

**NEW MEXICO STATE UNIVERSITY
COLLEGE OF AGRICULTURE AND HOME ECONOMICS
ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS**

**New Mexico Agricultural Experiment Station
and
New Mexico Cooperative Extension Service**

**For the Period Covering
October 1, 2005 – September 30, 2006**

LeRoy A. Daugherty
Associate Dean and Associate Director
Agricultural Experiment Station

Paul H. Gutierrez
Associate Dean and Associate Director
Cooperative Extension Service

Submitted April 1, 2007

Introduction

In this Report of Results and Accomplishments, we have organized the materials to reflect the Portfolios instituted by USDA-CSREES, and have adopted their Knowledge Areas as the programmatic areas we report. In each case, we have combined formula-funded research and Extension activities to give a more comprehensive accounting of programs supported by New Mexico State University's College of Agriculture and Home Economics.

A. Planned Programs

Goal 1: An agricultural system that is highly competitive in the global economy.

Overview

New Mexico agriculture must remain competitive in U.S. and world markets. This requires a continuous flow of appropriate technology addressing local needs within New Mexico. It is critical that the College maintains and strengthens programs that address these needs. The College recognizes that agricultural competitiveness and efficiency should take into account social and environmental costs. Determining these factors requires a coordinated, team approach within the College and among researchers and Extension faculty.

New Mexico Cooperative Extension has a tremendous role in helping to keep New Mexico's agricultural economy strong particularly in light of international border competition issues. Drought and water disputes, use of expansive range lands, invading diseases and pests, and national economic down turns, all play a role in maintaining, retaining and building anew Mexico's agriculture infrastructure. Extension specialists and agents are working toward resolving conflicts through researched solutions, mediation through involvement of clientele in problem solving, incorporation of technology applications whenever feasible, and continuous reintroduction of tried and true practices.

The New Mexico Agricultural Experiment Station and Cooperative Extension Service believe that they are meeting the short-term goals outlined under Goal 1 in the 5-year Plan of Work submitted in July 1999.

Total expenditures for Goal 1 were \$2,861,742 from Hatch Act funds. The number of full-time equivalents engaged in research for this goal was 37.856 FTE.

Total expenditures for Goal 1 were \$745,687 from Smith-Lever Act 3(b)(c) appropriated funds. The number of state-level full-time equivalents engaged for this goal was 10.17 FTE.

I. Plant Production

Plant Breeding

a. Description of Activity

This program develops chile, onion, alfalfa, and cotton cultivars for growers in New Mexico. The chile industry is a large employer in New Mexico. Keeping it competitive keeps the industry here instead of it moving out of state or offshore. Elucidation of taxonomic relationships among wild *Capsicum* species will open new genetic avenues for plant breeders to use. Very few commercial onion cultivars are adapted to the growing conditions found in New Mexico. In addition, the onion acreage in New Mexico is too small to warrant specific cultivar development by commercial seed companies. Our program develops high yielding, high quality, disease resistant, and bolting resistant cultivars that allow growers in New Mexico to be competitive with other onion markets in the United States. The New Mexico alfalfa industry faces an increasing number of challenges including diminishing water resources. Future strategies to improve alfalfa production in the irrigated southwest will require germplasm evaluation for improved water use efficiency (WUE) and subsequent enhancement for desirable agronomic traits. New approaches must also be developed to help breeders more knowledgeably manipulate WUE as a means of enhancing and stabilizing forage yield across diverse production environments. Cotton improvement in New Mexico has a very rich history and is recognized to be one of the most influential cotton breeding programs in the U.S. More than 40% of U.S. cotton cultivars developed from 1950-1990 contained New Mexico cotton germplasm. With the fast changes in cotton production and marketing, southwest cotton producers are facing many challenges to which the NM cotton breeding program can offer solutions. Acala 1517 fiber quality needs to be retained and improved for the niche market. To increase productivity and reduce production cost, cotton yield needs to be further increased; insect and herbicide resistance should be incorporated through the transgenic technology. Furthermore, root-nematodes and Verticillium wilt disease each causes approximately 5% yield loss annually. Developing and growing resistant cultivars can also minimize chemical input and protect the environment. Improving heat and drought tolerance in cotton could reduce irrigation need and realize high yield potential in the arid areas.

