V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Management of 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
101	Appraisal of Soil Resources	3%		3%	
102	Soil, Plant, Water, Nutrient Relationships	5%		5%	
103	Management of Saline and Sodic Soils and Salinity	5%		5%	
111	Conservation and Efficient Use of Water	18%		18%	
112	Watershed Protection and Management	9%		9%	
121	Management of Range Resources	12%		12%	
132	Weather and Climate	1%		1%	
133	Pollution Prevention and Mitigation	3%		3%	
135	Aquatic and Terrestrial Wildlife	24%		24%	
141	Air Resource Protection and Management	1%		1%	
205	Plant Management Systems	2%		2%	
305	Animal Physiological Processes	1%		1%	
307	Animal Management Systems	2%		2%	
403	Waste Disposal, Recycling, and Reuse	6%		6%	
405	Drainage and Irrigation Systems and Facilities	4%		4%	
605	Natural Resource and Environmental Economics	4%		4%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	7.3	0.0	14.3	0.0
Actual Paid Professional	4.5	0.0	14.4	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**
393483	0	1403325	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
393483	0	1403325	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

Claims for the right to use water in New Mexico's Rio Grande and other river basins exceed reliable supplies by a considerable amount. For example, in the Rio Grande Basin, demands for irrigation, urban use, the environment, and energy continue to grow, while supplies remain constrained by unsustainable use, drought and impacts of climate change. Policymakers in this basin face the challenge of designing plans for allocating the basin's water supplies efficiently and fairly to support current uses and current environments. Managers also seek to design and implement resilient institutions that can ensure adequate supplies for future generations. Ongoing work in New Mexico has addressed those challenges by designing and applying an integrated basin-scale framework that accounts for the basin's most important hydrologic, economic, and institutional constraints. We plan to use the knowledge gained in developing this analysis to gain insights into cost-effective water and agricultural conservation policies in New Mexico and other water-stressed regions of the world such as Iraq, Afghanistan, and Ethiopia. We are also looking for lessons learned that enable New Mexico water leaders to be better informed for the design of more resilient water institutions for the Rio Grande, Gila, and other critical basins in the face of potential drought and climate variability.

NMSU scientists have constructed models of regional habitat quality and connectivity for pumas in the southwestern United States. This information is being used by both state resource agencies to assist in the management of their puma populations. As a follow up to the project, researchers have now amassed a microsatellite database of over 800 puma and will be conducting a landscape genetic analysis of these genotypes to assess the efficacy of the connectivity maps previously developed. NMSU scientists have begun developing a project using GPS telemetery collars recently developed by the team that allow an assessment of energetic expenditure during movement.

The strategy of adaptive management was successfully implemented in collaboration with the Middle Rio Grande Conservation District to construct refugial habitats for the endangered Rio Grande silvery minnow. This strategy for sharing agricultural water with the environment enables the conservancy district to "leak" water to the refugial habitats when irrigation diversions deplete river flows. The work was featured in the online "Partners Magazine" published by the USDA.

Genetic tools were developed for studying crustaceans that occur in natural ephemeral lakes, flood ponds, and livestock watering ponds throughout the arid regions of southwestern United States. The tadpole shrimp are an important component of carbon flux in isolated watersheds of rangelands. The

results show that development of livestock watering facilities broadly provides habitat for these interesting and enigmatic animals. Two of the three species identified in the Chihuahuan Desert thrive in livestock ponds.

NMSU scientists tested effects of salinity on growth and lipid accumulation of biofuel microalga Nannochloropsis salina and invading organisms. They found that growing algae at 22 PSU salinity and increasing the salt concentration to 34 PSU upon reaching stationary phase maximizes algae productivity, while minimizing undesired invading organisms. Additionally, a bibliometric evaluation of research output in the biofuel fields revealed that the biofuel had received most attention during the last decade. The U.S.A. is leading the biofuel research and mainly collaborating with other productive countries like China, United Kingdom, Germany, Canada, and South Korea.

As a result of NMSU research, we will be better able to sustainably manage our native vertebrate fauna and desert and plains grasslands. This broad project will result in recommendations for grazing management that will incorporate measures of native biological diversity and ecological factors that influence diversity.

The Great Plains Burrowing Owl project (New Mexico, Texas, Colorado, South Dakota, North Dakota and Chihuahua Mexico), is the largest standardized monitoring effort for burrowing owls. In this project we examined daily nest survival across 1500 nest over three years, examined nest predators and predation rates, and conducted stable isotope analysis to examine burrowing owl movements across years. Contrary to expectations, habitat fragmentation appeared to have little effect on nest survival or productivity. Instead, factors at the nest and colony scale, including nearest neighbor fledging success, distance from colony edge, prairie dog colony size, and active prairie dog burrow density had the greatest influence on nest survival and productivity suggesting owls benefit from prairie dog presence and a buffer from colony edges. Nest predation rates were substantially higher in the southern plains compared to northern Great Plains. Badgers were a major predator across all sites and snakes were suspected to be a major predator at southern sites. An NMSU AES scientist is working with the USDA ARS to develop management recommendations for livestock grazing across plains grasslands with black-tailed prairie dogs and burrowing owls. We also are quantifying prey deliveries to nests from remote cameras to determine what factors influence the percentage of quality (vertebrate) prey items delivered to nests. We found that precipitation followed by owl density had the strongest impact on the delivery of vertebrate prey items; sites with higher preciptiation and lower owl density had greater delivery of vertebrate prey items. This suggests that precipitation was the main driving force in terms of prey quality but intraspecific competition for prey also likely had a role.

