management practices.
(4) Document the effectiveness of the BMP CHALLENGE and the comprehensive outreach campaign in promoting the long-term adoption of CT and nutrient BMPs.
(5) Expand and continue support of the BMP CHALLENGE CT and Nutrient management programs already established in Mid-Western and Mid-Atlantic States.

The initial project scope/area of this project was focused on California with additional BMP CHALLENGE enrollees in DE, ID, IL, IN, IA, MD, MI, MN, MO, NE, NC, NY, OH, PA, SD, VA and WI. The project expanded to include ME, MI, NH, SD, and VT.

Project Team

This project was made possible by partnerships between Agflex, Inc. ($165,500 cash match), University of California Extension and the CA Conservation Tillage Workgroup ($109,409.30 cash match), Sustainable Conservation ($23,550 cash match), Cachuma Resource Conservation District ($4500 cash match), American Farmland Trust ($150,000 cash match), and program income from farmer contributions ($13,000 cash match). Other relationships include with farmers and their in-kind contributions to attend meetings and learn and implement BMP CHALLENGE protocols and new BMP practices (estimated at $456,000), and with crop advisors to learn and carry out BMP CHALLENGE protocols. Specific members of the project team over the course of the project include:

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V. BACKGROUND

Agriculture in the SJV has new and growing opportunities to contribute to soil, water and air quality improvement through improved stewardship. This region, which extends from Bakersfield in the south to Stockton in the north, consists of highly diversified and historically very productive farms. Six of the nation's traditionally top ten agricultural counties, including Fresno, Tulare, Kern, Merced, Stanislaus and San Joaquin, are found in this region and account for a sizable portion of California's contribution to national production of a number of crops including processing tomatoes (95%), fresh market tomatoes (31%), melons (52%), onions (31%) and peppers (54%) (CA. Ag. Resource Directory, 2007). Much of the state's dairy industry, which is ranked first among US states (CDFA, 2007), is also found throughout this region.

In recent years, the eight-county SJV region has had one of the world's worst air quality problems and has been out of compliance with US Environmental Protection Agency air quality standards for particulate matter $(PM)_{10}$ (Madden *et al.* 2009). Because PM exceedances typically occur in the fall when considerable intercrop tillage is done, farmers throughout the region have been mandated since 2004 to employ at least five air quality conservation management practices and for the first time in history, "reducing or eliminating the need to disturb the soil" has been identified as a public policy goal in the SJV (AAQ, 2004).

Since 1997, more cropland acres have been farmed nationwide using CT practices than standard tillage practices (CTIC, 2004). However, despite the apparent attractiveness of reduced tillage or CT systems, NRCS estimates that less than one percent of row crop production acreage in California's Central Valley is currently farmed using CT practices (CTIC, 2004).

Reasons for this low rate of CT adoption in California are generally thought to include a lack of CT equipment being available locally, inexperience with CT techniques, the predominance of surface or gravity irrigation systems in California and the fact that tillage-intensive systems have been developed here for several decades and are generally quite productive.

In the spring of 2002, a survey was conducted of row crop producers in eleven Central Valley counties from Kern in the south to Yolo in the north to assess farmers' familiarity with and general perceptions of CT in California. Results from the survey also indicated that 55% of respondents saw benefits for their crops and 68% had a favorable impression of the potential of CT, with 40% indicating that it could be a useful practice. Major obstacles to broader adoption of CT by the respondents included lack of information about CT methods and availability of equipment, and concerns about the financial risks involved in experimentation. This survey confirmed some of the perceived reasons for the low rate of adoption of CT in California and it also provided valuable input that has now guided the development and execution of this CIG project.

The EPA National Academy of Sciences and more than 20 other studies have identified economic risk as a key factor preventing farmers from adopting improved practices like CT. Farmers often use additional inputs as a hedge against yield losses. By increasing inputs such as extra tillage passes or fertilizer to reduce risk, farmers are making a rational decision to reduce income fluctuations. The BMP CHALLENGE program was developed in order address this phenomenon which has also been found to be a major impediment to widespread adoption of CT in the SJV. The BMP CHALLENGE is designed to remove a major deterrence to trying improved practices by using the considerable risk management expertise of Agflex to mitigate risk associated with yield losses that may initially occur due to lack of experience during the transition period.

The BMP CHALLENGE program was initially developed for use on grain and silage corn, but we have found that the program is easily adapted to other crop types and practices, including efficient irrigation in broccoli, controlled release N fertilizer in sweet corn and potatoes and alternate furrow irrigation and efficient N fertilizer management in tomatoes. Other BMPs for grain and silage include manure injection, winter forage crops, use of Adapt-N management software and preseason nitrate testing.

Issues Addressed and Beneficiaries

The BMP CHALLENGE is best suited for side-by-side economic and environmental comparisons of a single BMP versus a grower's standard practice. Collaborators at Cornell Cooperative Extension in Suffolk County, NY are currently developing ideas and program criteria for a multi-BMP, whole farm system for soil health, controlled release N fertilizer and CT.

Our project addresses water quality, soil quality and air quality resource concerns. Reduced tillage systems have been shown to improve soil quality and structure and limit airborne particulate matter pollution. The eight-county SJV region has seen significant improvements in air quality since 2009; however the area remains prone to ozone and PM levels in excess of new health standards. And with more than 17% of $PM_{2.5}$ emissions attributable to agriculture, reduced

tillage remains a key solution to mitigating air quality issues in California (SJV Air Pollution Control District, 2014). It has also been one of the world's worst air quality basins and has been out of compliance with US Environmental Protection Agency air quality standards for PM_{10} (Madden *et al.* 2009).

Efficient and reduced fertilizer use simultaneously decreases the likelihood of nutrient leaching and runoff into waterways to cause harmful algal blooms and lessens demand for carbon-intensive fertilizer manufacture. Efficient irrigation techniques are critical in areas with limited freshwater resources, such as in the western US.

Fertilizer production and volatilization of synthetic N applied to fields directly contributes greenhouse gasses NO_x and CO_2 to the atmosphere. Increased atmospheric PM contributes to respiratory issues and other human health problems. Algal blooms in water resources threaten the health of aquatic ecosystems and the economic and recreational activities that depend on them. Excess tillage increases the chances of compaction and erosion, which leads to losses in productivity and soil health for the grower. Furthermore, applying nutrients in excess of need increases growers' input costs and hurts profits.

VI. REVIEW OF METHODS

BMP CHALLENGE is a collaborative project of the IPM Institute of North America, American Farmland Trust and Agflex, an Iowa corporation. American Farmland Trust's Agricultural Conservation Innovation Center began the BMP risk management project in 1996 with a broad survey of BMPs, cropping systems and analyses of economic risk as a barrier to BMP adoption, including nutrient management and IPM. The partners launched a BMP CHALLENGE pilot program in 2000. Since then, the program has enabled corn growers to experiment with BMPs on 351 fields and over 20,474 acres without risk to income (Table 3).

Since 2004, the nutrient management and CT programs have been marketed as Nutrient BMP CHALLENGE® and Reduced Tillage BMP CHALLENGE®, respectively. These two systems support participants who follow LGU recommendations for fertilizer application rates and tillage systems that maintain at least 30% residue cover. In contrast to PNR, these guarantee programs do not provide a farmer cost share and are intended for short-term participation, typically on one or two fields, until the farmer is comfortable with the BMP. The majority of participants adopt BMPs to at least some degree on a majority of their acreage after one year of participation.

American Farmland Trust and Agflex were the principal recruiters for this project. Recruiting has been accomplished through brochure mailings, e-mail campaigns, webinars, press releases, presentations at meetings, and personal contacts. These efforts targeted key influencers of farmers, including crop advisors and conservation professionals who have good personal relationships with farmers and who are ideally suited to present this potential opportunity.

Once enrolled in the program, each grower works with a chosen or appointed crop advisor to implement the BMP on the majority of the field, with 2-3 passes designated as a check strip of the grower's standard practice. With the assistance of their crop advisor, the grower harvests a check strip and two adjacent BMP strips and records population density, yield, moisture content and input costs per acre for treatment.

With increased accuracy of N contributions from manure, we were able to demonstrate effective N savings from light incorporation of manure, generally without loss to yield or income. Controlled release N fertilizer in sweet corn and potatoes has also demonstrated yield and income benefits to farmers.

Total enrolled acres were 12,882, just shy of our 13,000 acre overall objective. We failed to enroll 6000 acres in California's SJV, enrolling only 2636 total acres in the state. Project partners in California incurred expenses significantly above budget projections when enrolling acres due in part to higher costs due to variability in liquid manure performance and inability to control application rates. Agflex negotiated with California partners to reallocate funds to specialty crops, including processing tomatoes and broccoli.

We also encountered quality and technical issues with project implementation in California, particularly with our specifications for establishing representative check and BMP strips. Technical errors resulted in loss of usable data during the 2010 and 2011 seasons, contributing to the overall completion rate of 52%. In response to these challenges, we decided to focus on enrolling acres outside of California.

Other challenges included adverse weather conditions. Excess rainfall and flooding was the most common non-technical reason growers cited for not completing the program during a season, especially for CT.

Schedule of Events

From March 1, 2013 – March 10, 2014

- Worked with CropTech, an IL ag retailer and consultant, to host a BMP CHALLENGE workshop to review 2013 Adapt-N performance
- Worked with Cornell University to complete the BMP CHALLENGE using controlled release N fertilizer in Suffolk County with five new sweet corn growers, and expanded services to eight potato growers
- Worked with Cachuma Resource Conservation District to complete two fields in Efficient Nutrient Management and irrigation BMPs for broccoli in California
- Expanded work in the Mid-Atlantic and Illinois with a focus on precision-ag practices in order to enhance N-use efficiency. Practices implemented include: six Virginia growers who used PSNT; fourteen Illinois growers, two Pennsylvania growers and nine Maryland growers who used Cornell University's Adapt-N tool; and six Maryland growers who used manure incorporation.
- Expanded work in Vermont with a focus on reduced tillage. In total, ten growers in Vermont implemented reduced tillage, one grower used the Adapt-N tool and another grower implemented PNR.
- Completed 98 fields, 2,837 acres with 62 growers in eight states for the 2013 growing season
- Sent Enrollment Confirmation letters and Field Signs to 2013 participants
- Distributed two newsletters to 5,836 recipients nationwide
- Collected field information and nutrient inputs for the 2013 enrolled projects
- Analyzed yield assessments and net return analyses for 2013 enrolled projects
- Calculated net return assessments to determine economic impact of projects
- Calculated N credit and sediment loss reduction for 2013 fields to determine environmental impact of projects
- Analyzed results to determine the severity and frequency of risk from the BMP recommendations for several different comparisons

- Coordinated with Sustainable Conservation, UC-Davis, Cachuma Resource Conservation District, American Farmland Trust, Cornell University and other crop consultants and collaborators to write a final report analyzing the BMP CHALLENGE program and its potential for expansion and opportunities for further development

From September 1, 2012 – February 28, 2013

- Completed six BMP CHALLENGE development calls
- Calculated net return assessments for 2012 yield harvest information collected to determine economic impact of projects
- Calculated N credit and sediment loss reduction for 2012 fields to determine environmental impact of projects
- Analyzed results to determine the severity and frequency of risk from the BMP recommendations for several different comparisons
- Analyzed results to redesign protocol for upcoming growing season to limit risk and obtain more accurate comparisons
- Created a recruitment plan to focus on precision-agriculture tools and systems

From March 1, 2012 – August 31, 2012

- Completed three California working group calls
- Completed five BMP CHALLENGE development calls
- Enrolled two fields in liquid manure management in California
- Enrolled two fields in CT in California, one in silage and one in sorghum
- Met and exceeded deliverable status for acres and fields enrolled nationally in the BMP CHALLENGE (excluding California)
- Enrolled 11 sweet corn trials in Suffolk County, New York using controlled release N fertilizer
- Collaborated with the Cachuma Resource Conservation District in California
- Enrolled and harvested two broccoli fields in California
- Collaborated with The Nature Conservancy in Wisconsin for 2013 fields
- Presented on the BMP CHALLENGE at the Red Cedar: Land, Water and People Coming Together conference at UW-Stout, Wisconsin
- Presented a poster on the BMP CHALLENGE at the 2012 Land Grant and Sea Grant National Water Conference in Portland, Oregon
- Directed a symposium and presented on the BMP CHALLENGE at the Soil and Water Conservation Society 2012 Annual Conference in Fort Worth, Texas
- Wrote a BMP CHALLENGE newsletter focusing on the Feasibility Study results
- Standardized the Reduced Tillage BMP CHALLENGE program's cost calculations to provide more accurate net return results
- Focused on precision-ag practices in the Chesapeake in order to enhance N-use efficiency (e.g. preseason nitrate testing, Cornell University's Adapt-N tool, manure incorporation, fertilizer injection)
- Created six CT videos for outreach in California

From September 1, 2011 – February 29, 2012

- Completed eleven California working group calls
- Completed eleven biweekly BMP CHALLENGE calls
- Calculated net return assessments for yield harvest information collected
- Calculated N credit and sediment loss reduction for 2011 fields
- Analyzed results to determine the severity and frequency of risk from the BMP recommendations using liquid manure in California

- Analyzed results to redesign protocol for upcoming growing season to limit risk and obtain more accurate comparisons
- Created a recruitment plan
- Partnered with the MDA Nutrient Management Initiative to expand Minnesota acres
- Partnered with Cornell University to offer the BMP CHALLENGE to sweet corn growers in Suffolk County using controlled release N fertilizer
- Added Vermont to eligible states
- Altered the program forms to simplify the grower's and crop consultant's workload and clarify information needed to analyze results

From March 1, 2011 – August 31, 2011

- Completed eleven California working group calls
- Completed twelve biweekly BMP CHALLENGE calls
- Enrolled four tomato fields in a cost-share guarantee with Campbell's Processing Tomatoes, two in Alternate Furrow Irrigation and two in Efficient N Fertilizer Management
- Enrolled 16 fields in California for silage, a total of 925.43 BMP acres
- Developed liquid manure protocol to increase accuracy of results
- Determined a value for pound of N in manure
- Altered the Grower Agreement, Check Strip Information Form, and Yield Assessment Worksheet to simplify the grower's and crop consultant's workload
- Sent Enrollment Acceptance Forms and BMP CHALLENGE field signs

From September 1 2010 – February 28, 2011

- Completed eight California working group calls
- Completed eight biweekly BMP CHALLENGE calls
- Calculated net return assessments for yield harvest information collected
- Analyzed results for effectiveness of program and redesigned protocol for the upcoming growing season
- Finalized collaboration from Campbell's and Morning Star tomato processing companies
- Created a recruitment plan
- Expanded guaranteed BMPs to include reduced tillage, basic nutrient management, pre-side dress nitrate test, corn stalk nitrate test, minimum disturbance incorporation, manure injection, N inhibitor, sensor-based variable rate application and P reduction
- Distributed 1,200 nutrient management and CT newsletters to California dairy producers

From June 1, 2010 – August 31, 2010

- Three California working group calls
- Six biweekly BMP CHALLENGE calls
- Field information for all participants collected
- Discussions with Campbell's and Morning Star regarding processing tomato collaboration
- Net returns assessments begun for yield harvest information collected

VII. DISCUSSION OF QUALITY ASSURANCE

Site Description

Farmers were enrolled in the program based on their eligibility for EQIP programs. Many farmers were recruited through existing relationship with a crop advisor trained in administering the BMP CHALLENGE program. Sites were located in sites throughout the US initially

including CA, DE, ID, IL, IN, IA, MD, MI, MN, MO, NE, NC, NY, OH, PA, SD, VA and WI. The project expanded to include ME, MI, NH, SD and VT.