b. Impacts/accomplishments

- Improvement in selecting genetically superior green chile and cayenne germplasm and their maintenance was accomplished. Two distinct types of New Mexican pod type were grown, i.e., one to fit the “Big Jim” class and the other to fit the “New Mexico 6-4” class. Replicated yield trials were done with each plant being evaluated for a minimum of 26 characteristics, and based on the outcome of that evaluation selections were made. A cayenne replicated yield trial was accomplished. A key characteristic selected for was earliness. New Mexico State University has the longest continuous program of chile pepper improvement in the world. All New Mexican (Anaheim) green and red chile pepper types grown today gained their genetic base from cultivars first developed at New Mexico State University. According to the New Mexico Department of Agriculture

statistics, chile peppers were worth \$50 million at farm gate in 2004. With the majority of chile peppers processed, the chile pepper crop is worth much more. Improving ‘New Mexico 6-4’ and ‘NuMex Big Jim’ is important for the continued success of the industry. In addition, an improved open-pollinated cayenne cultivar would be important to cayenne production in the Southern New Mexico Production area. The cayenne industry in New Mexico has the potential for further growth and a high yielding open-pollinated cultivar with lower seed cost would aid in keeping growers competitive in the world arena.

- Measuring general combining ability (GCA) as a way to predict the usefulness of a alfalfa population as a parent in developing hybrids is very expensive. It requires the generation of numerous hybrids between populations by-hand and their subsequent evaluation. Hence, relatively few potential parent populations can be evaluated at any one time. Our diallel analyses indicate that measuring GCA or molecular genetic diversity is not strictly necessary to identify useful parents. Rather, it is sufficient to measure the yield performance of each individual parent population only (not its numerous hybrids) and each population’s fall dormancy response. This later approach requires far fewer resources. Hence, significantly greater numbers of populations can be evaluated and breeding program efficiency can be improved. The NM0307 alfalfa population appears to be performing well under both well-watered and water-limited conditions. It also appears to be broadly adapted throughout New Mexico. NM0307 will undergo additional characterization for resistance to important pests in New Mexico during 2007. It will be submitted for potential release in 2007 as a cultivar through the NMAES and the National Alfalfa Variety Review board. Commercialization of NM0307 directly addresses our objective to improve the profitability of alfalfa production in New Mexico under variable soil moisture conditions.
- Advanced yield trials on Acala 1517 Bt, RR, and Bt/RR cotton cultivars were conducted in 2006. After its release in early 2005, Acala 1517-99W was planted to 8,500 acres in New Mexico in 2006. This accounted for 13.4% acreage of Upland cotton grown in New Mexico this year.
- Private industry has expressed concern that yield loss may accompany utilization of unimproved alfalfa germplasms, such as many USDA-NPGS plant introductions. Our field experiments have demonstrated, however, that after only one cycle of selection the forage yield of many plant introductions and their hybrids can equal, or exceed, that of the best commercial cultivars. Also, many commercial populations have very broad genetic bases, limiting the potential to capitalize on heterosis. Our results, however, demonstrate the importance of heterosis effects on yield potential. Since many NPGS populations have much narrower genetic bases (i.e., have relatively greater genetic purity), their utilization should offer unique opportunities to capitalize on heterosis to improve alfalfa forage yield. The introgression of multiple pest resistance traits into more than 45 NPGS plant introductions, that have performed well under limited and optimum irrigation management, offers the potential to develop alfalfa cultivars with greater yield stability/environmental adaptation.
- 286 markers derived from *Medicago truncatula* cDNAs containing SSR motifs were evaluated for their association with forage yield under water deficit conditions. Based on

2005 yield data, 29 marker alleles were associated with biomass production ($p < 0.01$) with some alleles accounting for up to 18% of the yield variance. Individual allele effects ranged from -10% to +12% of the population mean. The magnitude of each marker allele effect differed between harvests, however, the direction of the influence for each allele was consistent across harvests. Most marker-trait associations localized to two regions on linkage group 1 (LG1) and one region on LG8. Marker alleles on LG8 primarily influenced May forage regrowth, while those on LG1 influenced June forage regrowth. Annotation results of 18 markers with greatest effects on forage yield indicated that half of them represented regulatory factors. The next most common functional marker group was associated with ion/sugar transport. Additional biomass data were collected in 2006 to verify the influence of these loci. Forty-five additional markers representing drought responsive genes and genes associated with key physiological responses, have been constructed with another 55 underway. These markers are currently undergoing segregation analysis to determine their allelic dosage prior to conducting additional mapping and QTL analysis. The frequency with which drought-responsive genes are associated with drought tolerance QTL will be compared to that of the random cDNA-SSR markers to determine if a candidate gene approach provides an enriched source of markers for detecting drought tolerance QTL. We have chosen the perennial legume, alfalfa, for our experiments because alfalfa is the most important cultivated forage in the United States. The value of direct sales for alfalfa hay in 2002 was estimated at \$7.2 billion. Alfalfa also provides the primary forage base for the multi-billion dollar dairy livestock industry, and is a critical legume rotation component in sustainable agricultural systems. Our study will identify physiological and genetic mechanisms influencing drought tolerance in alfalfa, which will contribute towards developing cultivars that can remain productive in environments with widely varying soil moisture availability. The growing of such crop varieties can conserve water resources, permitting expansion of agricultural related industries or transfer of conserved water to urban communities.

