2016 University of Arizona Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

We continue to do more with less. Despite limited appropriated financial support, we continue to make a difference, and are working to better balance our program areas with support.

• Arizona Cooperative Extension engages with people through applied research and education to improve lives, families, communities, the environment, and economies in Arizona and beyond. With offices in all 15 counties and on five tribal reservations, we bring knowledge to people every day to enhance their work and enrich their lives.
• The Arizona Agricultural Experiment Station stimulates learning through exploration and discovery to enhance agriculture, the environment, our natural resource base, family and youth well-being and the development of local communities. We accomplish this mission by the integration, dissemination, and application of knowledge in the agricultural and life sciences.
Research is conducted in the various departments and schools on campus, as well as at Agricultural Centers throughout the state. Research generated through the Experiment Station underlies and supports the academic and extension programs.
The College of Agriculture and Life Sciences has six programmatic focus areas:

- Environment, Water, Land, Energy and Natural Resources
- Plant Systems
- Human Nutrition, Health and Food Safety
- Family, Youth and Community
- Animal Systems
- Marketing, Trade and Economics

Environment, Water, Land, Energy and Natural Resources
Climate Science Extension for Natural Resource Management

• The Climate Science Applications Program website received over 5200 page views in 2016.
• New drought monitoring products (SPI plots) have been adopted by New Mexico and Arizona drought monitoring committees and viewed by 350 visitors on the site in 2016. Over 3400 people accessed new monsoon season monitoring plots and maps in 2016. The National Weather Service (Flagstaff and Tucson) has used these products in their climate briefings and updates. 'Cool Season' climate summary plots have been used in Twitter posts and interactions and blog posts.
• The SPI Explorer Tool is being used as an operational drought monitoring/planning tool by the USFS and livestock producers across the Tonto National Forest.
• The Precipitation Logbook Generator and new rain gauge design are being tested and used at 40 locations across the Tonto National Forest in central Arizona. These new monitoring data hold promise of helping the USFS and ranchers co-manage these public lands with important climate information to assess drought impacts.
Onsite Wastewater Education

• 183 professionals know how to inspect an onsite wastewater treatment system for the ADEQ Transfer

of Ownership Inspection Program. Without taking this course, these professionals would not have been eligible to participate as an inspector for the statewide program. Thus, 183 professionals either expanded their business model or were able to continue conducting business in this area.

• 37 practitioners (both regulators and in-the-field professionals) know more about conducting soil and site evaluation for onsite wastewater treatment systems and can use the Arizona code to conduct the evaluations. Without attending this class, these practitioners would not be able to conduct these evaluations as part of their jobs.

• 12 practitioners have increased knowledge about the issues and solutions for deciphering the symptoms and identifying the root problems of the observed and measured problems of the septic systems they encounter and know how to manage or design for better system performance.

• 14 practitioners have increased knowledge on designing onsite wastewater treatment and dispersal systems using Arizona regulations and code.

• 50 people have a better understanding of their septic systems and the management needed to extend the life of their system. Conventional septic systems in Arizona typically cost around $5000. Knowing how to take care of their septic system can save the homeowners at least that much.

• The UA Onsite Wastewater Education program is well-known throughout the state and nation. As a result, I am working with ADEQ to co-coordinate state-wide onsite wastewater treatment industry volunteer certification.

• 58 contacts in UA Extension, Arizona County Health Departments, and ADEQ received timely educational materials from ACE Onsite Wastewater Education Program and are more aware of the services that the program can and do provide.

Plant Systems

CEA for Commercial Food Production, Hobby Interests, and Community Benefits

• Exit responses and return meetings indicate that from CEA Extension activities that [1] knowledge was gained; [2] when implemented it saved on investment costs, having been directed in appropriate way to build production facility; [3] when implemented it saved on operation cots for energy resources, plant nutrient resources and labor resources, [4] when implemented it saved environmental impact of resource usage and resource discharge.

• Total production dollar value: The greenhouse annual vegetable sales value ($369M) was 37% of alfalfa, 98% of lettuce [essentially equal], 189% of cotton [nearly double], and 240% [almost 2.5 times greater] of melon sales values, respectively.

• Water resource efficiency: Irrigation water savings in crop production from 3 - 6 times in CEA compared to open field. Dollar Return per gallon of Water invested ranges from $0.20 - $0.12 per gallon for greenhouse tomato. This equates to 39x and 125x the dollar return to the grower for their water resource input when compared to alfalfa ($0.0051 per gallon water) and cotton ($0.0016 per gallon water), respectively.

Incorporating Key Pest IPM into Horizontal Contexts of Multiple-Pest IPM

• AZ cotton has now reached a major milestone in cumulative savings of over ½ billion dollars (1996-2016), in insecticide spray costs and in yield savings (in 2016 constant $).

• In 2016, we have returned to exceptionally low insecticide use in cotton, spraying less than 1.6 times all season long, mainly with very strategically, selective compounds that are safe to beneficials.

• Even with the recent uptick in insecticide use (2012-2014), broad spectrum and broadly toxic insecticides in use in cotton are down more than 93% since the early 1990s; all insecticides are down more than 82%.