NMSU's urban burrowing owl project just finished its 4th year of data collection on nest survival and productivity and second and final year of juvenile survival and dispersal through the use of radio telemetry. Analysis of daily nest survival and productivity indicates that daily nest survival is most strongly influenced by year and the number of habitat patches, with lower survival in more fragmented habitats. Interestingly measures of owl density, to a lesser degree, also influenced daily nest survival. Productivity, however, was most strongly and negatively influenced by measures of owl density. This data suggests that while owls may benefit from the presence of other nesting pairs, there is a negative impact of the number of young they are able to raise when they are forced to nest too close

In south central New Mexico, researchers examined measures of avian condition along a gradient of mesquite encroachment for winter sage sparrows (Amphispiza belli). We used traditional measures of avian condition and stress hormones (corticosterone) as indirect measures of fitness to correlate with habitat condition. Data suggest year had a greater influence on condition than levels of shrub encroachment. However, birds in the most desertified habitats were in poorer condition in years of low resource avialbility suggesting desertified habitats may be particularly poor for this species in years of low food production.

Approximately 90% of all participants of the Master Gardener program in New Mexico considered training in turfgrass maintenance important and 95% of the participants reported that turfgrass training increased their knowledge of turf maintenance issues to either a great or a fair extent (immediately following a 3 hour training program). Approximately 75% of all participants that have attended 3 or more years in the Master Gardener Program reported that repeated training in turfgrass maintenance has helped them greatly in their career as a Master Gardener, and 90% reported that repeated training changed and enriched their understanding of turfgrass management differently than one time training would have. More than 70% of all turfgrass maintenance professionals who attended the annual Southwest Turfgrass Conference rated the knowledge they gained with either 4 or 5 on a scale of 0 (no useful knowledge) to 5 (knowledge provided extremely helpful). More than 90% of the participants of the Rio Grande Golf Course Superintendents Meeting rated the knowledge they gained with either 4 or 5 (on a scale of 0 = none to 5 = a lot), more than 95% rated the usefulness of information with either 4 or 5 (0 = not at all to 5 = very), and nearly 70% rated the quality of the training with either 4 or 5 (0 = poor to 5 = excellent). The webinar that was presented in conjunction with the USGA (United States Golf Association) is considered one of the most popular one the USGA has ever done. Total registration was 338, with 224 attending the live webcast. Average attendance duration was 73 minutes.

AES scientists expanded their soil chemistry research to include native and bioenergy plants and their responses to saline and poor quality water sources. Research on soil quality continues to affect local and regional agricultural practices and potential remediation of contaminated soils. The work on salinity and contaminants, such as arsenic, should impact land application practices at wastewater facilities.

Composted biosolids may provide a beneficial use of what may otherwise have been waste. Biosolids may help improve tree nutrition and growth in initial stand establishment. This may be an important source of fertility as the price of manufactured inputs continues to rise.

NMSU researchers have developed efficient irrigation scheduling recommendations for drip-irrigated vegetable crops such as tomatoes, peppers, and sweet corn. Used by irrigators, these recommendations will result in high production while minimizing water waste. The project has also identified drip irrigation emitters (outlets) that function efficiently under low pressures such as those provided by elevated tanks in rainwater catchment systems or from trailer or truck beds. Use of the recommended emitters as prescribed will ensure adequate flow rate and water application uniformity when irrigating gardens or landscapes at pressures lower than recommended by the emitter manufacturer. Relationships between drip irrigation level and establishment and growth of various drought tolerant plant species that can be used in soil stabilization and wind erosion abatement have also been identified during this project.

Water used by agriculture is under intense scrutiny as supplies are tight and demand increases from non-agricultural sectors. Hydrologic research is increasing our understanding of how water diverted into community irrigation systems (acequias) of northern New Mexico can seep from ditches and percolate below fields and then reside in shallow groundwater for a time before returning to the river. This storage and release function provides water to the river in times of low flow and may actually save water on a regional basis by reducing evapotranspiration losses.

Researchers developed a method to quantitatively classify urban landscapes in New Mexico. This classification method will allow landscape planners to craft landscape-specific water conservation plans. This information also will help planners prepare better landscape drought mitigation plans.