- Acala 1517 cotton cultivars released from the New Mexico State University Cotton Breeding Program and other Acala cotton cultivars mainly released from California were compared in Mesilla Valley (Las Cruces) and Pecos Valley (Artesia), NM, in 2006 for fiber yield, yield component, quality, and *Verticillium* wilt resistance. The combined 2005-2006 results confirmed our previous analysis that yield improvement in Acala 1517 cultivars has been accompanied by an increase in lint percentage and micronaire, and a reduction in boll size. Fiber length, strength, and elongation in Acala 1517 cultivars have also gradually improved. *Verticillium* wilt significantly reduced lint yield, boll size, fiber length and micronaire. More recently released Acala cotton cultivars performed better under *Verticillium* wilt conditions. Many Acala germplasm lines with desirable traits have been identified for cotton breeding purposes.
- Since the advent of restricted fragment length polymorphism (RFLP), numerous molecular marker systems have been developed in the last 25 years. As genomic DNA sequences in most species were unknown, PCR-based marker technologies such as amplified fragment length polymorphism (AFLP) were developed. AFLP has been widely used to rapidly generate molecular markers among various organisms from bacteria to plants in various areas including genetic diversity, germplasm fingerprinting, linkage and quantitative trait locus (QTL) mapping, gene isolation, and marker-assisted

selection in breeding. The most recent focus in DNA marker development is on the detection of single nucleotide polymorphism (SNP) and expressed sequence tags (EST) have provided an ample source for mining and developing SNPs. However, differentiation between homologous loci and homeologous loci has been difficult for polyploid species such as cultivated tetraploid cotton. To reduce the complexity of the polyploid genome, we attempted to use AFLP technology to isolate SNPs in tetraploid cotton. DNA or cDNA libraries were constructed for Upland cotton SG 747, Acala 1517-99 and Pima Phy 76 using selective AFLP primer combinations or one AFLP primer in combination with one gene targeted primer. Plasmid DNAs were sequenced for the identification of SNPs by comparative analysis among the three genotypes. Our results have demonstrated that this AFLP-based SNP strategy allows high-throughput, low cost detection of SNP markers in cotton.

- We developed and released the first public transgenic Bt (insect resistant) cotton cultivar (1517-99W) in the United States in 2005 which was grown in more than 13% (8,417 acres) of cotton acreage in New Mexico in 2006, according to the “2006-2007 Variety Planted” report by USDA. The new cultivar 1517-99W increased cotton production by 70-140 pounds per acre, totaling 600,000-1,200,000 pounds (\$300,000-600,000) in increase for New Mexico in 2006 alone. The figure is expected to increase substantially in the years to come. Recently, New Mexico growers reported more than 3 bales (>1,440 pounds) per acre production from growing Acala 1517-99W in 2006. This translated to 25,251 bales (12,120,480 pounds) cotton fiber production by 1517-99W, totaling >\$6 millions gross income for New Mexico cotton growers. We are targeting ~50% acreage coverage by our new Acala 1517 cotton cultivars including this one (1517-99W) in our state in the next several years. Therefore, the economic impact of this cotton breeding program will soon be >\$25 millions for our state.
- cDNA using primers designed from disease resistance gene analogues (RGA) or combined with AFLP primers (RGA-AFLP) were amplified from three cotton genotypes (Acala 1517-99, Pima Phy 76 and SG 747). 810 fragments were cloned and sequence. Cluster analysis is also used to group the expressed RGA and RGA-AFLP into different categories. About 90% fragments were homologous to cotton EST deposited in Genebank and many isolated fragments were also homologous, rendering an opportunity for SNP identification. About 10% fragments were novel, representing new genes that have not been isolated before. Many cDNA RGA and RGA-AFLP fragments were found to be putative disease resistant, abiotic stress related or similar to nucleotide binding sequences, indicating the usefulness of the two systems.
- The New Mexico onion industry is economically significant and is highly competitive. The industry has a recent history of expansion, and the potential exists for further expansion. Further development and release of high-yielding, high-quality, well-adapted, bolting-resistant, disease-resistant, short-, intermediate-, and long-day onion open-pollinated and hybrid varieties with varying maturities, pungency levels, and scale colors will support industry growth in New Mexico. A new onion cultivar, NuMex Mirage, was released in 2006. Genetic improvement in bolting resistance, disease resistance, and bulb pungency also will facilitate further expansion and add significantly to New Mexico's economic development. Genetics and heritability studies on *Allium cepa* species are