• The economic benefits continue to grow, with 2016 being the 3rd lowest costs of foliar insecticides used in cotton in history (since records have been kept in 1979, in 2016 constant dollars). Fully 8 of the last 11 years have been record lows in cotton insecticide costs.

Human Nutrition, Health and Food Safety

Healthy Lifestyle Programs: Maricopa County

• Analyzed entry/exit survey data showed increases in participant knowledge. Examples include 70% of graduates made an improvement in nutritional practices including planning meals, reading nutritional labels, 43% improved sound food safety practices, 56% increased awareness of healthy food choices most of the time or always.

• Analyzed data showed positive behavior changes, & exceeded the objective to have at least 40% of graduates increase positive behavior changes. These include, at exit, 92% showed dietary improvement, 76% met the suggested healthy pattern of 3 meals & snacks/day, 65% of participants showed positive change in food resource management including comparing prices & NOT running out of food before the end of the month, 47% performed 30+ minutes of physical activity/day, 44% showed improved behavior changes in planning meals ahead of time.

• Reported data showed positive behavior changes due to SNAP-Ed classes. A few examples include, 72% increasing their healthy eating habits, 81% increasing their physical activity, 1.27 cups to 1.48 cups increase of vegetables consumed by adults (statistically significant).

Public Health Pest Integrated Pest Management

• In 2016 Pest Management Professionals were awarded 261 Arizona Division of Pest Management Continuing Education credits.

• Improved awareness, knowledge, and consideration of: risks associated with pests, reduced-hazard management options, IPM benefits, IPM cost effectiveness, benefits of a healthy, functional landscape, and improved turf management practices.

• Increased use of reduced-hazard management options, healthier school and home environments, reduced exposure to pests and pesticides, reduced school absenteeism due to asthma, increased compliance to State and Federal pesticide laws.

• Environmental Health Professionals were awarded 803 hours of National Environmental Health continuing education credits.

Family, Youth & Community

Agricultural Literacy

• Almost 500 "Bee" books have been distributed to elementary classrooms during AZ Agricultural Literacy Days. Ninety-nine have been sold during teacher trainings and educational events. The publisher has sold 1,338 books to stores and in individual purchases on Amazon. An additional 800 have been purchased for distribution to elementary schools by the Maricopa County Farm Bureau.

• Twenty-nine teachers participated in the five-day Summer Agricultural Institute (SAI), which the Agent facilitates. Participants earn 48 hours in Professional Development credit. These teachers from 10 counties and 24 school districts reported they teach 5,500 students.

• Thirty-four individuals and organizations provided $28,480 to fully fund the SAI.

• Assessments and evaluations of the educators participating in the Agricultural Literacy Program indicate an increased knowledge about agriculture and a willingness to use it to teach in their classroom, which means accurate information about agriculture will be taught by the educators.

Pima County 4-H 100% Engagement

• 124 youth participated at Davis Monthan AFB (Youth and Adult) participated in archery, photography, leathercraft, child care, sewing, cooking, foods/nutrition, and the 4-H High Ropes Course.

• 76.9% of the participants had never considered a STEM career as a possible future occupation prior their participation at the DM AFB Helicopter Camp.

• 61.5% of the participants plan to pursue a STEM occupation after their experiences at the DM AFB Helicopter Camp.

• 100% (n=50) of the workshop attendees self-reported that as a result of the STEM on The Cheap workshop, plan to utilize information presented.

Animal Systems

Arizona Dairy Farm Labor Training

• In 2016 we conducted 5 training workshops for dairy farm employees in three different dairy herds totaling about 50 employees and covering more than 6,000 dairy cows.
• In 2016 participants averaged 60% improvements as measured through pre and post testing. Training manual notebooks are distributed to participating herds and material is updated as needed for on farm employee reference.
• In 2016 we helped one producer overcome an aggressive coliform mastitis event through employee milking protocol training. Incidence of mastitis in dairy herds can be as high as 70% and can average 30% per herd (Cook & Mentink 2001). Clinical mastitis on average costs dairy producers from $200-$400 per case. In Arizona this means $12-24 million in losses.

The Informed Arizona Equestrian

• Rabies in Arizona: Equine Risk and Prevention (publication and media interview). The interview with KVOA aired locally in Tucson and increased Cooperative Extension's exposure in the local and regional community.
• While conducting this program we had several individual reports of intended changes on handling of employees and checking tack.
• Two ranchers indicated they would begin to check tack more closely to reduce their risk of liability in case of an accident, and four indicated they were likely to change or implement a vaccination protocol for their ranch horses.
• Horse owner called with a concern and questions about identifying a plant referred to as Texas crippler. Horse owner will now be more vigilant about checking for this plant in his pastures.

Marketing, Trade & Economics

Agricultural Marketing and Management

• At least 55 percent of our workshop participants reported that they developed a practical strategy for keeping records and implementing an overall risk management plan.
• Beginning Farmer programs were delivered at 8 different locations (including 3 hoop houses), providing 29 workshops with 101 hours of total instruction to 229 unique individuals.
• Of these participants, 45% have already started a business plan on AgPlan or another venue and 21% have taken an action from information learned in last year's Beginning Farmer trainings that they feel with increase the profitability of their operation.
• A PBS video was filmed regarding some of the Beginning Farmer activities and outcomes for Florence.