Extension workshops attendees were shown that the following mixture-comprised of several quick-growing garden annuals-can significantly increase populations of several groups of important predatory and parasitic insects, and can therefore be a valuable component of an IPM approach. Seeds of the

suggested plants are all readily available, relatively cheap, and easy to grow. In demonstrations, this mixture survived well in both sandy and clay soils and provided continuity of bloom from late June to early October with minimal care (i.e., regular watering and weeding during establishment). This mixture can also be used as a starting point to develop more complex blends by adding additional species (with appropriate adjustment of seeding rates). Within reason, the more species the better, since a greater diversity of plants will benefit more species of insects. If additional species are added to the core mixture, however, it is best to select single-flowered varieties rather than the more ornamental "double" ones since the nectar and pollen in the latter are often difficult for insects to access. It is also sensible to avoid species that are in the same botanical family as your crops. Normally, this is rarely a problem, but sweet alyssum, for example, is part of the cabbage family (Brassicaceae) and may attract pests of such crops (e.g., flea beetles, harlequin bugs [Murgantia histrionica], and Bagrada bugs [Bagrada hilaris]); hence, this species should be omitted if brassica crops, such as arugula, mustard greens, kale, Chinese cabbage, etc., are being grown.

Fish kills caused by diseases usually occur when fish are already stressed by environmental factors such as poor water quality or overcrowding. Because the fish are already stressed, they are more susceptible to diseases. In most situations, there is little that can be done once the fish are affected by the disease other than to let it run its course. However, disease-related fish kills can be prevented by taking simple steps, such as fishing the pond properly to prevent overcrowding, maintaining good water quality in your pond, and watching for signs of problems, such as poor fish growth, thin fish, and excessive numbers of small fish.

Dry land wheat production in Eastern New Mexico serves two purposes. The first is for winter grazing for livestock and the second is grain for marketing in the spring. Harvest in spring brought about the "Wheat Field Day and Variety Evaluation" educational program. Wheat producers in attendance were intrigued by the visual differences and noted on evaluations they would consider such varieties come planting time next year.

New Mexico's Extension Service has taught gardeners to adapt to challenges offered by soil, climate, insects and drought. These efforts must continue applying new technology and science to gardening challenges. The agent was able to answer some questions through first-hand knowledge while others required extra research, either by phone, email, or internet. Over 70% of clientele reported back that they had learned something from the information the agent provided. Evidence of successful Extension Horticulture teaching will result in gardeners changing their landscapes without loss of beauty or livability. Individual landscape water use is decreasing according to clientele reporting on their monthly water bills.

Master Gardeners provide an invaluable resource in volunteerism at many of our larger events, including the Chile and Pecan Conferences. Master Gardeners also provide a huge service through our office by way of the Master Gardener hotline to answer community questions about gardening. Their contribution allows the agent time to meet other obligations while still directing the Master Gardeners activities. This past year 2013, Doña Ana County Master Gardeners contributed over 6,857 volunteer hours towards helping the people of Dona Ana County. Based on the national volunteer hourly wage rate from the Bureau of Labor Statistics of $21.79, these volunteer hours translate into $149,414.03. Dona Ana County brings into this economy over 128 million dollars worth of direct revenues. Representatives of the Southern NM Correctional Facility are attending the fall 2013 Master Gardener Classes to gain an understanding of our program. The program will educate prisoners on gardening principles. The prisoners who finish this program will then be allowed to work in a prison garden where they will produce vegetables to help feed the homeless of Las Cruces and thus learn to give back to society.

Agents collaborated with surrounding Northeastern NM county Agents to develop a monthly series of rotating Ranch Management workshops focusing on pertinent area issues affecting livestock production. A panel of experts was solicited for each top and the workshop was presented two times per month in two

different geographical locations in the NE district area. The Guadalupe County Agent help prepare and design workshops related to range pasture management during drought; Weed Id and Herd Management in drought. The Agent held program evaluations that indicated that 100% of program participants received information in at least two topic area at each program that benefited their production practices or made them more capable to make decisions that would affect their profitability and sustainability.

2. Brief description of the target audience

Target audiences include:ranchers, farmers, urban landscapers, park departments, state and federal agencies, private homeowners, and recreational users of parks, forests, and waters.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	3	5	0

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- The specific output measures will vary according to the specific project being monitored. The

development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

Year	Actual
2013	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of trained professionals
2	# of research publications
3	# of Extension publications
4	% of people adopting NMSU recommendations

Outcome #1

1. Outcome Measures

# of trained professionals

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	11

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
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

# of research publications

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	57

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
141	Air Resource Protection and Management
205	Plant Management Systems
305	Animal Physiological Processes
307	Animal Management Systems
403	Waste Disposal, Recycling, and Reuse
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

# of Extension publications

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3

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
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

% of people adopting NMSU recommendations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	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
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

Key Items of Evaluation

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty.

Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'