Sampling Design

All measurements of yield, agricultural inputs, etc. were rounded to the nearest hundredth. Moisture levels were measured to the nearest tenth of a percentage and moisture factors to the nearest ten-thousandth.

We believe that the size of comparison strips and efforts to ensure accuracy yields results comparable to real-life cropping practices. In a 2011 survey of growers who participated in the program, 97% felt that the experimental setup and comparison of Check Strip to BMP Strips was accurate and fair (Table 5).

Estimates of N_2O and CO_2 reductions were derived from the following formulas:

N2O emissions from N fertilizer applied to cropland

E = .01(44/28)F

Where E is the emission rate (kg N_2O/yr)
0.01is the emission factor estimated at 1% of applied N
F is the amount of synthetic N (kg N/yr)
44/28 is the molar mass conversion rate for N to N_2O
Source: De Klein et al. 2006

Converting N_2O emissions to CO_2 equivalents (CO_{2e})

$CO_{2e} = 298*N_2O$
Source: Lemke et al. 2007

CO_2 equivalents from fertilizer manufacture (CO_2, N_2O and CH_4)

$Lbs.CO_{2e} = 1.31*$(lbs. fertilizer product)
Source: Wood & Cowie 2004 and references within

Procedures

Crop advisors and growers were provided with recordkeeping forms and an instruction packet detailing experimental setup, implementation and data collection methods at the time of enrollment. Specifically, crop advisors were contractually obligated to provide a preseason management plan detailing tillage and/or nutrient inputs at all stages of crop development for the comparison of BMP and grower's standard practice.

Crop advisors tracked inputs and costs and reported per acre nutrient and/or tillage expenses. They recorded observational differences in lodging, weed pressure, population and N deficiency in pre-harvest field assessments. Finally, growers and crop advisors recorded individual yields and moisture content for the grower's standard strip versus the two adjacent BMP comparison strips. Additional measurements, such as soil nitrate tests, were used in some cases including PSNT and Adapt-N projects.

Measurements recorded onto worksheets by crop advisors were shared with the BMP CHALLENGE project coordinator or assistant. The coordinator or assistant then manually entered this data into excel spreadsheets and extrapolated economic losses or gains and environmental benefits over the entire field, communicating with crop advisors and farmers when questions of accuracy arose. These net return calculations were reviewed by Thomas Green and Brian Brandt for accuracy.

Quality Control

Some have criticized the comparison of a single check strip versus two BMP strips because the lack of replication does not allow us to analyze variance and determine statistical significance in yield differences. Our project team worked with a statistician to determine that our check vs. BMP strip layout is yields comparable results to replicated trials. Our design is easier and cost-effective for growers to implement, and the level of accuracy is adequate for farmers to compare practices and make an informed and risk-free decision to implement a BMP.

BMP CHALLENGE incorporates many safeguards and standards to provide an accurate comparison between the grower's standard practice and the BMP. Crop advisors made every effort to locate the Check Strip and adjacent BMP Strips in a uniform portion of the field. At the outset, advisors identified, marked and recorded the locations of BMP and Check strips with flags, GPS and/or landmarks. If possible, they avoided areas that have variable soil types, slopes, irregular boundaries and variable fertility and/or tile lines running parallel to the row.

If it was not possible to avoid non-uniform areas, crop advisors took the following measures:

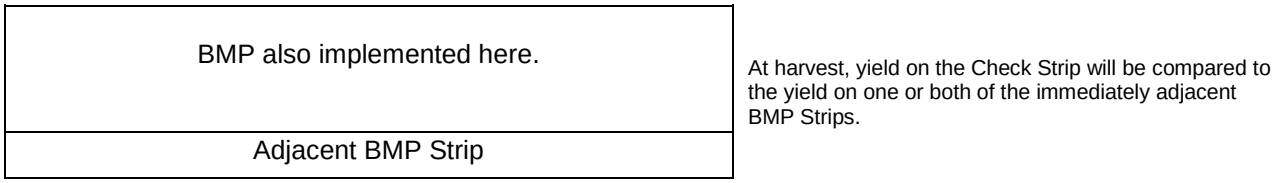
(i) If a slope, rocky area or any other feature disrupted field uniformity, strips were placed so they run across the non-uniformity affecting the Check Strip and adjacent BMP Strips equally.

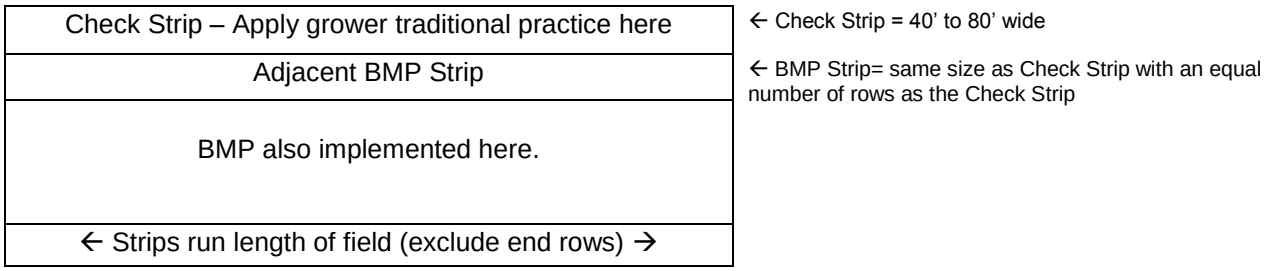
(ii) If the field had a small outcropping or a depression, strips were placed on one or the other side of these features.

(iii) If the field had two or more soil types, strips were placed so they crossed the different soil types at right angles, affecting the Check Strip and adjacent BMP Strips equally.

(iv) If the enrolled acres were in contour strips that were not wide enough to contain both a Check Strip and two adjacent BMP Strips, one strip was selected that best represents the productive capabilities of the covered acres and that is appropriate for use as a Check Strip. The contour strip was split in half and the grower applied the BMP rate of fertilizer on one half of the contour Strip and the grower's standard on the other half. Alternatively, the crop advisor could place the Check Strip in one contour strip and the BMP Strips in immediately adjacent contour strips, provided the three contour strips were reasonably uniform and representative of the balance of the field.

The schematic below illustrates the general layout of each field:





VIII. FINDINGS

A major indicator of long-term success for the BMP CHALLENGE program is continued adoption of BMPs in the seasons following program enrollment. We conducted two BMP CHALLENGE surveys in 2011, one with farmers just completing the 2010 program, and one for participants from the years 2003-2009. Responses indicate that 87% and 79% of nutrient management participants from 2003-2009 and 2010, respectively, have continued the practice or a modified version on their fields. 100% of reduced tillage participants from 2003-2010 continued the practice through 2011 at least. In addition, 39% of participants enrolled in the program for more than one season, often adding a new BMP to their fields, and 97% felt that the methods used for the comparison of standard practices to BMPs was accurate and fair. An additional survey of 2013 BMP CHALLENGE participants yielded similar results, with 72% reporting they will continue to use the BMP or a modified practice on an average of 67% of their acres in 2014. A full summary table of survey results can be found in Tables 5 and 6.

We successfully completed all aspects of the Nutrient BMP CHALLENGE on 5363 acres in 101 fields from 2010-2013. Nutrient management programs from 2010-2013 reduced nitrogen (N) applications by 228,182 lbs. and mitigated 3586 lbs.N_2O and 467 tons CO_2 generated during fertilizer production. We completed the Reduced Tillage BMP CHALLENGE on 1276 acres in 38 fields between 2010 and 2013. These efforts reduced sediment load losses by an estimated 1913 tons and phosphorus losses by 2551 lbs. (Table 4).

These estimated impacts are conservative; 79 to 87% of participants reported implementing the BMPs or a modified version on additional acres on an ongoing basis as a result of their experience in the program. We did not attempt to estimate these impacts.

IX. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Results from our Nutrient BMP CHALLENGE, Reduced Tillage BMP CHALLENGE and PNR programs demonstrate that, on average, farmers experience net income losses and foregone income in the first year of adopting a new BMP. This is especially true for reduced tillage.

Results from the Nutrient BMP CHALLENGE and from PNR, where farmers applied N at rates 15% below LGU recommendations, disproves the assumption that these recommendations have built-in fertilizer "cushions" that could be reduced to meet water quality goals with no risk to yield.

We attribute net income losses experienced here to the following:

a. Farmer and in some instance, crop advisor unfamiliarity with a tool or practice and associated learning curves.
b. Soil health metrics responding more slowly to tillage practice changes, causing temporary yield impairment on newly-converted fields.
c. Unusual weather including heavy rains during the time period between N application and crop need.

According to a 2010 survey of BMP CHALLENGE participants, financial risks from yield losses is the most common reason cited by farmers to explain their reluctance to adopt a promising new BMP. The BMP CHALLENGE demonstrates that, with technical and financial support, farmers are willing to experiment with innovative new practices, and that they adopt these practices as a result of their experience, improving protection of natural resource concerns.

Recommendations

Implementation

1. **USDA and US EPA should invest in a new effort to expand the Nutrient BMP CHALLENGE to help achieve water quality goals. EPA has strong potential to increase adoption of LGU recommendations in key corn-producing regions that are most at risk of N losses.** This effort should focus on accelerating adoption of Adapt-N, and split N applications, with the second application applied as sidedress and using PSNT or chlorophyll meter readings. The BMP CHALLENGE could also support adoption of new technology, including active sensors with potential to more accurately distribute sidedress N based on need within specific areas of the field.

   In addition to achieving a substantial portion of desired N-load reductions, application of the BMP CHALLENGE would provide critical technical assistance to producers with advanced N-management techniques, verify implementation of reduced N use and provide credible estimates of N-load reductions. The effort would also provide important feedback to Land Grant Universities and other scientists on the efficacy of current recommendations and implementation of new technology on soils, topography and weather conditions experienced in critical regions for sustaining agriculture while reducing impacts on water bodies. In conjunction, qualified crop advisors could also assess and address opportunities to reduce P and sediment losses, adding to the potential to increase efficiency and reduce costs.

2. **New efforts to expand BMP CHALLENGE participation should exploit the program's unique appeal to producers who fail to adopt practices due to fear of yield loss.** A variety of adoption incentives address the need for technical and financial assistance, however, the BMP CHALLENGE is the only approach that directly addresses the legitimate fear of income loss. This tool can be particularly valuable in situations where widespread participation is necessary to reach resource protection goals.

3. **Retain key BMP CHALLENGE mechanics moving forward with minor modifications.** BMP CHALLENGE mechanics are attractive to producers and crop advisors, result in high conversion rates to new practices, provide critical technical support and verification, and are delivered cost effectively by Agflex. These should be

maintained with ongoing research and development for continuous improvement and addition of new practices. Current mechanics have very high producer satisfaction and new-practice-conversion rates, and are compatible with NRCS programs and nutrient credit trading.

Given high post-participation adoption rates experienced here, BMP CHALLENGE costs per lb. of N reduced are extremely competitive with alternative practice. These should be used for implementation and scenario building going forward. Enrolling multiple fields per farm has potential to reduce consultant costs per lb. of N further. Administrative costs for the guarantee are not likely to have room for reduction without large increases in volume. It is unlikely that other private or public-sector providers entering the market for the services currently provided by crop consultants or Agflex will result in meaningful program cost reduction. Corn prices are the largest single driver of program costs; the greatest potential for cost reductions lie in choosing practices that minimize yield loss.

Administrative costs for the guarantee are not likely to be reduced without large increases in volume. It is unlikely that other private or public-sector providers entering the market for the services currently provided by crop consultants or Agflex will result in meaningful program cost reduction. Corn prices are the largest single driver of program costs; the greatest potential for cost reductions lie in choosing practices that minimize yield loss.

4. **Additional improvements should include upgrading data collection to include site-specific rainfall amounts, timing and intensity; yield history; soil type and slope; and topographic and location factors needed to allow more extensive data analysis and more precise calculation of N-load reductions.** Post-participation results should also be improved to increase sample size and accuracy.

Policy

3. **In collaboration with partners, build support for the guarantee approach in the new Farm Bill.** Farm-bill conservation programs administered by NRCS are the single largest near-term source of funding for the guarantee system. The Nutrient BMP CHALLENGE is an ideal adoption support tool consistent with NRCS EQIP limited-term contracts to provide cost share and technical assistance to overcome barriers including up-front investment costs, learning curve and foregone income/fear of foregone income. This can be accomplished by including specific language in the next Farm Bill or report language directing NRCS to offer the BMP CHALLENGE as an option for farmers. NRCS needs a clear signal that Congress wants the Service to move forward with this option. While there is strong support among individuals within NRCS at the federal, regional and state level, the December 2010 guidance issued by NRCS national agronomist was inconsistent with prior analysis, expert review and USDA FCIC board approval of the single-check-strip approach (Widman 2010). The guidance required a minimum of six to seven replicated strips in each field, which is cost prohibitive and unnecessary for farmer demonstration purposes. We are disappointed that this promising and demonstrated program did not receive support in the 2014 Farm Bill.

4. **PNR remains a cost-effective practice for a substantial number of acres in comparison to other options and should be considered for corn for grain grown on the most cost-effective acres, i.e., those most at risk of N loss.** Care needs to be taken to position the practice properly to encourage a favorable response from potential participants and other key influencers. Modest cost savings may be obtainable by moving to an estimated-foregone-income-only model if a sufficient number of farmers are willing to accept payments based on our historical results without on-site harvest assessment and check strips, or with a county-average-based net returns adjustment system.

Research

4. **Additional investments should be made to identify the most cost-effective practices that still suffer low adoption due to lack of technical support and income protection.** A wide variety of improved practices have potential to benefit from the BMP CHALLENGE approach, including practices with less risk to farmer net returns such as split N applications with in-season testing and Adapt-N. Given that a great majority of US farmers growing corn for grain do not have fully implemented nutrient management plans compliant with LGU recommendations, there is fertile ground for many practices in corn. Our results also demonstrate potential in fresh market sweet corn, broccoli and potatoes. Expert interviews and farmer surveys can help identify additional potential crops and practices. Pilots will then be needed to collect performance data on selected practices. Priorities should include practices with the greatest potential to address resource concerns.