Improving Vegetable Production through Utilization of Spike Wheel Liquid Injection Technology

• In 2016, data from the 2014-2015 on-farm and research center trials were formerly analyzed. The results support previous findings. Again, we found that through use of the point injection system with conservation tillage farming systems that fertilizer rates could be reduced by 25% without negatively affecting yield in lettuce and by over 50% in broccoli.
• Although not statistically significant, there were yield increase trends of 11% in romaine and more than 8% in broccoli when conservation tillage systems were used.
• In 2016, all labeled and alternative application methods were equally effective at controlling root rot. On average, disease incidence was reduced by about 45%.
• At one site, the advantage was about 80 lbs/ac of lint. Using an average cotton price of $0.65/lb, this translates into an increase in returns of over $50/ac.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	250.0	0.0	400.0	0.0
Actual	250.0	0.0	400.0	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Combined External and Internal University External Non-University Panel

2. Brief Explanation

All new proposed Hatch projects are reviewed by an ad hoc review panel of 3 qualified faculty with no conflicts of interest. All renewal projects are reviewed by a panel of 2 similarly-qualified faculty. The Associate Dean oversees this process and ensures that any suggested changes are made to the satisfaction of the reviewers and the Associate Dean. External review of programs and projects is obtained from County Extension Advisory Boards established under Arizona state law and from Agricultural Center Advisory Boards who meet on a regular basis.
Programs, whether continuing or new, are circulated around Extension and Research leadership to ensure they fulfill the mission of Arizona Cooperative Extension and are set up to deliver on our overall goals and objectives. We also ensure that all stakeholders are considered when implementing the programs.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals

Brief explanation.

A major rewrite of the College's Strategic Plan that covers the research, extension and academic programs of the College was completed in 2013. This effort involved review and comment by all faculty and staff, all advisory boards, major commodity organizations and selected stakeholders across the state. The major input was obtained from our advisory boards and meetings with major commodity organizations.

In addition, Extension conducted its own stakeholder survey to audiences that may not know what Cooperative Extension is, or have only some small idea. The survey instrument was finalized, and we are currently beginning to implement some of the suggestions.
Finally, and internal Climate Survey was conducted to gauge the climate of Extension personnel and whether they feel we're hitting our marks as we deliver for our communities. We've used that

feedback to be more transparent about what programs are active in the specific areas.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

Over 100 county advisory board members provide input and priorities to county programs on an annual basis. Input for the research program is provided by advisory boards for our outlying Agricultural Centers. These groups plus numerous meetings with commodity organizations provide input annually for both Extension and Research programs

We've also beefed up efforts to collect contact information from program participants and reach out to them to gauge their interest(s) in being involved at a more connected level with Extension to help shape future programming.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

Brief explanation.

This is normally done by faculty meeting with the stakeholder groups throughout the year and providing them with written materials for their review and input. This may be expanded to a web-based survey available to all interested.
We also brought on a Marketing/Promotion specialist who will attend various trade organization events and deliver information on Extension and collect contact information. She has been building a list of future collaborators.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

Input is collected, categorized, filtered, and then disseminated to the appropriate team members to begin incorporating into strategic planning - from programs to administrative activities. We see feedback as a gift and welcome all opportunities to obtain the information so we know what we're doing well and where our opportunities are.

Brief Explanation of what you learned from your Stakeholders

All input is considered in all our planning and even reporting. We're learning that not everyone wants the same type of information we've provided in the past. And if they do, they don't want it in the same fashion. We're reaching out to younger audiences and the information they're looking for is not the same as what we've provided to earlier generations. So, by soliciting their input we can fully understand what information is valuable to them and what will initiate further action to be involved.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
2040900	0	2529278	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	2019509	0	2557649	0
Actual Matching	2019509	0	2557649	0
Actual All Other	0	0	0	0
Total Actual Expended	4039018	0	5115298	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

ENVIRONMENT, WATER, LAND AND NATURAL RESOURCES

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	35%		44%	
111	Conservation and Efficient Use of Water	30%		25%	
112	Watershed Protection and Management	15%		10%	
121	Management of Range Resources	20%		21%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	20.0	0.0
Actual Paid	9.7	0.0	802.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
871014	0	826638	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
871014	0	826638	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Climate Science Extension for Natural Resource Management
Issue
The impact of climate variability and change on natural resource management is garnering much attention in recent years. Over eleven years of intense drought, record setting wildfire events in the summers of 2002, 2003 and 2011, large-scale forest mortality due to the interaction of climate and insect outbreaks, water resource concerns and most recently record breaking winter precipitation and flooding events have brought climate to the center of public attention.