needed to support onion plant genetic improvement programs for the bulb onion.

- c. Source of Federal Funds — Hatch
- d. Scope of Impact — Multi-state Research, with states AL, AR, AZ, CA, CO, GA, HI, ID, LA, MS, MT, NC, OK, OR, TX, UT, WA, WY

Genetic Resources/Genomics

- a. Description of Activity

This research area focuses on elucidating fundamental biochemical processes of crop plants. The research also seeks to develop methods to manipulate biochemical processes within living plants to increase crop productivity and drought tolerance, and to provide alternative crops for new markets.

- b. Impacts/accomplishments

- A set of 71 recombinant inbred lines (RILs) of chiles established a host differential that indicates that phytophthora resistance is controlled by many genes and/or alleles. A genetic study using the RILs and other plant materials indicated that a gene-for-gene interaction within the *P. capsici-Capsicum spp.* System is present. A gene-for-gene model in which 13 genes were identified was described (*Prr-1* through *Prr-13*). In addition, six RILs have the apparent same high level of resistance that the universal resistant line, ‘Criollo de Morelos-334’, possesses. These lines will be used to hybridize with susceptible parents to assess the feasibility of a single donor parent giving F₁ hybrids the necessary level of resistance needed for commercial seed production. A total of 300 RAPD primers were used to find possible molecular markers linked to resistance to phytophthora root rot. This study also indicated that the resistant genes tend to cluster in specific chromosomal regions. Currently, the major research effort on disease resistance in the United States revolves around the comparatively simple vertical resistance involving “gene-for-gene” interactions. Our system is shedding light on a more complex and much less understood resistance responses, that comprise the majority of plant-pathogen interactions. Overall, it is anticipated that novel control techniques of national significance may be a long-term outcome of this research
- We have shown that GS₁ in plants is regulated at the level of transcript turnover and at the translational level. Using a Glycine max (soybean) GS₁ transgene, with and without its 3’UTR, driven by the constitutive CaMV 35S promoter in *Medicago sativa* (alfalfa) and *Nicotiana tabacum* (tobacco), we have shown that the 3’UTR plays a major role in both transcript turnover and translation repression in both the leaves and the nodules. Our data also suggests that the 3’UTR mediated turnover of the transcript is regulated by a nitrogen metabolite or carbon/nitrogen (C/N) ratios. We have also shown that the 3’UTR of the soybean GS₁ gene confers posttranscriptional regulation on a reporter gene. Understanding the regulatory mechanism underlying the expression of GS₁ in alfalfa will allow us to design genetic engineering approaches to increase GS activity in the appropriate cell types. Increased GS activity in alfalfa will result in increased growth and

biomass production under low nitrogen conditions thus improving its nitrogen use efficiency.