5. **Further develop and test an alternate adjustment system that would reimburse forgone income based on county-average net returns rather than an individual field. Use of county data would reduce the cost of implementing a check strip and would allow application on a larger scale.**

X. APPENDICES

Appendix A. References Cited

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Appendix B. Charts and Tables

Table 1: Summary of enrolled and completed acres in Nutrient Management and Reduced Tillage in 2013

	Enrolled fields	Enrolled acres	Completed fields	Complete acres
California[1]	2	26	2	26
National (excluding California)	77	2857.2	64	2646

Table 2: Summary of enrolled and deliverable acres from 2010-2013

	Enrolled fields	Enrolled acres	Deliverable fields	Deliverable acres
California	45	2610.5	60	6000
National (excluding California)	206	10360.5	70	7000

[1] Includes two broccoli fields enrolled in efficient irrigation and N fertilizer program

Table 3: Summary results for 2000-2013 completed acres

2000-2013 RESULTS	Nutrient BMP CHALLENGE®	Reduced Tillage BMP CHALLENGE®	Planned N Reduction (through 2010)	Totals
Total acres, 2000-2013	8184.59	3220.57	9,069.05	20474.21
Total fields, 2000-2013	174	77	100	351
BMP average yield (bu/acre)	170.07	154.08	149.17	-
BMP minimum yield (bu/acre)	56.30	28.35	55.68	-
BMP maximum yield (bu/acre)	247.85	322.14	229.40	-
Check-strip average yield (bu/acre)	177.45	163.65	161.46	-
Check-strip minimum yield (bu/acre)	49.80	24.37	63.12	-
Check-strip maximum yield (bu/acre)	246.61	331.31	264.00	-
Average farmer net returns after fertilizer or tillage savings ($/acre)	($12.16)	($36.30)	($36.50)	-
Minimum net return ($/acre)	($501.57)	($714.87)	($330.00)	-
Maximum net return ($/acre)	$158.99	$157.41	$ 105.24	-
2000-2013 Total Payout	$147,786.01	$129,788.11	$347,595.16	$625,169.29
Total N use reduction (lbs)	356,921	-	244,199	601,120
Estimated sediment reduction (tons)	-	4,830.9	-	4,830.9
Estimated P load reduction (lbs)	-	6,441	-	6,441
Estimated N2O reduction (lbs)	5,609	-	3,837	9,446
Estimated CO2 reduction (tons)	730.6	0.8	499.8	1,231.2

Table 4: Summary results for 2010-2013 completed acres

2010-2013 RESULTS	Nutrient BMP CHALLENGE®	Reduced Tillage BMP CHALLENGE®	Planned N Reduction (2010 only)	Totals
Total acres, 2010-2013	3,365.7	1,275.5	1,997.1	6,638.3
Total fields, 2010-2013	75	38	26	139
BMP average yield (bu/acre)	177.1	146.1	140.4	-
BMP minimum yield (bu/acre)	61.5	28.4	91.4	-
BMP maximum yield (bu/acre)	247.9	322.1	213.2	-
Check-strip average yield (bu/acre)	185.3	156.7	151.2	-
Check-strip minimum yield (bu/acre)	69.3	24.4	84.0	-
Check-strip maximum yield (bu/acre)	246.6	331.3	245.6	-
Average farmer net returns after fertilizer or tillage savings ($/acre)	($20.29)	($65.14)	($34.98)	-
Minimum net return ($/acre)	($501.57)	($714.87)	($305.36)	-
Maximum net return ($/acre)	$158.99	$157.41	$84.22	-
Total Payout, 2010-2013	$15,233.52	$74,959.23	$72,186.68	$162,379.43
Total N use reduction (lbs)	176,523	-	51,658	228,182
Estimated sediment reduction (tons)	-	1,913.3	-	1,913.3
Estimated P load reduction (lbs)	-	2,551	-	2,551
Estimated N2O reduction (lbs)	2,774	-	812	3,586
Estimated CO2 reduction (tons)	361.3	0.3	105.7	467.4

Table 5: Results of a survey of BMP CHALLENGE participants from 2000-2010

1) Approximately how many of your acres are planted with the following types of crops each year?	Response Count	Response Percent
Corn		
0-250	3	19%
251-500	6	38%
501-750	3	19%
751-1000	4	25%
Total	**16**	**100%**
Soybeans		
0-250	5	31%
251-500	6	38%
501-750	2	13%
751-1000	3	19%
Total	**16**	**100%**
Wheat		
0-50	1	50%
51-100	1	50%
Total	**2**	**100%**
Other		
0-50	3	38%
51-100	1	13%
101-150	2	25%
151-200	2	25%
Total	**8**	**100%**
2) To which of the following age groups do you belong?	Response Count	Response Percent
Under 20	0	0%
20-30	1	6%
31-40	1	6%
41-50	5	28%
Over 50	11	61%
Total	**18**	**100%**
3) Approximately, how many years have you been farming?	Response Count	Response Percent
Less than 10 years	1	6%
10-20 years	2	11%
21-30 years	5	28%
Over 30 years	10	56%
Total	**18**	**100%**
4) Which of the following best describes your level of education?	Response Count	Response Percent
Some high school	0	0%
High school diploma / GED	7	39%
Some college	3	17%
College degree	8	44%
Total	**18**	**100%**

5) How much of your household income comes from non-farm sources (off-farm employment, pensions, investment income, etc.)?	Response Count	Response Percent
All from off-farm	0	0%
More than 1/2 from off-farm	6	33%
Less than 1/2 from off-farm	12	67%
Total	**18**	**100%**

6) Before you participated in the BMP CHALLENGE, what source(s) of information did you rely on to develop your nutrient and tillage practices for corn?	Response Count	Response Percent
University/Extension Service	8	33%
Ag Retailer	9	38%
Crop Consultant	15	63%
Seed Dealer	0	0%
Neighbors/Friends	3	13%
Family Members	2	8%
Farm Magazines	4	17%
Other	7	29%
Total	**24**	**100%**

7) Circle the response that best describes you.	Response Count	Response Percent
I am usually one of the first operators in my county to try out a new conservation practice.	8	42%
I prefer to wait and see how a new conservation practice works for other operators in my county before trying it myself.	11	58%
I prefer to wait until most operators in my county are using a new conservation practice and reporting on its advantages and disadvantages before trying it for myself.	0	0%
Total	**19**	**100%**

8) The BMP CHALLENGE is designed to protect your income when adopting a new BMP. Did you feel this was accomplished?	Response Count	Response Percent
Yes, the BMP CHALLENGE Program protected my income.	25	89%
No, the BMP CHALLENGE Program did not protect my income.	1	4%
My income was protected, but participating had other costs that were not covered.	2	7%
Total	**28**	**100%**

9) Were you satisfied that the method used to determine net returns and calculate guarantee payments was accurate and fair? (i.e., comparing yields from a single check strip to adjacent BMP strips)	Response Count	Response Percent
Yes	27	96%
No	1	4%
Total	**28**	**100%**

10-NM) How much did the income guarantee (the agreement to pay for any net loss) influence your decision to try the Nutrient BMP CHALLENGE program?	Response Count	Response Percent
Very little	3	15%
Somewhat	10	50%
A great deal	7	35%
Total	**20**	**100%**

10-CT) How much did the income guarantee (the agreement to pay for any net loss) influence your decision to try the Reduced Tillage BMP CHALLENGE program?	Response Count	Response Percent
Very little	3	27%
Somewhat	3	27%
A great deal	5	45%
Total	**11**	**100%**
11-NM) Have you continued the practice that you tried with the Nutrient BMP CHALLENGE program?	Response Count	Response Percent
No, I have not continued use on my fields.	3	19%
Yes, I have continued use on my fields, but not regularly.	0	0%
Yes, I have regularly continued use on my fields.	8	50%
I use a modified version of the practice	6	38%
Total	**16**	**100%**
12-NM) Reasons you have not continued the practice you tried with the Nutrient BMP CHALLENGE program:	Response Count	Response Percent
Cost of implementation	2	29%
Requires too much time	1	14%
Not applicable to my operation anymore	0	0%
Fear I would lose yield / income	5	71%
Lack of technical assistance	2	29%
Other	0	0%
Total	**7**	**100%**
11-CT) Have you continued the practice that you tried with the Reduced Tillage BMP CHALLENGE program?	Response Count	Response Percent
No, I have not continued use on my fields.	0	0%
Yes, I have continued use on my fields, but not regularly.	2	67%
Yes, I have regularly continued use on my fields.	0	0%
I use a modified version of the practice	1	33%
Total	**3**	**100%**
12-CT) Reasons you have not continued the practice you tried with the Reduced Tillage BMP CHALLENGE program:	Response Count	Response Percent
Cost of implementation	0	-
Requires too much time	0	-
Doesn't apply to my operation	0	-
Fear I would lose yield / income	0	-
Lack of technical assistance	0	-
Total	**0**	-
14) Do you think that yield guarantees should always be offered to farmers considering a new BMP?	Response Count	Response Percent
No	5	28%
Yes	13	72%
Total	**18**	**100%**
15) What would be the best way to deliver yield guarantees to farmers?	Response Count	Response Percent
Federal Crop Insurance	3	25%

NRCS Conservation Crop-Share Program	6	50%
Other	3	25%
Total	**12**	**100%**
16 a) Part of the BMP CHALLENGE agreement with producers asks them to contribute a third of any fertilizer cost-savings, up to a maximum of $6 per acre, back to the program if they experience a net income gain. This contribution helps other farmers participate in the BMP CHALLENGE. Would you be willing to contribute if you were participating now and had a net income gain?	Response Count	Response Percent
Yes	11	73%
No	4	27%
Total	**15**	**100%**
16 b) Part of the BMP CHALLENGE agreements with producers asks them to contribute a third of any fertilizer cost-savings, up to a maximum of $6 per acre, back to the program if they experience a net income gain. This contribution helps other farmers participate in the BMP CHALLENGE. Would this contribution request keep you from participating in the BMP CHALLENGE?	Response Count	Response Percent
Yes	2	12%
No	15	88%
Total	**17**	**100%**
18-NM) Before you participated in the Nutrient BMP CHALLENGE program, what statement best described your corn fertilization practices per acre?	Response Count	Response Percent
More than 50 pounds over Extension-recommended BMP fertilizer rates	1	6%
25 to 49 pounds over Extension-recommended BMP fertilizer rates	2	13%
0 to 24 pounds over Extension-recommended BMP fertilizer rates	8	50%
0 to 4 pounds below Extension-recommended BMP fertilizer rates	1	6%
5 to 24 pounds below Extension-recommended BMP fertilizer rates	0	0%
More than 25 pounds below Extension-recommended BMP fertilizer rates	2	13%
Not sure if my rates were above or below Extension-recommended BMP fertilizer rates	2	13%
Total	**16**	**100%**
19-NM) Before you participated in the Nutrient BMP CHALLENGE program, what was your impression of Extension-recommended BMP fertilizer rates for corn?	Response Count	Response Percent
Extension-recommended BMP fertilizer rates do not yield as well as my traditional rates on my farm.	2	13%
Extension-recommended BMP rates may be adequate, but I cannot afford the risk of trying them on my farm.	7	44%
Extension-recommended BMP rates are adequate and I follow them regularly.	4	25%
Other	3	19%
21-CT) Before you participated in the Reduced Tillage BMP CHALLENGE program, what statement best described your tillage practices for corn?	Response Count	Response Percent
Mold board plow/finishing tool	0	0%
Chisel plow/finishing tool	2	50%
Finishing tool	0	0%

Other	2	50%
Total	**4**	**100%**
22) Number of years enrolled in the BMP CHALLENGE program	Response Count	Response Percent
1 Year	17	61%
2 Years	2	7%
3 Years	5	18%
4 Years	3	11%
5 Years	1	4%
Total	**28**	**100%**

Table 6: Results from a survey of 2013 BMP CHALLENGE participants

Response	# Responses	%	Question
			QUESTION 1
A. I used Adapt-N with an income guarantee from Agflex's Nutrient BMP CHALLENGE on one or more fields.	12	80%	Select the option that best describes your use of Adapt-N in 2013.
B. I used Adapt-N on a demonstration strip with no income guarantee from Agflex.	3	20%	
TOTAL	15		
			QUESTION 2
1	1	7%	Rate your level of satisfaction using the Adapt-N tool in 2013. (1 = not satisfied, 5 = very satisfied)
2	0	0%	
3	6	40%	
4	4	27%	
5	4	27%	
TOTAL	15	Average rating	3.666666667
			QUESTION 3
1	0	0%	How likely are you to use the Adapt-N tool in the future? (1 = not likely, 5 = very likely)
2	1	7%	
3	7	47%	
4	5	33%	
5	2	13%	
TOTAL	15	Average rating	3.533333333
			QUESTION 4
YES	5	33%	Do you have plans to continue using Adapt-N on all or a portion of your fields for 2014?
NO	10	67%	

TOTAL	15		
			QUESTION 5
0-20%	1	20%	If yes, on what portion of your fields will you implement a precision ag technique?
20-40%	0	0%	
40-60%	0	0%	
60-80%	1	20%	
80-100%	3	60%	
TOTAL	5		
			QUESTION 6
A. Implementation cost	0	0%	If no, select one or more reasons influencing your decision.
B. Too much time	2	20%	
C. Not applicable to my operation	0	0%	
D. Fear loss of yield/income	5	50%	
E. Lack of technical assistance	0	0%	
F. Not confident in Adapt-N accuracy	6	60%	
G. Other (describe)	3	30%	
TOTAL	10		
			QUESTION 7
A. Very little	2	13%	How much did the Nutrient BMP CHALLENGE income guarantee (the agreement to pay for any net loss) influence your decision to use Adapt-N?
B. Somewhat	4	27%	
C. A great deal	8	53%	
D. I did not participate in BMPC	1	7%	
TOTAL	15		
			QUESTION 8
a) Adapt-N	12	57%	Name of practice implemented in 2013.
b) Reduced tillage	5	24%	

c) Basic nutrient management	0	0%	
d)Vertical tillage	1	5%	
e)Incorporation	0	0%	
f) Controlled release N fertilizer	3	14%	
TOTAL	21		
			QUESTION 9
1	17	85%	Number of years you have been implementing this practice with the BMP CHALLENGE
2	1	5%	
3	1	5%	
4	0	0%	
5	1	5%	
TOTAL	20		
			QUESTION 10
a) Never heard of it	8	44%	If this practice was NOT a regular part of your farm operation before participating in the BMP CHALLENGE, why not?
b) Fear I would lose yield/income	6	33%	
c) Cost of implementation	1	6%	
d) Lack of technical assistance	2	11%	
e) Requires too much time	0	0%	
F) Other (please specify):	2	11%	
TOTAL	18		
			QUESTION 11
a) Very little	4	19%	How much did the income guarantee (the agreement to pay for any net loss) influence your decision to try this practice?
b) Somewhat	7	33%	
c) A great deal	10	48%	
TOTAL	21		
			QUESTION 12

a) I am usually one of the first operators in my county to try out a new precision ag practice.	14	67%	Which response best describes you?
b) I prefer to wait and see how a new conservation practice works for other operators in my county before trying it out myself.	5	24%	
c) I prefer to wait until most operators in my county are using a new conservation practices and reporting on its advantages and disadvantages before trying it for myself.	2	10%	
TOTAL	21		
			QUESTION 13
a) More than 50 pounds over Extension BMP recommendations	1	5%	What statement best describes your corn fertilization practices per acre before you participated in the BMP CHALLENGE program?
b) 25 to 49 pounds over Extension BMP recommendations	5	24%	
c) 0 to 24 pounds over Extension BMP recommendations	9	43%	
d) 0 to 4 pounds below Extension BMP recommendations	2	10%	
e) 5 to 24 pounds below Extension BMP recommendations	0	0%	
f) More than 25 pounds below Extension BMP recommendations	0	0%	
g) Not sure if my rates were above or below Extension BMP recommendations	4	19%	
TOTAL	21		
			QUESTION 14
a) Extension-recommended BMP rates do not yield as well as my traditional rates on my farm	5	25%	Before you participated in the BMP CHALLENGE Program, what was your impression of Extension-recommended BMP fertilization rates for corn?
b) Extension-recommended BMP rates may be adequate but I could not afford the risk of trying them on my farm	4	20%	
c) Extension-recommended BMP rates are about right and I follow them regularly.	5	25%	
d) Other (please specify):	6	30%	