What has been done
New real-time drought monitoring products have been added to the CSAP website in 2013 including... http://cals.arizona.edu/climate/misc/spi/spi_contour.html http://cals.arizona.edu/climate/misc/spi/spi_contour_states.html . These products have been accessed over 350 times in 2016 and are being used in several climate summaries and blogs across the U.S. including the AZ Governor's Drought Task Force. Working with a team of researchers and IT developers to develop an online tool to use remote sensing imagery to track drought across the Southwest. The recently released beta site DroughtView (droughtview.arizona.edu) is being used in regional training and monitoring workshops and being refined with user feedback. Drought impact reporting tools (to replace the defunct AZDroughtWatch.org website)were implemented in 2016 and have been collecting reports from resource managers and ranchers (in partnership with range extension agents).
Onsite Wastewater Education
Issue
Nearly 50 million people in the United States use a septic tank as the primary treatment system for household waste. A properly functioning septic system (conventionally a septic tank and subsurface disposal trench, bed, or pit) is one of the most efficient treatment methods available. However, the Arizona Department of Environmental Quality (ADEQ) identified onsite/septic wastewater treatment facilities as the overwhelming activity/facility contributing to water quality impairment in Arizona -- over 90% of the identified activities. There is a need to educate onsite system owners and operators about the proper management of their systems and to educate the onsite wastewater treatment industry about proper design, installation, and maintenance practices. This program was established through two one-year grants with USDA-NIFA: Water Quality Education for Under-Served Arizona Communities and Expanded Water Quality Education for Under-Served Arizona Communities. The objectives of these projects were to increase the participation level of adults and youth in the selected under-served communities in identifying and solving local water quality concerns by increasing the awareness level of adults and youth of the importance of maintaining water quality and of the relationship between septic systems and drinking water. The Arizona Extension Onsite Wastewater Education program voluntarily brought a national organization to the State to provide training in inspection of onsite wastewater treatment systems. As of the 2006 Arizona Administrative Code changes, the ADEQ now requires this course as part of the eligibility to be an inspector for the Transfer of Property Inspection program. Also, the ADEQ requires soil and site evaluation education for those practitioners who are not a registered sanitarian, registered geologist, or professional engineer. The ACE Onsite Education program is one of three organizations that have completed the necessary steps to qualify as an ADEQ-accepted course AND is the only organization that conducts on-going training.

What has been done
Conducted two 2-day NAWT Inspection Training & Certification classes to 183 professionals who want to be eligible to be Transfer of Property Inspectors. By law, part of the eligibility is that they must attend and be certified by a recognized ADEQ course. This is the only course recognized by ADEQ to meet the requirements of the law. I negotiated a contract with the National Association of Wastewater Technicians (NAWT) to teach the course AND provide the credentialing and web database for Arizona.
Conducted a 2-day Soils & Site Evaluation class to 37 practitioners (up from 20 the previous year). This is

one of three courses recognized by ADEQ, and the only one offered regularly, that allows non-registered professionals (the regulations recognize registered professionals as engineers, sanitarians, and geologists) to conduct soil and site evaluations for onsite wastewater treatment systems. I developed the manual, the field skills, and the course completion exam. I contract with nationally-recognized instructors to help teach the class.
Conducted a new 1-day In-depth Technology-specific Education class dealing with troubleshooting onsite wastewater systems to 12 practitioners. A topic that all levels of professionals can learn and develop a plan for deciphering the symptoms and identifying the root problems creating a plan for better system performance. The activities fit between System inspection and System O&M, applying to both but being outside this class will develop a plan for evaluating systems by measuring a couple key factors. Then applying the information to create a solution for the identified conditions. Having a clear set of measurements and connections allows for professionals to develop system renovations that can be a long-term solution for the site. This class provides another avenue for certified NAWT inspectors to obtain their 8-hours every 2 years of continuing education. I was VERY disappointed in the attendance for these classes and am considering eliminating these 1-day classes. The reason I initiated them was to provide alternative choices to those seeking recertification hours.
Conducted a 1-day introduction to design class to 14 practitioners for designing onsite wastewater treatment and dispersal systems using Arizona regulations. A homework assignment was used to provide practical application of material learned in the workshop. This class is not required by Arizona law, so those attending really want to learn best practices, and this class met the 8 hours of continuing education required to maintain NAWT certification.
Delivered a 2-1/2-hour presentation to Cochise County's Water Wise workshop series on "Septic Care" to 50 homeowners in Sierra Vista.

2. Brief description of the target audience

Natural resource managers, Governor's Office and state agencies, municipal organizations and leaders, households, consumers, youth, master gardening and master watershed programs.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	46675	71070	13256	25750

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	20	60	80

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of individuals participating in educational programs

Year	Actual
2016	59931

Output #2

Output Measure

- Number of individuals adopting new technology

Year	Actual
2016	1545

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Effectiveness of research programs will be based on publications, external grant support, and integration into existing extension programs
2	Number of individuals gaining knowledge by participating in educational programs
3	Volunteers completing Master Gardening training
4	Create awareness and increase knowledge

Outcome #1

1. Outcome Measures

Effectiveness of research programs will be based on publications, external grant support, and integration into existing extension programs

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
All participants in the research and extension programs and the respective clientele for these programs are seeking programs and offerings to make their lives better.

What has been done
Arizona has a fully integrated research and extension program and all faculty strongly pursue competitive grants.

Results
More than $1.5 million dollars in non-USDA grants were obtained to support this program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources

Outcome #2

1. Outcome Measures

Number of individuals gaining knowledge by participating in educational programs

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources

Outcome #3

1. Outcome Measures

Volunteers completing Master Gardening training

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	198

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Master Gardener program is an important component of our Cooperative Extension program.

What has been done
1,378 volunteers donated their time teaching others

Results
Master Gardener volunteers donated over 99,534 hours in 2016

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources

Outcome #4

1. Outcome Measures

Create awareness and increase knowledge

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
All recipients of our programs care about increasing their knowledge.

What has been done
1,378 Master Gardener volunteers shared information directly with 23,596 program participants.

Results
The majority of the recipients consistently indicate a change in knowledge resulting from our programs and materials.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

We've taken steps to conduct user experience evaluations. This gives individuals the opportunity to provide rich feedback about what they enjoy about the program(s) and what they feel we can do better at how we deliver on our mission. Much of the results are qualitative and commentary. However, we're optimistic about what we're hearing and how people continue to be excited about what we're offering.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

PLANT SYSTEMS

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		30%	
205	Plant Management Systems	25%		15%	
206	Basic Plant Biology	25%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		20%	
212	Pathogens and Nematodes Affecting Plants	20%		15%	
215	Biological Control of Pests Affecting Plants	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	40.0	0.0
Actual Paid	3.0	0.0	6.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
289194	0	666163	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
289194	0	666163	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

CEA for Commercial Food Production, Hobby Interests, and Community Benefits
Issue
In the 2012 census, the total number of Arizona greenhouse farms for vegetables and fresh cut herbs was 108, which had increased from 26 farms in 2007. Nationwide, the number of farms for greenhouse vegetable and herbs is increasing, but Arizona has increased 400% rate over 5 years, probably the largest in the nation. Currently the combined number of nursery, greenhouse, and floriculture farms in AZ is 516, compared to the number of vegetable farms (open fields) in AZ which is 1945 (119,610 acres). The numbers are small but the profits large.
What has been done
Controlled Environment Agriculture programs at ABE-CEAC are integrated by Production Education Greenhouse (ProdEdGH), a public-private partnership based on CEA R&D and manifested in a for-profit, educations & production greenhouse facility in Tucson highlighting Extension & Outreach from CEAC called Hungry Planets; Short- and Intensive-courses, social media, and traditional outreach media like newsletters.
Incorporating Key Pest IPM into Horizontal Contexts of Multiple-Pest IPM
Issue
The Brown Stink Bug posed special problems 2012-2014, especially in identifying practices compatible with key pest IPM (see 1st program for details). Aflatoxin levels were at decade's high levels in 2013 and widely present again in 2014. Questions remain about the relationship between insect feeding and toxigenic A. flavus spread. Problems of palestriped flea beetles and other stand-reducing insects in establishing guayule has been identified as important priority for this burgeoning cropping system. The exotic and invasive sugarcane aphid dramatically arrived and impacted our state this year, in particular in Sorghum. Inadequate chemical and other controls were identified by practitioners as a serious impediment to the production of forage sorghum for our large central AZ dairy industry. Lastly, there is an urgent need to find alternatives to the highly hazardous, greenhouse gas eliciting methyl bromide for remediation of shipping containers, especially as they relate to quarantine and international transport issues.
What has been done
Growers and consultants have adopted more selective technologies for pest control, realized larger contributions of natural enemies and other ecosystem services, resulting in more efficient use of technologies and better-integrated, more stable systems of management in cotton. In every extension and academic presentation to clientele or scientific communities, I attempt to frame the topic in the context of multiple-pest IPM, if not whole systems ICM.

2. Brief description of the target audience

Commodity groups, state agencies, pest management advisors, pesticide applicators, youth, ag-ventures programs.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	6338	18540	3789	12360

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	15	100	115

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of individuals participating in educational programs

Year	Actual
2016	10127

Output #2

Output Measure

- Number of research projects conducted on all aspects of Plant Sciences, and Agriculture and Resource Economics

Year	Actual
2016	260

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adoption of better management practices for crop production
2	Adoption of alternative crop technologies
3	Adoption of more cost effective means for controlling plant diseases along with insect issues

Outcome #1

1. Outcome Measures

Adoption of better management practices for crop production

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Adoption of alternative crop technologies

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Adoption of more cost effective means for controlling plant diseases along with insect issues

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New pests and diseases are appearing each year as they become more resistant to pesticides. Major insect damage to crops costing significant dollars and utilizing major amounts of pesticides.

What has been done
An integrated pest management program (IPM) established in Arizona in 1996, refined in 2006 and continued through today uses insect growth regulators (IGRs) effective against whiteflies, transgenic cotton (with Bt (Bacillus thuringiensis) effective against pink bollworms, and a reduced-

risk feeding inhibitor (effective against Lygus bugs.)

Results

Statewide averages for cotton insecticide use patterns in Arizona from 1979 through 2010 show that insecticide use on cotton for all insects combined?including whiteflies, pink bollworm, Lygus bug and others reached a 32-year low over the last 5 years, while also reducing costs to all-time lows. The estimated cumulative savings in control costs and yield (from reduced losses to insects) from 1996 through 2010 was more than $223 million.