TOTAL	20		
			QUESTION 15
a) University/Extension Service	5	24%	Before you participated in the program, what source(s) of information did you rely on to develop your corn fertilization rates?
b) Ag retailer	1	5%	
c) Crop consultant	14	67%	
d) Seed dealer	4	19%	
e) Neighbors/friends	1	5%	
f) Family members	0	0%	
g) Farm magazines	1	5%	
h) Other (please specify):	2	10%	
TOTAL	21		
			QUESTION 16
a) Yes, the BMP CHALLENGE Program protected my income.	16	80%	The BMP CHALLENGE Program is designed to protect your income when adopting a new BMP. Are you satisfied with the results of the program?
b) No, the BMP CHALLENGE Program did not protect my income.	0	0%	
c) My income was protected but participating had other costs that were not covered	3	15%	
d) I was not enrolled in the BMP CHALLENGE Program.	1	5%	
TOTAL	20		
			QUESTION 17
a) Yes	21	100%	Are you satisfied that the method used to determine net returns and calculate guarantee payments is accurate and fair? (i.e., comparing yields from a single check strip to adjacent strips).
b) No	0		
c) N/A, did not participate	0		
TOTAL	21		

		Average acres	QUESTION 18
a) Yes, I have adopted the practice on ___% of my corn acres.	10	48%	Have you adopted or do you plan to adopt the new practice on your corn crop in other fields not enrolled in the BMP CHALLENGE?
b) No	6	29%	
c) I have reduced my fertilizer rates on ___% of my corn acres, but not as much as I did when using the BMP CHALLENGE.	1	5%	
d) I have adopted a modified practice on ___% of my corn acres (please describe):	4	19%	
TOTAL	21	13 acre reports	67%
		Average acres	QUESTION 19
1. An income guarantee and a cost-share contract.			If you answered <u>No/Somewhat</u> on question 18, would you use the new practice on your corn acres if the following were available?
a) Yes, I would use it on ___% of my corn acres.	4	40%	
b) No, I would not use it	1		
2. Only an income guarantee without a cost-share contract?			
a) Yes, I would use it on ___% of my corn acres.	5	21%	
b) No, I would not use it	1		
3. Only a cost-share contract without a guarantee?			
a) Yes, I would use it on ___% of my corn acres.	3	32%	
b) No, I would not use it	3		
4. On your own without other assistance?			
a) Yes, I would use it on ___% of my corn acres.	4	48%	
b) No, I would not use it	2		
TOTAL	6		

			QUESTION 20
a) None	2	10%	Have you talked with other farmers about your experience with the BMP CHALLENGE Program? How many?
b) 1-3	7	33%	
c) 4-8	6	29%	
d) 8 or more	6	29%	
TOTAL	21		

QUESTION 21

Are there other agronomic BMPs that you have not yet adopted that you would consider adopting if the BMP CHALLENGE were available to you? Circle Y or N for each response.

Practice	Conservation till	Implement a NM plan	PSNT	CSNT	Use N inhibitors	Vertical tillage	Manure injection	VRT/precision application	Adapt-N
Have adopted	13	12	15	3	11	8	4	10	5
Have not adopted	1	0	1	4	3	3	5	2	2
Would consider with guarantee	2	2	1	6	2	2	1	3	11
Would not consider	2	2	0	4	0	4	5	1	0
TOTAL	18	16	17	17	16	17	15	16	18
Percentage	11.1%	12.5%	5.9%	35.3%	12.5%	11.8%	6.7%	18.8%	61.1%

Appendix C. BMP CHALLENGE: An Assessment for California for Sustainable Conservation

A report of BMP CHALLENGE experiences in California prepared by project partner Steven Shaffer, Environmental Consulting for Agriculture.

BMP Challenge
An Assessment for California
For
Sustainable Conservation
By
Steve Shaffer
March 30, 2014

Executive Summary

The purpose of this study is to assess the utility of the BMP Challenge (BMPC) or similar risk management approach to accelerate adoption of environmentally beneficial management practices in a variety of crops settings in California. The study describes potential future opportunities where a BMPC approach can benefit growers and the environment in California. We identify factors to consider when implementing a BMPC type program, including grower situation, industry structure - grower autonomy (e.g. dairy operators), contract with processors (e.g. tomatoes), cooperatives, boards, and commissions (e.g. almonds), and grower- shipper relationships (e.g. leafy greens).

Sustainable Conservation has been an active partner with American Farmland Trust, AgFlex, Inc. and UC Cooperative Extension under a 2009 Conservation Innovation Grant to use the BMP Challenge to accelerate grower adoption of conservation tillage and nutrient management practices in various cropping systems in California. From its experience with the BMP Challenge during the past five years, Sustainable Conservation and its partners gained valuable experience working with dairy producers and tomato and cool season vegetable growers to support adoption of Best Management Practices (BMP).

Opportunities exist to incorporate elements of the BMPC when developing new programs and incentives to support grower adoption of BMP. This report takes an in-depth look at the BMPC experience in California to better tailor future incentive-based programs to support BMP adoption by growers.

Specific results, findings and recommendations are summarized below.

- Fifty-five projects involving 49 farmers were supported by the BMPC in California. More than 3,000 acres were enrolled, primarily to support Conservation Tillage and Dairy Nutrient Management in dairy forage systems. Sixty acres of broccoli were enrolled in five projects, involving two growers.
- Twenty-one farmer-participants were surveyed for this report, along with representatives of all project partners.
- Farmers were generally satisfied with the BMPC and saw the value of a program that combined technical assistance with a BMP performance guarantee. However, most farmers were primarily motivated by the educational opportunity to try a new BMP.

- Farmers identified several barrier to adoption of new BMP, however lack of technical assistance was identified by more participants than any other (Chart 7, page 13.
- Farmers identified several potentially effective methods to support BMP adoption, indicating that a toolbox of methods is needed (Chart 9, page 15).
- A complex implementation structure emerged (Chart 3, page 8) to properly implement the program in California. Such a connected support network, we believe is key to any future success.
- BMPC partners found that providing adequate technical assistance in California was a much more intensive and costly effort than in the Midwest. It is also more costly to fund a performance guarantee since crops are more valuable, potentially leading to larger payouts for losses.
- Any BMP supported by a BMPC-type program needs to be carefully evaluated for commercial readiness. Closely associated, any farmer must be carefully evaluated for his/her ability to successfully implement the supported BMP.
- Opportunities are presented to structure a BMPC approach as part of a robust conservation toolbox with various actors in the agricultural community.

Introduction

In California, farmers and ranchers are increasingly being asked by the public, through new laws and regulations, and wholesale and retail buyer demands to improve their environmental performance by protecting surface water and groundwater quality, reducing air emissions, using water more efficiently, and protecting wildlife. Farmers and ranchers are also under competitive pressure in the marketplace to become more efficient in using production inputs, including water, fertilizers, crop protection materials, and energy. In order to do so, farmers and ranchers are constantly innovating by adopting new Best Management Practices (BMP). Depending on individual grower's approach to BMP adoption, they adopt BMP at different rates, and need different technical and financial support tools. One of the more important factors that growers consider when adopting BMP is the risk to crop yield and quality. Growers reduce this risk using various methods. They accumulate information on the BMP from various sources. They test the BMP on a small scale. Some are incentivized to then try the BMP on a commercial scale. Some growers may be more receptive to implementing a BMP if an economic safety net such as a performance guarantee is available.

Program Overview

The BMP Challenge is one program that offers indemnification (defined as providing compensation for incurred loss or damage) in the form of a performance guarantee to growers who wish to try selected BMPs. The BMP Challenge is not strictly an insurance policy against crop or income loss.

The BMPC offers Service Agreements to growers who want to "kick the tires" of a BMP on a commercial scale. In most cases technical assistance is provided to the grower cooperator to help with the learning curve and assure success of the BMP. Either a check strip or a split field project design is used to accurately compare the grower's standard management practice to the BMP. If the BMP performs worse than the standard practice, beyond a specified margin of error with respect to crop yield, quality and/or production cost, the grower is then compensated for the difference. If the BMP performs better than the standard practice, on a voluntary basis, the grower pays a certain agreed-upon percentage of the realized additional income back to the program. This feature serves to assure grower commitment to the project and to help maintain and expand the needed funding reserve to support BMP adoption on more acres.

History and Evolution of the BMPC

Defined peril crop insurance has been around since 1939 and is still commonly available today. It is primarily used to indemnify growers against weather related losses such as drought, flood, or freeze. The idea of applying the defined peril indemnification concept to reduce the risk (perceived or real) to growers for implementing IPM or BMP was first considered by the original proponents of Integrated Pest Management at UC Berkley in the late 1950s. It wasn't until crop insurance program restructuring in the 1994 Farm Bill, that indemnification for IPM or BMP adoption was discussed. A 1995 USDA-ERS study, "Voluntary Incentives for Reducing Agricultural Nonpoint Source Water Pollution"

reported results of grower surveys that although they understand that BMP can reduce costs, they still will not adopt them due to the perceived risk to yield, with the risk as high as 70% to 80%.

However, in 1994, Bolkan and Reinert reported in the journal Plant Disease, a program they initiated in 1992 to implement a comprehensive IPM program with their growers of tomatoes, carrots and celery. This program combined strong technical assistance with grower indemnification to reduce the risk of adoption of the new IPM practices. This program resulted in a 50% reduction of pesticide use by their growers over a course of four years, in California, Ohio and Mexico.

From 1998 through 2002 Tom Green, Director of the IPM Institute in Madison, WI and Jim Cubie, Director of the Agriculture Conservation Innovation Center and former Council to the US Senate Agriculture Committee performed extensive research and feasibility analysis for a crop insurance type program to support IPM/BMP adoption in various crops in various regions of the US including disease forecasting in tree fruit and vegetables. Their work was supported by USDA SBIR planning and implementation grants. After successfully demonstrating grower interest in an indemnification approach, they formed a private company, Agflex, Inc. to commercialize an income guarantee program, calling it the BMP Challenge. This approach was supported with initial funding from American Farmland Trust and USDA-NRCS Conservation Innovation Grants in 2004 and 2009. Fully half of the 2009 CIG was dedicated to California. Appendix 1 provides additional detail compiled by Tom Green regarding early indemnification projects to support BMP and IPM adoption.

Results to date of the BMP Challenge - Nationwide, excluding California

AgFlex, under the current BMP Challenge, provides income guarantees and technical assistance for the following practices in field corn in the Midwest: reduced tillage systems; basic nutrient management; Pre-Sidedress Nutrient Testing (PSNT), Corn Stalk Nutrient Testing (CSNT), manure injection; enhanced nitrogen fertilizer products (such as timed release); and variable rate fertilizer application.

From 2000 through 2011, the BMP Challenge obtained the following results:

Table 1

2000-2011 RESULTS	Nutrient BMP CHALLENGE®	Reduced Tillage BMP CHALLENGE®	Planned Nitrogen Reduction	Totals
Total acres, 2000-2011	5082 acres	2534 acres	9069 acres	16,685 acres
BMP yield, average and range	159.8 bu/acre 56.3-237.0	158.5bu/acre 31.9-237.0	150.5 bu/acre 55.7-229.4	
Check-strip yield, average and range	166.4 bu/acre 49.8-230.0	167.1 bu/acre 26.2-242.0	162.4 bu/acre 63.1-264.0	
Average farmer net returns after fertilizer or tillage savings	($5.10) ($89.85)-$109.50	($9.96) ($156.77)-$130.20	($35.29) ($330.00)-105.24	
Total N use reduction	190,001.4 lbs	-	244,199.1 lbs	434,200.5 lbs
Estimated sediment reduction	-	3800.7 tons	-	3800.7 tons
Estimated P load reduction	-	5067.6 lbs	-	5067.6 lbs
Estimated N2O reduction	3582.9 lbs	-	4604.9 lbs	8187.8 lbs
Estimated CO2 reduction	530.3 lbs	1266.9 lbs	681.5 lbs	2478.7 lbs

Charts 1 and 2 below, provided by Agflex and American Farmland Trust, document clearly that implementing new practices is not without risk. It often takes growers more than one season to refine a new practice in order to optimize it for their specific growing conditions. As these charts show, both for nutrient management and for reduced tillage BMP, approximately the same number of growers lost income as gained income when first implementing the BMP. It is important to consider the role of competent technical assistance, and the need for growers to adequately familiarize themselves with the new BMP.

Chart 1

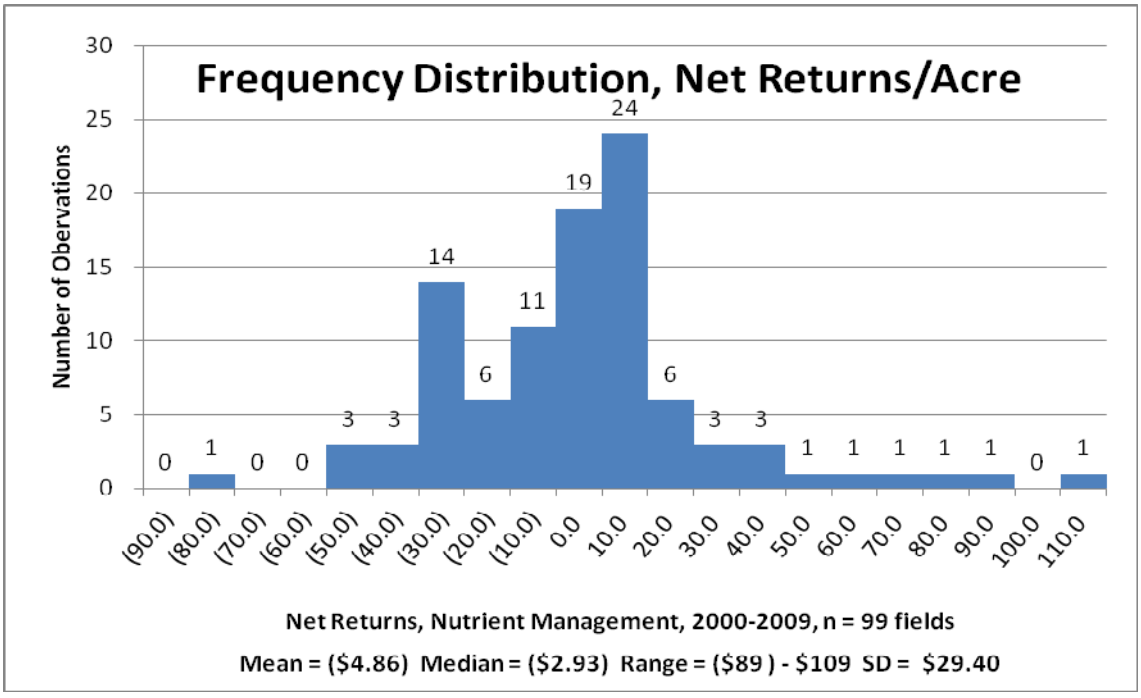
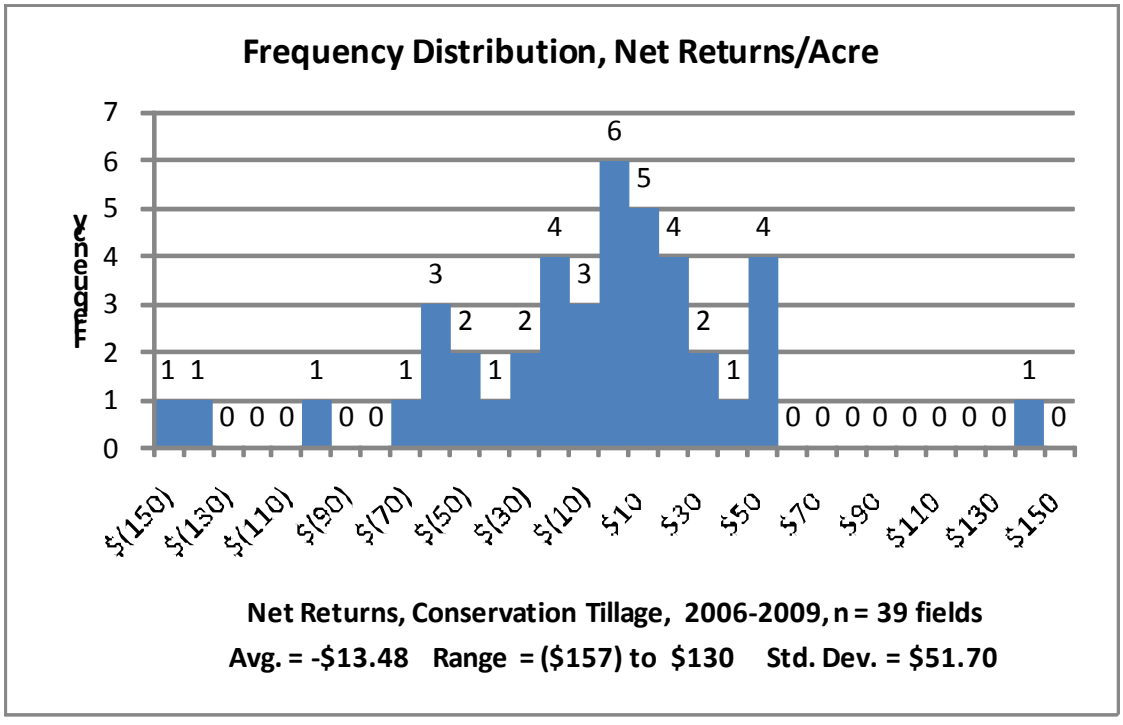