Growers applied 4.15 pounds of active insecticide ingredient per acre of cotton in 1995. In 2009 and also in 2010 the amount of active ingredient applied per acre was reduced by 3.66 pounds, or 88.3 percent, to just 0.48 pounds per acre. This is the equivalent of applying less than a can of soda on an area the size of a football field just once over the cotton season (March to October).

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

With more and more community members seeking ways to create their own gardens, we've experienced an increase in contacts for information and resources with Plant Sciences. This has led to more robust outreach and engagement with the community. Using this feedback as well as data analytics from our web site(s), we're able to capture the topics that

stakeholders are seeking and can adapt our planning as such.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

HUMAN NUTRITION, HEALTH & FOOD SAFETY

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	10%		40%	
703	Nutrition Education and Behavior	75%		20%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	15%		40%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	9.0	0.0	10.0	0.0
Actual Paid	2.6	0.0	1.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
201749	0	160679	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
201749	0	160679	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Healthy Lifestyle Programs: Maricopa County
Issue
There is a local & national concern about childhood & adult obesity. Schools & other major community entities that serve the public have mandates to teach healthy lifestyles that focus on proper nutrition & physical activity. To address the health concerns & associated mandates, the goals of the Maricopa County Cooperative Extension (MCCE) nutrition programs are to increase nutritional & physical activity knowledge, improve associated behaviors & health through research-based nutrition education programs.
What has been done
Healthy Lifestyle programming was planned & implemented in collaboration & consultation with: MCCE Director E. Martin, CALS EFNEP/SNAP-Ed Director S. Misner (Dept of Nutritional Sciences), & former CALS Associate Director of Programs, L. Houtkooper, along with other faculty, community members, health professionals, & agencies. Additionally, Native American Connections, Maricopa County Department of Public Health, school health advisory boards, food banks, & government housing sites provide input to identify needs for nutrition program planning, strategic planning, & networking. Other sources that aid in this are data from the most recent census, CDC, School Free/ Reduced Lunch Program, & the USDA. Two Healthy Lifestyles nutrition programs being delivered in Maricopa County by this Agent are (1) the Expanded Food & Nutrition Education Program (EFNEP), & (2) the Supplemental Nutrition Assistance Program-Education (SNAP-Ed).
Issue
Numerous pests and pest management challenges pose risks to human health. Community Integrated Pest Management efforts focus on sensitive built environments, with the goal of reducing risks associated with public health pests and pest management practices. Needs are identified through interactions with stakeholders including residents, industry members, state and federal agency staff, and advocacy organizations. Committee membership includes: Arizona Department of Agriculture, Division of Pest Management, Exam Development Subcommittee; NIFA IPM for Sensitive Sites in the Built Environment Work Group, Western Region IPM Bed Bug Workgroup; National School IPM Steering Committee, eXtension Urban IPM Community of Practice, StopPests, Federal Advisory Committee Act - Pesticide Program Dialog Committee and NGO efforts. Involvement in these and other committees maintains an ongoing level of issue awareness, involvement and leadership opportunities.
What has been done
Collaborative teams and communication networks are well established and focus efforts on a number of common objectives 1) deployment and further expansion of Stop School Pests IPM training materials for school communities (funded by NIFA North Central IPM Center); 2) IPM education materials for environmental and public health professionals (funded by CDC).

2. Brief description of the target audience

General public, educators, health professionals, extension educators.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	216631	412000	135812	257500

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	8	22	30

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Effectiveness of the research program will be based on publications, external grant support, and integration into existing extension programs

Year	Actual
2016	162

Output #2

Output Measure

- School districts, youth, and adults will address obesity issues
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Create awareness and increase knowledge
2	Number of individuals adopting recommendations for nutrition and health
3	Reduce childhood obesity

Outcome #1

1. Outcome Measures

Create awareness and increase knowledge

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	352444

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
All citizens need to be aware of importance of nutrition, health and food safety

What has been done
Workshops, health fairs, including EFNEP and SNAP-Ed programs.

Results
352,444 participants, not including indirect contacts were made aware and gained knowledge of these issues.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of individuals adopting recommendations for nutrition and health

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	352444

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Reduce childhood obesity

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

In addition to the factors mentioned above, there is a strong sentiment that constant and social media are having a factor in people wanting to learn more about human health and nutrition. The health industry is a billion-dollar industry and people are tired of throwing money at it. Instead, they're looking to resources like Extension to fill that gap of information with scientific-backed information.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

We are learning that more and more individuals are using the power of technology to be at the forefront of the health and nutrition revolution. Wearable technology and smart phones are making information and data easily accessible. The issue is how much is too much data and information and who is showing people what to do with that information.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

FAMILY, YOUTH, AND COMMUNITY

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
802	Human Development and Family Well-Being	20%		80%	
806	Youth Development	80%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	0.0	4.0	0.0
Actual Paid	5.6	0.0	0.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
380475	0	101201	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
380475	0	101201	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Agricultural Literacy

Issue

More food will have to be produced in the next 50 years than the past 10,000-combined (Borlaug, N. (2000)). There are about 57,900 annual jobs in agriculture but only about 34,000 students, a 41% gap, are graduating in directly related degree programs (NIFA, 2015). A majority of consumers--youth and adult--do not have a fundamental understanding of agriculture or how it impacts their lives (Doerfert, D. L. (2011)). In order to expand the pool of young people who might consider a career in a food and agricultural field, more should be done to teach children in elementary school in urban and suburban settings about the basic facts of food and agriculture in a way that holds their attention and interest (AGree, 2015).