Chart 2



Farmers continued or modified the nutrient management and conservation tillage practices they implemented under the BMP Challenge on additional acres at a high rate. 87% of nutrient management participants from 2003-2009, 79% of 2010 participants, (including planned nitrogen reduction), and 100% of reduced tillage participants from 2003-2010 continued the BMPs.

Grower participants were quite satisfied with the program. 89% felt that their income had been protected. 97% said the procedure to calculate guarantee payments was accurate and fair. 70% claimed they received "economic benefits" by participating. 39% of farmers repeat the program more than one year, often adding a new practice.

BMP Challenge - The California Experience

The BMP Challenge was first piloted in California in 2009 and funded by a 2009 USDA-NRCS National Conservation Innovation Grant to expand the program significantly in 2010. The program under the grant concluded in September 2013. The primary purpose of the program was to extend the BMP Challenge approach to support expansion of conservation tillage in dairy forage (corn silage) systems. A small amount of the grant was dedicated to also piloting the program in high value specialty crops by supporting conservation tillage in processing tomatoes. Just as the program was implemented in California, dairy operators and specialty crop growers were faced with new strict water quality regulations that in part, require much greater precision in applying dairy nutrients (lagoon water and solids) and commercial nitrogen fertilizer. Program partners decided to also demonstrate the BMPC approach to support growers to implement nutrient management BMPs, both on dairies and in specialty crops.

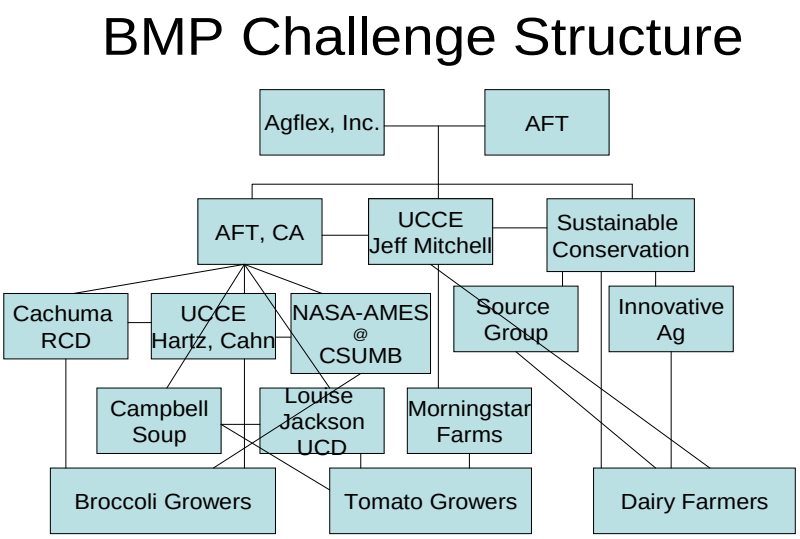
Structure and partnerships

The BMPC team in California included Agflex, American Farmland Trust, Sustainable Conservation and University of California Cooperative Extension (UCCE). Private project recruiters and technical assistance providers for dairy projects, recruited by Sustainable Conservation included the Source Group and Innovative Ag Solutions. Campbell Soup Research was a partner in the attempt to develop irrigation and nutrient management projects in processing tomatoes. Cachuma Resource Conservation District was a recruiting and TA partner in the first irrigation and nutrient management project in broccoli in 2012. NASA-AMES Research at Cal State Monterey Bay and Monterey County Cooperative Extension are TA partners on two broccoli irrigation and nutrient management BMP projects in 2013 with the large farming company Tanimura and Antel.

To date, these efforts have led to 10 Conservation Tillage (CT) projects in corn silage systems, 37 projects supporting Dairy Nutrient Management (DNM), 2 irrigation management projects in processing tomatoes and 4 projects supporting irrigation and nutrient management systems in broccoli on the Central Coast. Each application of the BMPC to these cropping systems had its own unique set of issues regarding grower recruitment, project design, level and cost of technical assistance, project monitoring and

performance assessment. Chart 3 depicts the extensive collaborative structure that developed to extend the BMP Challenge to growers in California.

Chart 3



Applications
Charts 4 and 5 summarize the number and types of projects and number of acres enrolled in BMP Challenge in California.

Conservation Tillage (CT) in Dairy Forage Systems
Growers were first recruited in 2009 to implement Conservation Tillage in dairy forage systems in California. Two projects totaling 190 acres were implemented. These were supported under the 2006 CIG grant and were an initial test of the approach in California. In October 2009 a new CIG was received totaling $947,000 with half the funds dedicated to projects in California. These funds supported 3 CT projects comprising 330 acres in 2010, 2 totaling140 acres in 2011 and 2 comprising of 93 acres in 2012.

Dairy Nutrient Management (DNM)
In 2009 a total of 5 nutrient management projects were supported under the 2006 CIG. The five projects represented 367 acres ranging from 18 to 180 acres. All supported blending of dairy lagoon water through the farm's irrigation water distribution system. There were 19 projects in 2010 and 14 in 2011, representing 1,079 acres and 1,013 acres respectively. In 2012 there were only 2 projects on a total of 110 acres. Each of these projects focused on installing infrastructure to precisely blend dairy lagoon nutrients into irrigation water distribution systems and monitoring protocols to apply the nutrients precisely regarding appropriate time, amount and placement.

Conservation Tillage in Tomatoes
Jeff Mitchell, a co-applicant under the 2009 CIG and Ron Harben (NRCS, retired) worked to recruit processing tomato growers to implement CT in processing tomato production systems in both the Sacramento Valley and San Joaquin Valley. Jeff, through his extensive work for well over a decade to develop, demonstrate and implement CT systems in corn and other forage systems, cotton and both fresh and processing tomatoes recruited heavily, but was unable to formally enroll any growers in the BMPC for CT in tomatoes in 2010 - 2012. He has continued to establish research and demonstration projects with many tomato growers throughout California apart from the BMPC.

Efficient Irrigation and Nutrient Management in Processing Tomatoes
The 2009 CIG allowed for demonstrating the BMPC approach to incentivizing adoption of approved BMPs in other specialty crops in California. Approved BMPs included well-demonstrated nutrient management practices, including related irrigation management practices. The AFT consultant was not able to formally enroll any growers under the BMPC, however he was able to obtain the results of the work of Louise Jackson in collaboration with Campbell Soup on Alternate Furrow Irrigation, which took place on three fields, totaling 200 acres near Davis (2) and Dixon (1).

Efficient Irrigation and Nutrient Management in Broccoli
The AFT consultant, with input from other BMPC partners, started seeking out other opportunities to apply the BMPC incentive to other cropping systems. Of particular interest were lettuce and broccoli on the Central Coast. These crops particularly receive significant nitrogen fertilizer and irrigation water inputs, and specific, well-proven BMPs were available for more extensive use by growers in the region. In 2012, two broccoli fields were enrolled in the BMPC, with six of twelve acres of each field managed under an Efficient Irrigation and Nutrient Management (EINM) BMP. A third field was later planted and managed using the same EINM BMP, but not formally enrolled in the BMPC. Two field of broccoli were enrolled in 2013 using a very similar EINM BMP. Each field is approximately 12 acres with one acre in each managed under the EINM BMP.

Chart 4

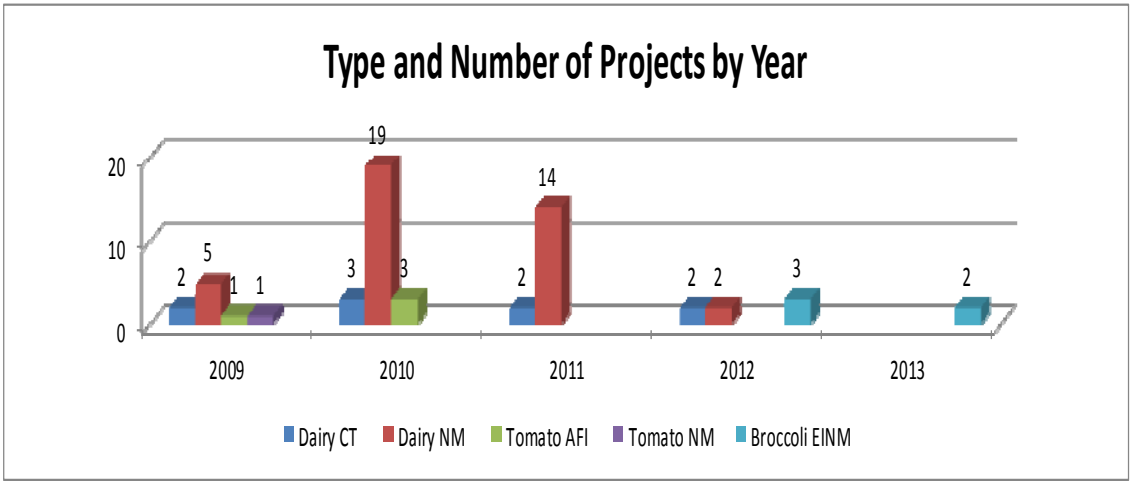
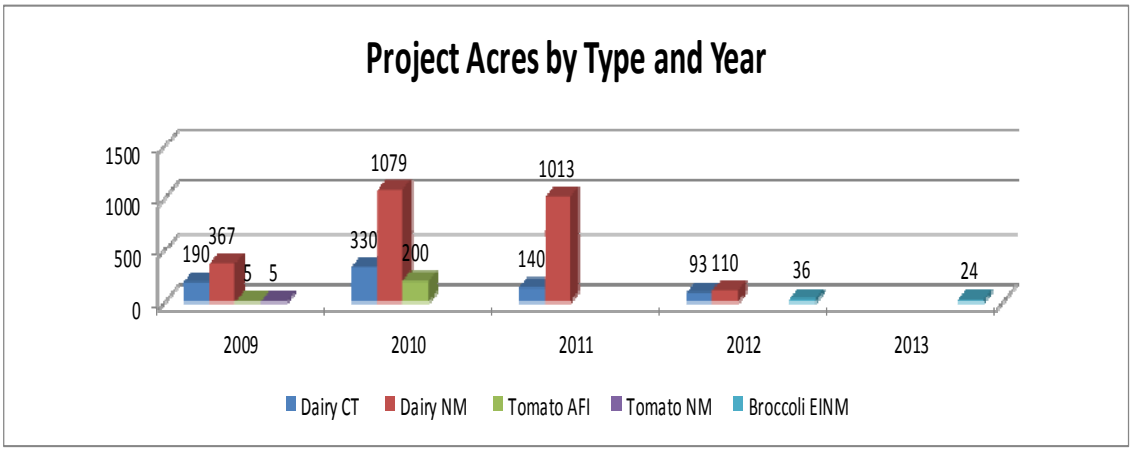


Chart 5



Study Objectives and Methods

Objectives

The purpose of this study is to assess the utility of the BMP Challenge or similar risk management approach to accelerate adoption of environmentally beneficial management practices (BMP) in a variety of crops settings in California. The study describes grower-cooperator opinions of having participated in the BMPC, opinions of the partners and collaborators supporting the BMPC and potential future opportunities where a BMPC approach can benefit growers and the environment in California. We identify factors to consider when implementing a BMPC type program, including commercial readiness of the BMP, grower readiness, grower - buyer relationships and other grower-industry structures.

Methods

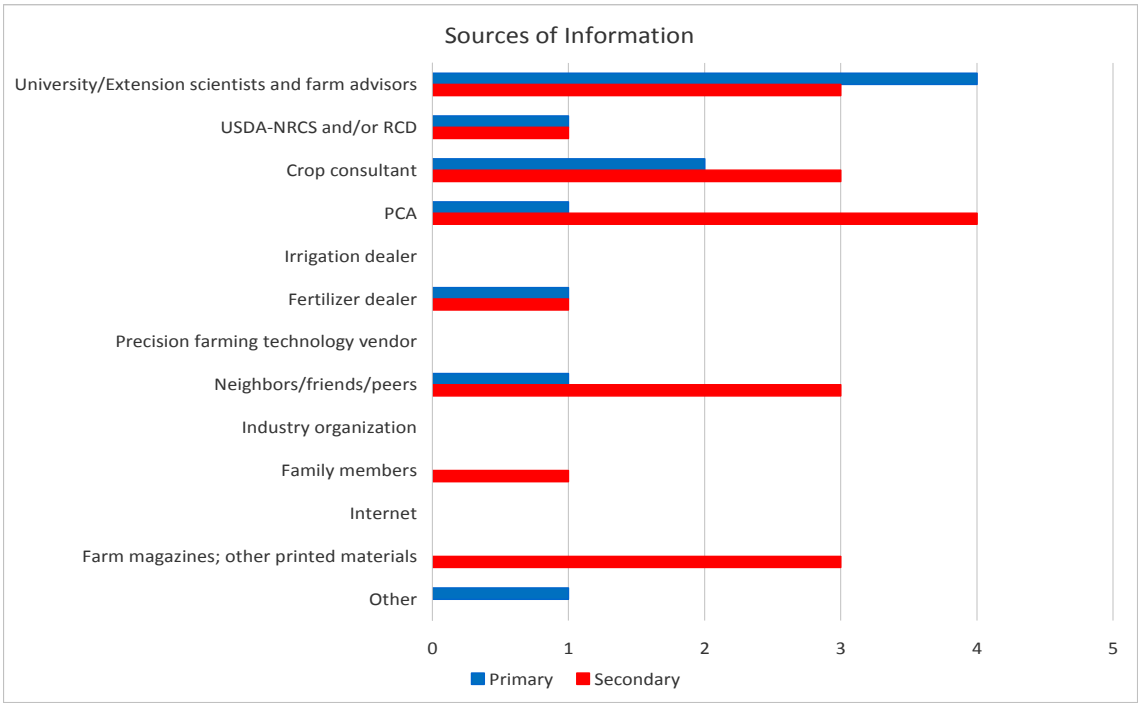
A survey of grower participants was conducted to provide quantitative data regarding their participation in the BMPC and questionnaire for partners and TA providers. In addition, individual interviews were conducted with most TA providers and with selected participants (selected to represent the full range of participant experiences). Three surveys were prepared to take into account variations in the BMP (Conservation Tillage, Dairy Nutrient Management or Broccoli Efficient Irrigation and Nutrient Management). The survey was administered by mail, email, on-line and by telephone. Partner and TA provider questionnaires were administered by email and telephone. The surveys and questionnaires can be found in Appendix 3.

Results and analysis

We not only wanted to know what grower-cooperators thought about their experience with the BMPC, but also gain some insights into how they approached adoption of new BMP. Of the 55 projects supported under the BMPC, 21 were surveyed for this study. Since some farmers participated in more than one project, fewer individuals were surveyed - 15. Thirteen of those fifteen fully completed the survey. One dairy producer had four projects, with varied experiences among the projects. Two other dairy producers interviewed had two projects each. The responses of one of two broccoli growers are not tabulated in the graphs, but are reflected in the narrative. The responses of the second broccoli grower have not yet been received, however some of his thoughts, obtained by personal communications (telephone and email) are included in the narrative. Please refer to Appendix 2 for the complete project list, with survey respondents highlighted.

Chart 6 shows that dairy farmers rely on a diversity of sources of information. They rely on more than one source. Their primary sources are University of California farm advisors and their private crop consultants. The 1 "other " response was their own personal experience.

Chart 6

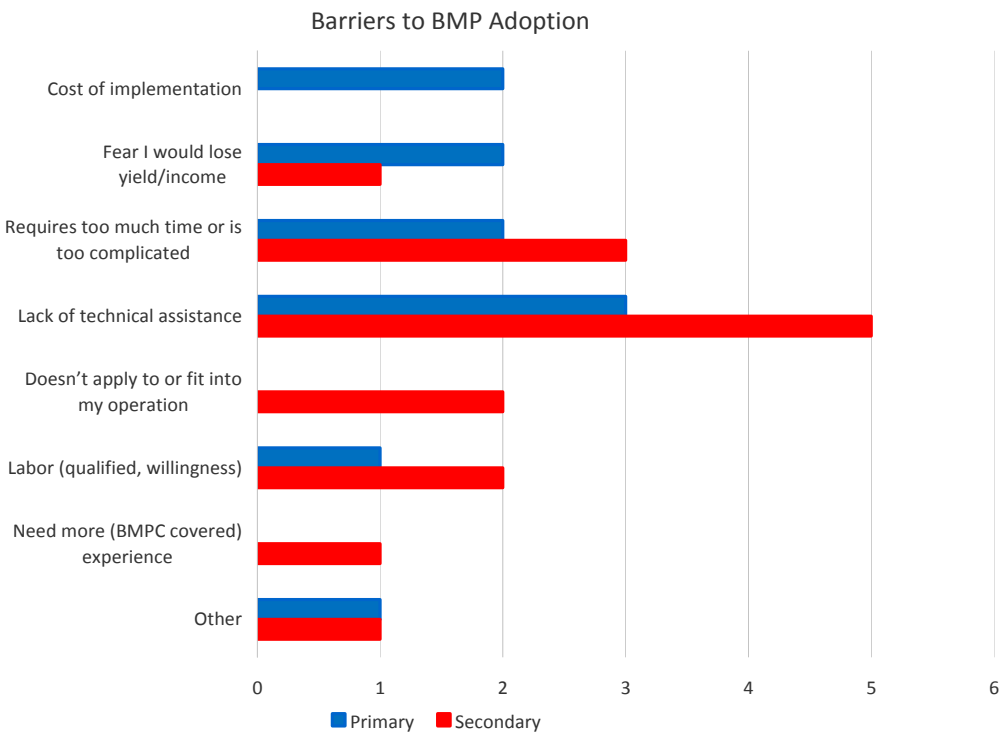


When asked if they followed UC Extension recommended practices pertaining to nitrogen fertilization rates or tillage practices prior to participating in the BMPC, growers were aware of them, but six of eleven believed they did not yield as well as their own practice. Four of eleven followed Extension recommendations.

When asked about their prior knowledge of the BMP they tried under the BMPC, most were aware of the BMP but had no direct experience with it. When asked when they usually adopted a new BMP relative to their peers, five identified themselves as early adopters, five as middle adopters, and only one self-identified as a late adopter.

Chart 7 indicates that there were a variety primary and secondary barriers identified with implementing a new BMP. While cost and potential yield impacts were definitely factors growers considered when implementing a BMP, eight out of eleven identified lack of information as a primary or secondary barrier to adoption.

Chart 7



Growers' thoughts regarding the BMPC

Twelve out of thirteen farmers were satisfied with the support, information and incentives provided by the BMPC. Eight believed that their income was fully protected, while four believed their income was somewhat protected. One grower commented that there were other costs associated with participation that were not covered (labor). One CT participant believed he was misinformed as to the amount covered by the BMPC.

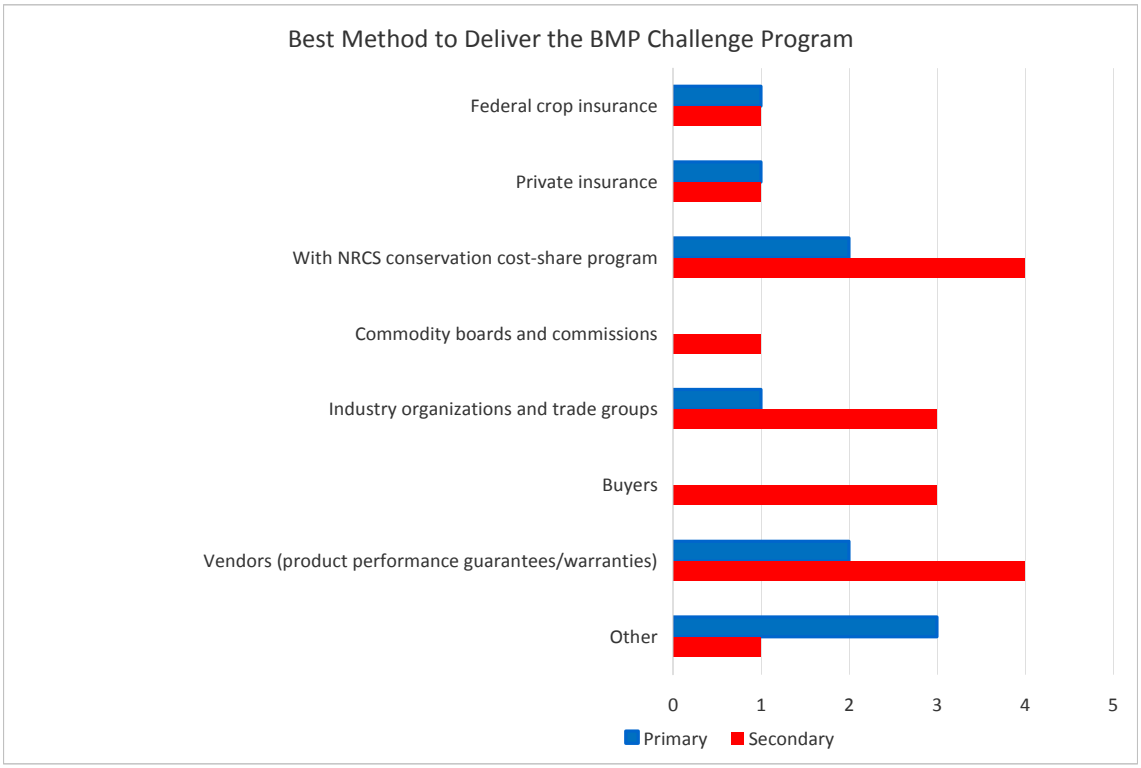
Nine of the thirteen respondents believed that the method used to calculate yield/income loss payments was fair and transparent.

Tellingly, all thirteen felt that a BMPC-type program should be widely available to growers as an option to support adoption of a new BMP. They understood that risk was a barrier to many growers, even if not a substantial one to themselves. Using the BMPC on a relatively small field made sense. Several commented that projects should be two or three years long so that they could really get a good sense of how the BMP performed in varying conditions and to improve grower comfort with the BMP.

The dairy farmers surveyed (Chart 8) seemed familiar and comfortable with NRCS cost-share programs that also offer technical assistance. If the several forms of offering a BMPC program from the private sector are aggregated, that becomes an approach that was well supported by the participants. The "other" responses were variations on NRCS

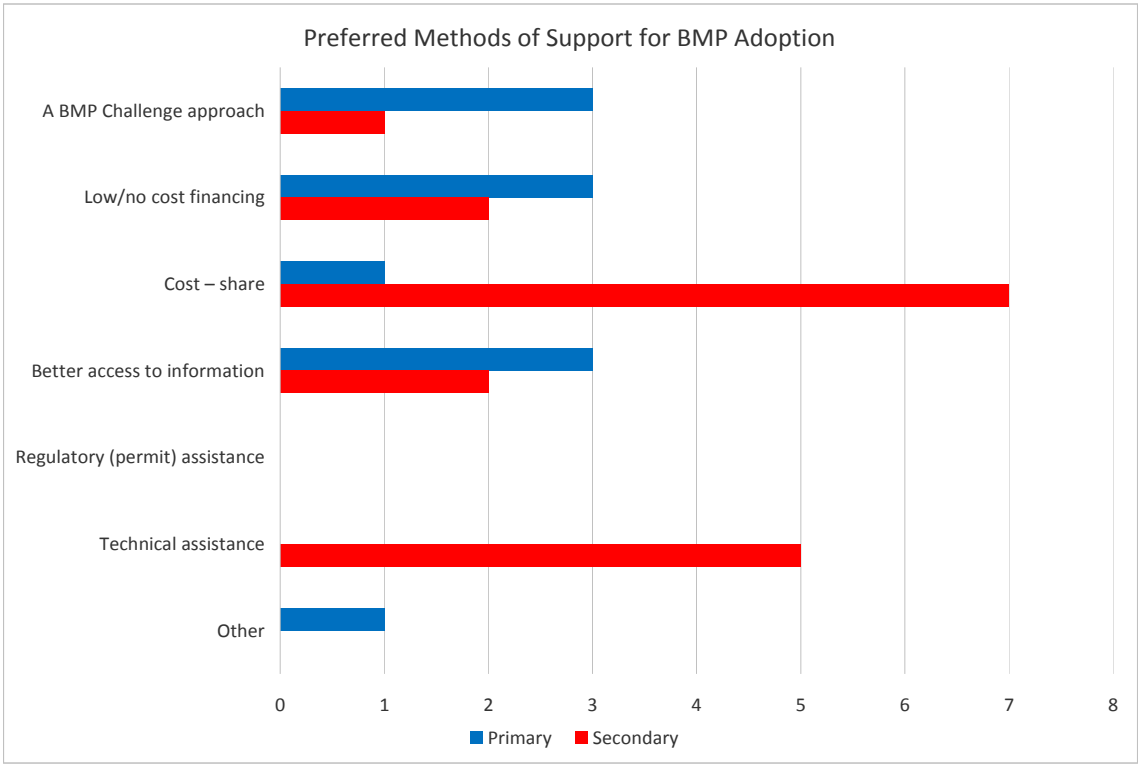
cost-share programs and private consultants and vendors providing performance guarantees.

Chart 8



The growers surveyed provided more comments to answer the question of how best to support BMP adoption, to augment their responses (Chart 9) than to any others. Those that added comments (5 of 11) all expressed the need for technical assistance from local providers (government or private) who really know the growing conditions (soil types, water quality, weather, etc.). Several thought that access to the technical assistance providers was not as good as it could have been. These comments, all provided by dairy producers, reflected availability and adequacy of the technical assistance provided under the BMPC; and poor internal communications within the dairy operation. Private technical assistance providers sometimes could not or would not provide the information and guidance sought by the dairy operator. In some instances the custom operator hired by the dairy operator was not informed adequately or was unwilling to adhere to the BMP. Proper buy-in and oversight by the dairy operator sometimes was lacking. These issues were more common with the CT projects, than with the DNM projects. Additional discussion is provided in the Project Design, Implementation and Monitoring section on page 18.

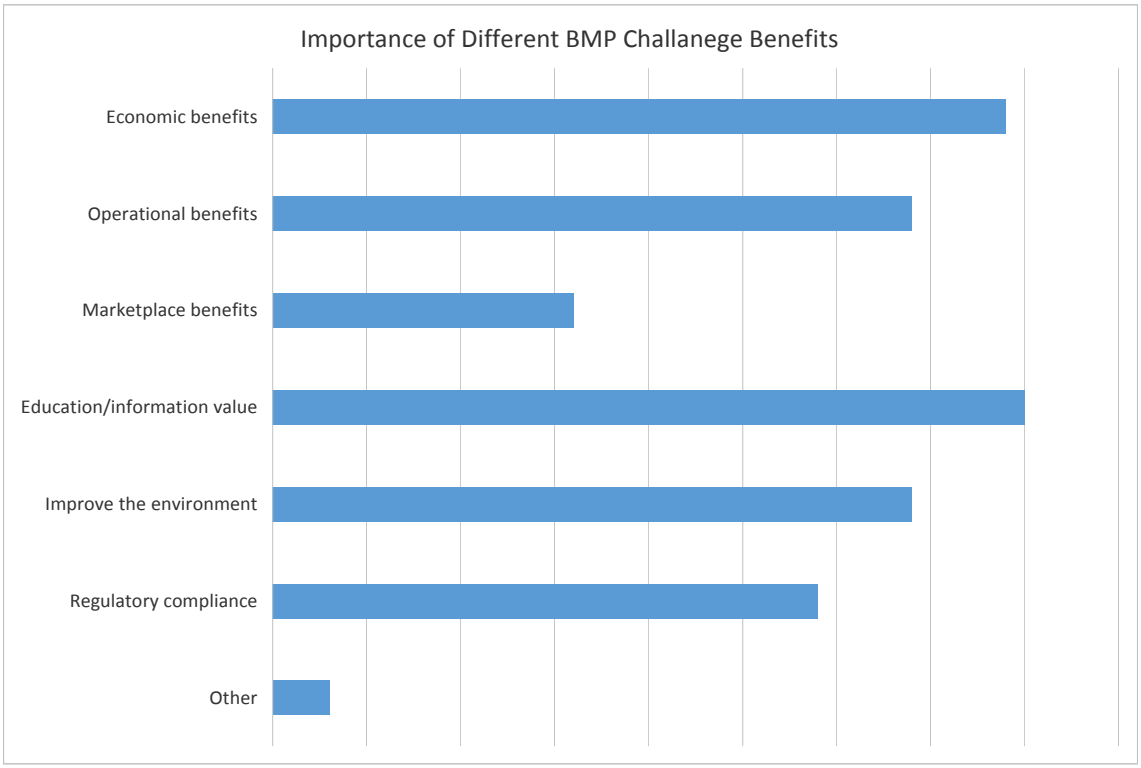
Chart 9



Growers were also asked if they would be willing to pay back a portion of their increased net profits, if successful, up to $6 per acre, to fund a BMPC-type program. (In fact, this was a provision of the BMPC agreement that growers signed, but was declared to be voluntary by Agflex and AFT.) Eight out of twelve responded that they would, but only one actually made the payment back to the program.