What has been done

The Agricultural Literacy program conducted by the Agent, through advice from an Advisory Committee, provides professional development opportunities through an Institute, various workshops and classes for K-12 educators to learn about Arizona agriculture and how to incorporate agricultural topics into their current curriculum. The program's educational components are all aligned to Arizona's College and Career Ready Standards.

Pima County 4-H 100% Engagement

Issue

According at a 2015 Cooperative Extension Stakeholder survey, respondents recognize the importance of engaging youth in volunteer projects that give back to the community as well as the importance of providing youth with life skills education, reconnecting youth with nature and healthy living activities. As a research based program with a direct connection to the University of Arizona that can provide curriculum and training, 4-H is well positioned to provide professional development to individuals from other organizations as well as provide programming to non-traditional audiences.

What has been done

By continuing relationships with other organizations as well as reaching out to new audiences, the county agent set up meetings with various stakeholders and partners in order to provide a wider array of opportunities to the community at large. STEM initiatives were a huge draw for many youth in the county and the activities drew large numbers of youth from the area.

2. Brief description of the target audience

Parents, educators, youth, community groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1030	257500	115967	51500

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	14	43	57

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of individuals participating in educational programs

Year	Actual
2016	0

Output #2

Output Measure

- Number of educational events, training workshops and clinics

Year	Actual
2016	592

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adoption of essential life skills by Arizona's youth that leads to a responsible, productive, and healthy life-style
2	Adoption of life building skills including self-discipline, responsibility and leadership

Outcome #1

1. Outcome Measures

Adoption of essential life skills by Arizona's youth that leads to a responsible, productive, and healthy life-style

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

Outcome #2

1. Outcome Measures

Adoption of life building skills including self-discipline, responsibility and leadership

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

We have learned that we can no longer attempt to reach our audiences through solely traditional methods. For example, within 4-H, using a 4-H listserv or newsletter is not the most efficient way to attract and engage children of the Gen Y or iGen categories. They prefer to have their information reach them in the palm of their hand. So, based on our

evaluations, we need to become creative with our outreach and reach children where they want to be contacted.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

ANIMAL SYSTEMS

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	30%		15%	
302	Nutrient Utilization in Animals	20%		15%	
305	Animal Physiological Processes	15%		20%	
306	Environmental Stress in Animals	15%		30%	
311	Animal Diseases	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.5	0.0	14.0	0.0
Actual Paid	0.6	0.0	3.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
57556	0	455461	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
57556	0	455461	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Arizona Dairy Farm Labor Training
Issue
More than half of the workforce in U.S. dairies is of immigrant origin. This workforce often has limited agricultural background and varied academic training. Of these nearly 100,000 employees almost 95% are from Spanish speaking countries and nearly 90% of those employees are from Mexico. Dairy operations depend on this labor force to produce high quality and safe milk in a profitable way. Training of these employees is much better served in their native language, as they often lack Basic English comprehension. The implementation of a Labor Training Program will benefit dairy producers in Arizona and provide a better working environment for those employees.
What has been done
The Dairy Farm Labor Training program trains, in their native language, Arizona dairy farm employees in order to improve dairy profitability, reduce on farm accidents, maintain proper food safety standards, and improve the quality of the working environment. We implement a 10-module curriculum (recently developing a new one on CPR/First Aid). Main modules include Milking techniques for Better Milk Quality and Reduced Mastitis, and Farm Safety.
The Informed Arizona Equestrian
Issue
According to the 2012 US Census of agriculture, Sales of equines (horses and ponies) and equids (donkeys, mules, and burros) in Arizona was valued at $31.8 million (10th highest in the nation). There are approximately 92,384 total equines in the state, up 35% from 68,745 in 2007 (US Census of Ag 2012). Arizona Cooperative Extension equine programming has been fairly inactive (with the exception of county 4-H activities) for the last several years, making it necessary to develop relationships with professionals and clientele as well as identify stakeholder needs and methods for delivery. Other topics of need expressed by stakeholders at recent cooperative extension events include farrier knowledge and basic ranch hoof care skills and emergency first aid in the field.
What has been done
Reinvigorate the equine extension programming on a statewide and county basis by having at least 120-150 equine owners in Arizona attend a UA Cooperative Extension educational workshop or seminar per year. (as measured by attendance at equine extension events). Increase the number of equine owners who change at least one behavior to improve their horse's health care, vaccination status, management, nutrition, biosecurity, or overall welfare (measured by post workshop evaluation). Increase public knowledge and perception of the value of the horse industry as a part of Arizona's economy, history and appeal to outside visitors, stakeholders, industry members/leaders, and other Cooperative Extension Professionals.

2. Brief description of the target audience

Commodity groups, state agencies, pest management advisors, pesticide applicators, youth, ag ventures program. Plans are underway to attempt to include non-traditional audiences.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	515	3090	96	1545

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	11	59	70

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of individuals participating in educational programs
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of research projects conducted on all aspects of Animal Sciences, and Agriculture and Resource Economics
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of farmers adopting more sustainable and profitable large scale dairy production practices

Year	Actual
2016	186

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adoption of better management practices for animal production
2	Adoption of alternative animal technologies
3	Adoption of more cost effective means for controlling animal diseases along with noxious plant issues
4	Number of farmers adopting more sustainable and profitable large scale dairy production practices

Outcome #1

1. Outcome Measures

Adoption of better management practices for animal production

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals

Outcome #2

1. Outcome Measures

Adoption of alternative animal technologies

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals

Outcome #3

1. Outcome Measures

Adoption of more cost effective means for controlling animal diseases along with noxious plant issues

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals

Outcome #4

1. Outcome Measures

Number of farmers adopting more sustainable and profitable large scale dairy production practices

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	186

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
311	Animal Diseases

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Through evaluations, we're seeing that not only are our efforts making an impact on the animal systems, but our actions within the human behaviors and how they impact animal systems can be implemented. with adequate training and communications, we have the ability to make a positive difference on how our animal systems are set up for success. We're seeing a bigger need for more of this training in large groups, which adds tremendous value to the systems.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

MARKETING, TRADE, AND ECONOMICS

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	40%		40%	
605	Natural Resource and Environmental Economics	40%		40%	
608	Community Resource Planning and Development	10%		0%	
610	Domestic Policy Analysis	10%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	0.0	6.0	0.0
Actual Paid	1.9	0.0	3.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
219521	0	347507	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
219521	0	347507	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Agricultural Marketing and Management
Issue
The primary objective of this program is to serve as a key resource for information and applied research analyses related to marketing and management issues surrounding Arizona's agricultural production inputs and commodities. Extension programs were primarily identified through my participation and interaction with other specialists, agents, producers, agribusiness managers, commodity associations, government individuals, and others. The convergence of priority issues and program content is often made at key meetings with campus, county, industry, and government partners.

What has been done
In addition to workshops and presentations, numerous requests for information via email and phone were returned on an individual basis from agents, specialists, producers, government individuals, commodity associations, consultants, agribusiness managers, newspaper writers, and TV stations. A Livestock Monitor synopsis was emailed out about every month to over 400 livestock producers in Arizona. RMA education addressed vegetative index insurance, recordkeeping tools and whole farm revenue protection. Four of the nine RMA workshops conducted were comprised of mainly Native American producers. Overall, an estimated 868 unique individuals were reached with an average education/contact time of 2.3 hrs. per individual.
Improving Vegetable Production through Utilization of Spike Wheel Liquid Injection Technology
Issue
Arizona farmers have a difficult task to produce high-quality vegetables while maintaining costs. Add to that the importance of applying safe chemicals to the vast acres of crops without negatively impacting yields, and the work is that much more difficult. Point injection systems utilize spikes attached to a rotatable wheel to inject agricultural liquid chemicals into the soil with minimal root damage and soil disturbance. Research studies have shown that use of the system can improve nutrient use efficiency, provide measurable yield benefits and be used to successfully deliver soil applied pesticides post emergence. Few Arizona growers utilize this technology primarily because they are unaware of its existence or potential benefits. An outreach program is therefore needed to educate growers about this technology.
What has been done
From 2014-2016, field trials have been established to investigate the potential of using point injection systems in conservation tillage farming systems. This project is being partially funded by the Arizona Department of Agriculture Specialty Crop Block Grant Program. State funding had been used to help support a Staff Technician working on the project. In 2016, all funding has come from extramural grants. The findings from the 2012-2013 and 2014-2016 studies were published in a manuscript in 2016.

2. Brief description of the target audience

Commodity groups, state and government agencies, financial institutions, producers, marketing organizations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2947	7725	12895	25750

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	12	28	40

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of economic analysis publications completed
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of individuals participating in educational programs.

Year	Actual
2016	15843

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adoption of better management practices for crop and animal production
2	Adoption of alternative technologies
3	New community gardens or farmers' markets

Outcome #1

1. Outcome Measures

Adoption of better management practices for crop and animal production

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Financial resources continue to be a top concern among farming and ranching communities.

What has been done
Outreach and advocacy for making financial resources stretch.

Results
Improved fiscal resources.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

Outcome #2

1. Outcome Measures

Adoption of alternative technologies

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Financial resources continue to be a top concern among farming and ranching communities.

What has been done
Outreach and advocacy for making financial resources stretch.

Results
Improved fiscal resources.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

Outcome #3

1. **Outcome Measures**

New community gardens or farmers' markets

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Our evaluation results indicate that there is a huge need for cost-cutting, but not quality-cutting, measures on agricultural entities within the state. Individuals and small farms need assistance with developing technologies to reduce their costs and other overhead. By delivering our scientific research and other behavioral shifts, we're seeing how these communities are able to save on certain costs and apply them to alternative areas to see their bottom line improve.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.