When asked about benefits derived from participating in the BMPC (Chart 10), the greatest response was educational value, closely followed by economic benefits. Operational benefits, environmental benefits and regulatory compliance benefits were also highly regarded, while marketplace benefits were a distant last. Note that this question was about the BMP Challenge program and not about the benefits derived from the BMP itself.

Chart 10



Five of twelve growers indicated that the income guarantee aspect of the BMPC was a major factor in their decision to participate, while seven growers, including both broccoli growers indicated it somewhat influenced their decision.

When asked if they had continued using the BMP introduced under the BMPC, all seven DNM respondents continued, 2 of 4 CT respondents continued, as well as one broccoli grower. Many of the DNM participants continue to fine-tune the BMP to better fit their own growing conditions. They now monitor their fields more closely using soil and tissue testing. One was afraid of over-applying nutrients, but testing verified he was safe. Of the two CT growers who continued the BMP, one continues to expand the BMP to a few more fields each year. The two CT participants who did not continue with the BMP indicated that it was due to the unwillingness of their custom operators to adopt CT. Weed management was the primary issue. One broccoli grower has now expanded the BMP to more than 50% of his fields. He would expand the BMP more rapidly if he had additional technical assistance and could find willing and qualified labor. The other broccoli grower just completed the project on two fields, with excellent results. NASA-AMES scientists said that Tanimura and Antle management expressed strong interest in expanding use of the BMP.

Partner Experiences

The primary goals of the BMPC program in California were to expand adoption of Conservation Tillage (CT) and nutrient management in dairy forage (corn) systems, building upon experience in the Midwest. There was a small element to pilot the BMPC in specialty crops, focusing on CT in processing tomatoes and associated crop rotations. The program ran from October 2009 through October 2013. The program was funded by a 2009 USDA-NRCS Conservation Innovation Grant, with approximately half of the $947,000 dedicated to projects in California. The four partners on the grant were Agflex, LLC, American Farmland Trust, UCCE Cropping Systems Specialist leading the Conservation Tillage Work Group and Sustainable Conservation. Program implementation was conducted with a backdrop of impending water quality regulations imposed on dairies in 2007 (The Central Valley Dairy General Order Water Quality Regulatory Program) and cropland in 2008 (the Central Valley and Central Coast Irrigated Lands Regulatory Program), implicitly requiring growers to adopt irrigation and nutrient BMP by 2012 and 2014, respectively to meet water quality improvement goals. These new regulatory programs, require reporting the amount of nutrients produced and used, a farm nutrient management plan to protect surface and groundwater quality, and in some cases limit the amount of nitrogen fertilizer (no matter the source) a grower may apply to a field/crop. Thus growers were perhaps more receptive to learning about and trying new BMP to assist them with meeting these regulatory requirements.

Outreach

Sustainable Conservation staff focused on implementing DNM and CT projects building on their relationship and experience with the industry (Source Group and Innovative Ag Solutions) and with the UCCE Conservation Tillage and Cropping Systems Workgroup, led by the Cropping Systems Specialist. The specialist also led the effort to use the BMPC to extend CT into processing tomato production systems. The AFT consultant worked to pilot the BMPC to support adoption of irrigation and nutrient management BMP in processing tomatoes and later in broccoli and other cool season vegetables on the Central Coast.

Outreach to inform growers of the BMPC was conducted in many ways. The core team in California (Sustainable Conservation, UCCE, AFT) met as a team and individually with dairy industry organizations, tomato industry organizations, tomato grower organizations and attended other meetings held by UCCE with individual tomato processors and with individual growers. The team also publicized the program at the Fertilizer Research and Education Program annual conferences, and at the World Ag Expo. Sustainable Conservation staff identified and worked with equipment manufacturers and private dairy crop consultants to successfully develop an additional layer of partners closer to the growers. In the dairy sector, these partners were key to building the program from eight projects in 2009 to 21 and 16 projects in 2010 and 2011, respectively.

The AFT consultant in California and others on the BMPC team believed there was an opportunity to expand implementation of proven efficient irrigation and nutrient management practices (EINMP) BMP in processing tomatoes, a crop grown on

approximately 280,000 acres in the Central Valley. In 2009 and 2010 the AFT consultant interviewed many growers individually and also attended tomato industry meetings where the BMPC was presented to support the adoption of either CT or EINMP, with little success. In 2010 the AFT consultant presented the opportunity to Campbell Soup, whose research director at the time, Hasan Bolkan was directing several trials at the Campbell's research farm near Davis, CA. As referenced above, Bolkan was intimately aware of the BMPC approach to supporting growers to adopt new BMPs, and believed their work at the research farm was ready to extend to growers the following year (2011).

Campbell's was also collaborating with Professor Louise Jackson at UCD who received a CA Specialty Crop Block Grant to demonstrate Alternate Furrow Irrigation in processing tomatoes. Both were amenable to proposing the BMPC to their grower-collaborators, but although the AFT consultant tried repeatedly to meet with the growers, he was unsuccessful. Growers working with Jackson were already willing to collaborate on the project and needed no further incentive to do so. Bolkan retired in early 2011 and his successor, while supportive of BMP adoption assistance to growers, being new to the organization, was not in a position to collaborate.

One of the obstacles to promoting the BMPC was its perception by growers that it was a government subsidy. While it is true that the BMPC was funded by a USDA grant, it was to demonstrate a support mechanism that would not ultimately be government run. Many specialty crop growers often cooperate with their local farm advisors on research and demonstration projects as matter of doing business, thus the BMPC is not needed as an incentive, and also considered a government subsidy. Staff for one of the major tomato growing and processing companies in California suggested that a BMPC approach might be more attractive to smaller and medium sized growers if promoted through industry organizations, farm advisors, seed dealers and other well established and trusted entities. This phenomenon seems less prevalent in the dairy industry, where producers are more comfortable with government intervention in the marketplace (e.g. milk pricing and production quotas).

The UC Conservation Tillage Working Group did provide technical assistance to several tomato growers who tested CT, but none were interested in enrolling in the BMPC. The same situation was encountered with several county farm advisors who routinely partnered with growers on BMP field trials. Gaining first hand experience with the technology was the primary motivation for the growers, while risk mitigation was not a key factor in the decision to try a new BMP.

The AFT consultant regularly attended the Agriculture Water Quality Alliance (AWQA) meetings (with grower participants) and reached out to County Farm Bureaus, Resource Conservation Districts (RCDs) and farm advisors on the Central Coast in an effort to recruit growers to adopt a suite of well proven Efficient Irrigation and Nutrient Management (EINM) BMP for cool season vegetables developed by UCCE specialists and farm advisors and identified by them as underutilized. These efforts finally paid off with four EINM projects in broccoli (second only to lettuce in acreage) in 2012 and 2013.

It was local contacts - Cachuma RCD and NASA-AMES at Cal State Monterey Bay with the Monterey County Farm Advisor who identified willing growers. Both provided the technical assistance and monitoring for the projects.

Project Design, Implementation and Monitoring

The BMPC was initially designed for Midwest corn growers to reduce soil erosion and fertilizer runoff. A limited number of CT and NM practices were supported, for one crop, where irrigation was not used. These practices were all well proven and widely supported by private crop consultants as well as cooperative extension agents and USDA-NRCS. Translating the design and structure for the Midwest to California conditions proved to be a challenge. Aside from the need to develop a new technical support structure, as detailed above, project design and logistics had to be revamped to accommodate the way corn is grown in California. In the Midwest, a simple check strip is delineated in the field for the conventional practice, with the balance of the field (up to 100 acres) uses the BMP. A Certified Crop Consultant is paid $6 to $9 per acre to design, provide technical assistance, and monitor results (collect yield data) of the project.

In California corn production, irrigation is key to high yields. Working in irrigated fields necessitates accommodating project design to the irrigation systems. Check strips as used in the Midwest were virtually impossible. Various alternate approaches were tried including comparing adjacent fields, splitting fields and delineating check strips based on irrigation blocks. Some growers took advantage of adjacent field comparisons, knowing one field did not produce as well as its neighboring field. Apparently even obtaining field history data was not enough to overcome this situation. Splitting fields also presented problems, as variability across a field can also be a significant confounding factor. (Splitting smaller fields, the project design used for the two 12 acre broccoli fields in Santa Maria worked well. These were irrigated using surface drip systems that could easily be split into two blocks.) Check strips were ultimately used in corn systems and in two broccoli fields, but based on irrigation blocks. This design made obtaining yield date more difficult, but doable.

Technical assistance (TA) is the major component of the BMPC that attracts many if not all growers to participate in the BMPC. It is fair to say that demand for TA in California exceeds supply in many instances and for several reasons. BMPC leads and their TA partners underestimated the amount of TA required to assure successful implementation and monitoring of BMPC projects.

Regarding CT projects, TA and monitoring logistics was often difficult due to capacity constraints brought about by limited funding. Sufficient TA was provided to set up and operate equipment, but not always provided during the rest of crop production to assure proper crop management (irrigation, weed control, etc.) under the CT system. Assuring accurate yield monitoring often proved challenging logistically, as harvesting was often scheduled with little lead time to allow for partners to travel to the project site to oversee harvest and direct data acquisition. With respect to DNM projects, TA delivery to grower

participants primarily provided by Source Group in the northern San Joaquin Valley and Innovative Ag Solutions in the southern San Joaquin Valley was performed diligently. However, these organizations were not brought into the program originally to provide intensive TA. Again, the need for intensive consistent TA was not realized at the beginning of the California effort. Expectations were based on the Midwest experience where crop consultants were paid $6 to $9 per acre.

The Alternate Furrow Irrigation (AFI) projects supported by Campbell Soup and UCD (Jackson) were already in place when they were approached to participate in the BMPC. Both Campbell (Bolkan) and UCD (Jackson) were interested to know how growers would respond to the BMPC, but due to circumstances already described did not facilitate grower conversations with BMPC collaborators. The growers participating in the AFI work were already committed, with no additional incentive needed.

Cachuma RCD actively partnered with the AFT consultant to find a grower interested in implementing EINM in either broccoli or lettuce. When a broccoli grower expressed interest, a project was designed and implemented. Intensive TA was provided to the grower, including a full assessment leading to an upgrade of the surface drip irrigation system. RCD staff intensively monitored the projects by installing flow meters and soil moisture monitoring equipment, and by taking periodic soil samples to record nitrogen levels. This intensive work was expensive, but provided excellent grower support and hands on experience for the RCD.

The same can be said for the NASA-AMES CSUMB / UCCE EINM project. The fact that the BMPC offered both TA and indemnification for income loss attracted the grower to the project. Since this project was considered experimental by Agflex and AFT, an arrangement was made with Agflex which provided a fixed amount of funding for the project that would either be used for grower indemnification, or, if not needed to cover the grower's losses would go to defray the costs associated with project design, set up of the irrigation system, intensive field instrumentation and monitoring, and yield data collection.

Partner survey results

Partners were asked ten open-ended questions regarding their experience with the BMPC. Nine partners responded. Their responses are summarized here. When asked about advantages of the BMPC compared to other BMP support programs, most appreciated the ability to work closely with growers to tailor the BMP to the growers' specific conditions and needs. Most believed that the indemnification feature was somewhat of a factor in attracting growers to participate, but that the educational opportunity was the primary motivation for growers. Several estimated that for approximately 20% to 25% of growers, mitigating risk would be the primary factor. Two believed that the indemnification feature of the BMPC was counter-productive. They believed that since there was no risk to the grower, the grower was less motivated to work to assure the best performance of

the BMP. Given that most growers were motivated by the educational opportunities. In reality "gaming the system" was an exception, rather than the rule.

Difficulty with the BMPC included the need to better assess growers' capability to implement the BMP as conceived. Another difficulty was not carefully assessing the readiness of a BMP to be successfully implemented by a grower. For example, projects involving management of nutrients in dairy lagoon water were often problematic because dairies often did not have the proper infrastructure (pipes, valves, flow meters) to blend lagoon water in irrigation water and distribute it among fields properly. There also is not yet enough scientific knowledge of the make up of lagoon water nitrogen (predominantly in the ammonium and organic forms) and its behavior in various soil types and weather conditions. This situation makes it difficult to identify proven BMP to growers.

One partner was frustrated with some of the administrative aspects of the program, with Sustainable Conservation staff not being available enough or in a timely manner. Field staff of this partner felt providing TA, rather than just project monitoring (collecting yield data, etc.) was beyond their responsibility, deferring that role back to Sustainable Conservation. During the life of the program, there were several protracted discussions and negotiations with the BMPC leadership (Agflex) regarding funding for the more intensive and therefore expensive TA required in California. Budget constraints in 2012 led to a significant decrease in the number of CT and DMN projects supported in 2012. A California administered program would help eliminate these frustrating conflicts.

Discussion, Recommendations and Conclusions

Key findings from the California experience

During the relatively short four years history of the BMPC in California, it could be termed a qualified success. More than fifty growers participated in CT, dairy nutrient management and Efficient Irrigation and Nutrient Management BMP. Many of them successfully implemented the BMP and have continued to use and expand use of the BMP. Virtually all growers who responded said that there is a place in the conservation incentives toolbox for a BMPC-type program. Most wanted to see it offered in combination with a cost-share program such as EQIP.

There was a steep learning curve on the part of partners and the growers to understand the BMPC - its objectives and structural rational, how it worked, how to adapt it to California's complex agricultural system, and the associated costs. Complex new social networks were, or in the process of being formed to support the BMPC approach. This in and of itself is providing benefits to the effort of expanding BMP adoption to improve the environment and grower economic performance.

Due to the complexity of the system and higher value of the crops, program costs were significantly higher than in the Midwest. This is especially true when using a BMPC approach to support BMP adoption in specialty crops.

The California partners were most concerned with meeting program targets of number of growers signed up and number of acres enrolled. It was only later that the partners came to the realization that both potential grower-cooperators and the BMP offered by the BMPC needed to be screened carefully and selected to assure success.

All this being said, partners generally saw value in participating in the BMPC. They were able to establish new working relationships with grower-clients. They also expanded their own technical expertise and gained broader situational experience working to solve grower-specific needs.

Several significant payments were made to farmers who suffered substantial yield losses in CT projects and in some DNM projects. Sustainable Conservation staff observed that if more funds were dedicated to TA upfront, that grower indemnification payments would have been much less, and BMP adoption would have been more successful.

Several projects in corn and three of four broccoli projects encountered significant communication issues that lead to poorer results or very near misses in proper BMP implementation and/or performance monitoring. These communication failures occurred within the farming organization, and between farm managers and irrigators and TA providers and project monitors. It is paramount that strong consistent lines of communication be established and maintained to assure project success.

Lessons from the Midwest Experience (from Tom Green)

Commodity organizations may offer potential for an “out-of-the-box” solution such as a specialized, mutual insurance organization specifically focusing on IPM/BMP risk management. Mutual insurance companies exist solely to serve the risk management needs of their policyholders, in contrast to stockholder-owned companies, which serve the stockholders. A mutual organization operated by a board including crop consultants, Extension, producers and other direct stakeholders could determine farmer, advisor and IPM/BMP system eligibility for coverage; coverage limits; terms, etc. Such an organization might maximize IPM/BMP benefits to members by testing the limits of current thresholds; responding rapidly to changes in pesticide registrations, IPM/BMP techniques or seasonal weather or market conditions; providing incentives for early detection and localization of pests with potential for rapid spread; providing coverage for member participation in on-farm research or demonstrations; and acquiring outside public and private sector funding to subsidize indemnities and administration.

Recommendations

There are a number of efforts currently in place to support BMP adoption by farmers. Based on responses by specialty crop farmers surveyed by American Farmland Trust in 2011 and dairy farmers who responded here, they want better access to information and TA provided by trusted sources who are familiar with their farming operation. They believe the system can and needs to be improved to provide them with the information they need to adopt new BMP. The entire technical assistance system, comprised of public and private sector players, that provides growers information is fragmented and not well

coordinated. TA capacity needs to grow in both the public and private sectors to meet grower TA demand. The "big conversation" as to how to improve the TA delivery system has yet to occur among stakeholders - growers and their representative groups; buyers, agencies; private consultants; vendors and NGOs.

Reducing the risk of BMP adoption by providing TA and indemnification against financial loss combines two tools in a conservation toolbox that contains many. The use of this combination of tools is new to California, but initial results show that with careful planning and implementation it can be a useful approach that will be well-received by select growers. The question is how best to provide this service to growers in an effective, cost-efficient manner.

The field production research program at Campbell Soup proved the effectiveness of the approach in the 1990s. They were uniquely positioned as the agent of the buyer of growers crop to incentivize the grower to participate in the introduction of the BMP. Buyer influence over grower practices is becoming even more evident as they demand food safety and sustainability accountability of their grower-suppliers. There are a number of these types of grower/buyer relationships that might be explored to determine if there is a willingness on the part of buyers to support grower BMP adoption so that growers can more easily meet buyer-imposed sustainability standards, thus assuring consistent supply at reasonable cost, while documenting and marketing environmental responsibility. These relationships include growers/processors; growers/shippers; growers/wholesalers; grower/retailers; and grower/end consumer.

Commodity Boards and Commissions (e.g. Almond Board; Strawberry Commission) are self-organized grower entities with government oversight and regulation. They may be amenable to establishing indemnification pools and providing resources for TA to their members.

Industry organizations including grower cooperatives such as Blue Diamond, trade groups such as Western United Dairymen may be receptive to seeking funding to provide TA and indemnification services to their producers.

A different use of the indemnification tool would be to provide 'safe harbor" to Certified Crop Advisors for recommending precise fertilizer and/or irrigation rates based data obtained from appropriate testing protocols.

Technology vendors (CT, nutrients, irrigation, testing services, etc.) may be willing to provide performance guarantees for their products and services. Such guarantees could provide a marketing advantage for the vendor.

Government regulatory (and support) agencies such as the State Water Resources Control Board or CDFA (FREP) may be receptive to better leveraging funds to support wider BMP adoption using a BMPC approach, as a stand alone or in combination with other incentives such as cost-share and low interest loan programs.

Consider seeking new legislation that would establish a tax credit (rather than deduction) to offset the cost of adoption of (certified) BMP. There is precedence for this when CDFA in the late 1990s to early 2000s (seven years) administered a rice straw utilization tax credit program to reduce rice straw burning. The tax credit program was capped on an annual basis and by individual to limit loss of state tax revenues. Applications were taken on a first-come-first-served basis, with appropriate documentation of purchase and use provided.

A BMP certification process could be designed and implemented so as to limit liability exposure, making the approach more cost-effective and popular with growers. The only liability associated with this non-regulatory certification would be born by the BMPC-type pool of funds. The performance guarantee could limit liability by capping the amount of income/crop loss covered. This cap could be modified depending on the level needed to attract growers, crop value, level of confidence that the BMP will perform as designed, and level of TA and project monitoring provided.

Develop and implement a grower readiness evaluation process to assure a good match between the grower and the BMP, thus increasing likelihood of success. Provide grower training to build the population of interested and qualified growers by working with farm advisors, industry organizations and private consultants and vendors.

Consider seeking funding from private foundations that would be interested in leveraging funds by contributing to an indemnification pool that would cover only certified BMP and qualified growers. They might also be interested in funding development of a BMP certification process and grower readiness assessments (educational workshops).

Approach NRCS and USDA-Risk Management Agency (RMA) to determine if a collaborative pilot program might be established that combines EQIP TA and cost share with RMA-supported indemnification. USDA-Rural Development (RD) may also be approached. RD may be more flexible than RMA in providing a performance guarantee rather than formal crop insurance.

Conclusion

Indemnification against the risk of adoption of a new BMP is attractive to some, but not all growers. It is a tool in a well-stocked conservation toolbox and is available for use when appropriate. Most likely, indemnification alone will not be effective in extending new BMP to growers.

The TA function in any type of BMP adoption support program needs to be robust and accurate. TA built upon a strong grower-TA provider relationship is the best method to assure success and thus limit indemnification payouts. TA funding in any BMP adoption support effort must be robust and secure relative to other program elements.

Appendix 1

The following information was compiled and graciously provided by Tom Green in support of this assessment.

Innovative Financial Risk Management Programs for IPM/BMP Risks

Conceptual insurance models - Insurance to cover risks associated with IPM approaches have been proposed for IPM fruit growers in Chile (Romero and Gonzalez 1992) and for users of IPM expert systems in cotton in Australia (Mayers 1992) and fruit crops in Europe.[1] Insurance has also been examined as a replacement for prophylactic insecticide treatments for sporadic pests of field corn in Ontario (Groenewegen and Stemeroff 1992), with 60% of growers participating in a focus group expressing willingness to purchase such a policy. None of these concepts has reached the market to date.

Processor stewardship - An insurance-like arrangement with processing crop growers was pioneered by Campbell Soup Company. The Company requires performance of specific IPM practices by its contract growers and in return guarantees purchase of the crop at full value should an IPM technique fail (Bolkan and Reinert 1994, Kashmainian 1998). The program has delivered a 50% reduction in input use and not had a single grower claim in its eight years of existence.[2]

Agchem warranties - A similar insurance-like arrangement with farmer customers has been pioneered by Western Farm Service and by Novartis. Western Farm, an agchem retail chain, offers a "Complete Crop Care" program to some customers in limited markets in California.[3] For a per acre annual fee, the program provides farmers with all necessary fertilizer and pesticide inputs in accordance with Western Farm's IPM/BMP service and recommendations. The farmer pays the same annual fee regardless of the amount of inputs provided. Western Farm thus maximizes its returns by minimizing inputs and is able to provide income incentives to its field staff who fully utilize IPM/BMPs to reduce input use. Risk is removed as a barrier to customer acceptance by a guarantee of a clean marketable crop backed by Western Farm.

Novartis, a pesticide manufacturer and distributor, operates a similar guaranteed flat-rate input program in several markets under the "Solutions" brand (e.g., Citrus Solutions, Carroll 1999).

Informal risk pools – IPM/BMP adoption in Indiana and Illinois has benefited from unique risk pools designed with involvement by the Agricultural Conservation Innovation Center (ACIC). In one location, participating farmers agreed to make a financial contribution to cover losses by any one participant if a conservation tillage technique

[1] Pers. comm., Sept. 1998, Bernard Blum, Agrometrics, Basil Switzerland
[2] Pers. comm., Oct. 2000, Hasan Bolkan, Campbell Soup Co.
[3] Pers. comm., Mar. 1999, James Dana, Western Farm Service, Santa Maria CA

resulted in reduced yields. In a second location, participating farmers contributed to a pooled risk fund to support nitrogen fertilizer reduction through soil and manure testing.

In a third location, an agchem retail cooperative agreed to offer a warrantied custom tillage service using a specialized tool bar.

Specialty insurance policies - A specialty policy offered for processing tomatoes in California since 1995 is the first conventional insurance product, which in practice has acted as a surrogate for some pesticide applications. The policy covers losses caused by excess rainfall prior to and during harvest. Covered perils include inability to gain access to fields for harvest and also rain-induced fruit rots. The policy effectively replaces late-season prophylactic fungicide treatments which are unnecessary in most years. This policy is currently offered by three insurers, one of which (Rain and Hail) writes $1.25 million in premiums annually on this policy.[4]

A second specialty policy marketed in Iowa for the 2001 growing season is the first specifically designed to cover an IPM/BMP risk. Developed by the principles on this project along with a consortium of Iowa crop insurance companies and the Iowa Department of Economic Development, the policy protects farmers and their advisors who reduce nitrogen fertilizer applications according to Iowa State University Extension soil/manure testing and crediting recommendations. This first-of-its-kind policy was underwritten by the Iowa Farm Bureau Insurance Company (Farm Bureau Mutual Insurance Co. 2000). Minnesota Farm Bureau was to bring the policy to its state for the 2002 season. Wisconsin Department of Natural Resources (DNR) and USDA Natural Resource Conservation Service (NRCS) have proposed adding a phosphorus sufficiency component to the nitrogen policy and offering an N plus P policy to Wisconsin farmers in 2002 along with a subsidy on premiums.

[4] Pers. comm., 1999, Thomas Withoff, Rain & Hail Insurance, Des Moines IA

Appendix 2
BMP Challenge - California Participants

Those participants highlighted in yellow completed the grower survey.

Year	Name	Address	Practice	Acreage
2009	K-Baar Dairy	Visalia, CA	Nutrient Mgmt.	180
2009	John Machado & Sons Dairy	Elk Grove, CA	Nutrient Mgmt.	120
2009	Frank Gwerder Dairy	Modesto, CA	Nutrient Mgmt.	13
2009	Joey Rocha Dairy	Turlock, CA	Nutrient Mgmt.	36
2009	Victor Fanelli Dairy	Hilmar, CA	Nutrient Mgmt.	18
2009	Joseph Gallo Farms	Atwater, CA	Conservation Tillage	70
2009	Flint Dairy	Merced, CA	Conservation Tillage	120
Total				**557**
2010	BarMac Dairy	Gustine, CA	Nutrient Mgmt.	48
2010	Brasil & Sons Dairy, Inc.	Escalon, CA	Nutrient Mgmt.	63
2010	D & M Ag	Denair, CA	Nutrient Mgmt.	10
2010	Dairy Central	Hilmar, CA	Nutrient Mgmt.	106
2010	DeJager Dairy North #1	Chowchilla, CA	Nutrient Mgmt.	74
2010	DeJager Dairy South	Chowchilla, CA	Nutrient Mgmt.	45
2010	Double DJ Dairy	Chowchilla, CA	Nutrient Mgmt.	107
2010	Fanelli Dairy	Hilmar, CA	Nutrient Mgmt.	18
2010	Frank Gwerder	Modesto, CA	Nutrient Mgmt.	13
2010	M & M Cardoso	Delhi, CA	Nutrient Mgmt.	11
2010	Michael Brasil Dairy	Stevinson, CA	Nutrient Mgmt.	30
2010	Milk Made	Snelling, CA	Nutrient Mgmt.	55
2010	Red Rock Dairy	Merced, CA	Nutrient Mgmt.	114

2010	Silveira Holsteins	Hilmar, CA	Nutrient Mgmt.	20
2010	Vista Verde Dairy	Chowchilla, CA	Nutrient Mgmt.	74
2010	Wickstrom Jersey Farms	Hilmar, CA	Nutrient Mgmt.	18
2010	Lone Oaks 1	Hanford, CA	Nutrient Mgmt.	125
2010	DeGroot Dairy North	Hanford, CA	Nutrient Mgmt.	74
2010	DeGroot Dairy South	Hanford, CA	Nutrient Mgmt.	74
2010	Joe B Pacheco Dairy	Hanford, CA	Conservation Tillage	125
2010	Correia Family Dairy Farms	Gustine, CA	Conservation Tillage	125
2010	Lone Oaks 1	Hanford, CA	Conservation Tillage	80
2010	Campbell Soup	Davis, CA	Proc Tom Irr and Nut Mgmt	10
Total				**1,419**
2011	A & L Dairy	Tulare, CA	Nutrient Mgmt.	40
2011	Bosma Milk	Tipton, CA	Nutrient Mgmt.	76
2011	Holland's Dairy	Hanford, CA	Nutrient Mgmt.	41
2011	PH Ranch Inc.	Winton, CA	Nutrient Mgmt.	42
2011	Double DJ Dairy	Chowchilla, CA	Nutrient Mgmt.	85
2011	Red Rock Dairy	Merced, CA	Nutrient Mgmt.	78
2011	Vista Verde Dairy	Chowchilla, CA	Nutrient Mgmt.	79
2011	DeJager Dairy North #2	Chowchilla, CA	Nutrient Mgmt.	74
2011	Rock Shar Dairy	Merced, CA	Nutrient Mgmt.	77
2011	DeJager Dairy South	Chowchilla, CA	Nutrient Mgmt.	49
2011	Tony Lopes Dairy L.P.	Gustine, CA	Nutrient Mgmt.	117
2011	P and D Dairy	Gustine, CA	Nutrient Mgmt.	98
2011	P and D West Dairy	Gustine, CA	Nutrient Mgmt.	

				57
2011	Cascade Dairy	Tulare, CA	Nutrient Mgmt.	100
2011	Fiscalini Farms	Modesto, CA	Conservation Tillage	40
2011	Cloverdale Farms	Hanford, CA	Conservation Tillage	100
2011	Blake Harlan	Davis, CA	Proc Tom Irrig Mgmt	80
2011	Blake Harlan	Davis, CA	Proc Tom Irrig Mgmt	80
2011	Roy Gill	Dixon, CA	Proc Tom Irrig Mgmt	40
Total				**1,353**
2012	Haringa Dairy	Denair, CA	Nutrient Mgmt.	60
2012	PH Ranch	Winton, CA	Nutrient Mgmt.	50
2012	Adams Dairy	Selma, CA	Conservation Tillage	22
2012	Valadao Dairy	Hanford, CA	Conservation Tillage	71
2012	Main Street Farms	Santa Maria, CA	Broc Irrig & Nut Mgmt	24
Total				**227**
2013	Tanimura and Antel	Salinas, CA	Broc Irrig & Nut Mgmt	24
Total				**24**

TOTAL NUMBER OF FARMS:	55
TOTAL ACRES:	3,580

Appendix 3
Grower and Partner Surveys

Links to Surveys

Conservation tillage survey: http://www.surveymonkey.com/s/Z6H55ZG
Dairy nutrient management survey:
http://www.surveymonkey.com/s/5KM53KV
Project partner survey: https://www.surveymonkey.com/s/2VYBSG6

Links to Survey Results: The password for all links is Best90Mana12gement

Conservation tillage survey:
https://www.surveymonkey.com/sr.aspx?sm=XdJINtazP1vjJ3_2b_2b79Dz3Hov3S1qnrdjBKFvoBJheqE_3d
Dairy nutrient management survey:
https://www.surveymonkey.com/sr.aspx?sm=yawbHJ63bNuP_2fY_2bHyclJT2ZIZ3dnfeSDH_2bQiNQ9YVtc_3d
Project partner survey:
https://www.surveymonkey.com/sr.aspx?sm=6TUL1vSvBqSzYna7BkEWuztdJ4KM_2bqrxoqDBZzCuIHw_3d