- We have identified a single putative plastidic glutamine synthetase (GS₂), isolated from *Medicago sativa* (alfalfa) leaf. We show that, although expressed in the photorespiratory tissues, the alfalfa GS₂ gene is also expressed in nitrogen fixing root nodules where its expression is not regulated by fixed nitrogen. Treatment with nitrate results in the induction of GS₂ in the roots and leaves of alfalfa, but the signaling mechanism in the two organs is different. In the roots NO₃⁻ appears to act as a direct signal for the induction of GS₂ whereas in the leaves secondary metabolites of NO₃⁻ probably act as the signal. Finally, we demonstrate that 2-oxoglutarate (2-OG) in combination with nitrate appears to significantly induce GS₂ expression, pointing to 2-OG as a primary metabolic inducer of alfalfa GS₂. Our interest ultimately lies in dissecting how carbon:nitrogen status modulates the expression of GS at transcriptional and post-transcriptional levels.
- NMSU researchers have constructed a total of nine cDNA libraries; drought-stressed leaf: *Capsicum chinense*, *Phaseolus acutifolius*, *Trifolium purpureum*, *Dactylis glomerata*, *Medicago sativa*; drought-stressed roots: *Phaseolus acutifolius*, and *Medicago sativa*; drought-stressed stems: *Medicago sativa*; and roots for *Capsicum annuum*, Criollo de Morelos 334, challenged with *Phytophthora capsicii*. DNA sequences on approximately 6,000 clones have been obtained to date and these DNA sequences are under analysis. To date, four microarrays have been produced and used. The first consists of approximately 5,000 cDNAs from drought-stressed leaf of *Capsicum annuum*, *Phaseolus acutifolius* and *Trifolium purpureum*. The second microarray consists of approximately 10,000 cDNAs from drought-stressed roots of *P. acutifolius* and *Phytophthora capsici*-challenged roots of *C. annuum*. *P. capsici* is the fungal causal agent of chile root rot. The third array is a subset of the second array with a reprinting of all of the genes identified as responsive in the interaction between chile and *P. capsici*, about 1,000 responsive genes + 1,000 control elements. The fourth array contains a subset of the *Phaseolus* genes that are drought responsive, about 5,000 genes from leaves or roots of drought stressed tepary bean. We have submitted a manuscript describing our bioinformatics methods of data analysis using the chile-fungal interaction data. We have completed the microarray experiments comparing expression patterns across multiple sources of disease resistance in chile and are now analyzing that data. Use of microarray technology has thus allowed the rapid identification of new genes likely to play important roles in the intricate interaction between host and pathogen. The future characterization of these genes promises to shed light on novel aspects of disease resistance at the molecular level.
- Quantitative genetics experiments (diallel analyses) conducted over 10 years have identified novel alfalfa germplasm that can be sexually hybridized with adapted New Mexico populations to introduce new genetic variation as a means to increase yield potential. Superior hybrid populations developed from the above research were evaluated in 2004 and 2005 yield trials at Las Cruces, NM. Under optimum irrigation management, the data indicated that among 36 commercial cultivars/experimental lines tested, the numerically highest yielding population was a New Mexico hybrid. Four additional NMSU experimental lines (two of which were hybrids) also yielded as well as the best commercial accessions, and significantly outperformed the NMSU cultivars ‘Wilson’ and

‘Dona Ana’ by 10 to 17%. First year data from an independent yield trial (managed at 50% of normal irrigation), indicated that three of these same NMSU experimentals (two of which are hybrids) outperformed the drought tolerant cultivar, Wilson, by 9 to 11%. In other studies, the most comprehensive DNA marker linkage map (286 markers) developed in tetraploid alfalfa was completed. Total composite map length was 624 cM. Backcross derived families from each mapping population genotype were evaluated in 2005 for yield performance under drought-stress and well-watered conditions. Significant yield variation was observed among families.

- The integration of DNA marker linkage data with field performance of mapping population families under varying soil moisture conditions should prove useful towards identifying genes associated with quantitative trait loci that influence drought tolerance. This work will permit us to genetically dissect drought tolerance mechanisms in alfalfa. It will also demonstrate how genomic technologies developed in model plants such as *Medicago truncatula* can be applied to characterize and ultimately improve complex physiological crop traits.
- c. Source of Federal Funds — Hatch
- d. Scope of Impact — Multi-state Research, with states AZ, CA, CO, HI, ID, MT, OR, UT, WA, WY

Plant Management Systems

a. Description of Activity

This area focuses on integration of production practices into an integrated system for managing annual and perennial plant population densities, fertility, irrigation, precision agriculture, and other cultural practices in an efficient and effective manner.

b. Impacts/accomplishments

- The first Organically Certified research acres at New Mexico State University continue to be used at the Sustainable Agriculture Science Center at Alcalde to assist fruit, medicinal herb, and specialty crop growers interested in producing and marketing organically. Based on this research, several local growers have begun to grow and sell organic strawberries grossing the equivalent of up to \$40,000 per acre.
- Research plots using under-tree sprinkler systems in tree fruit and drip systems in berries and medicinal herbs, have resulted in several growers adopting these methods and thus irrigating more efficiently on their farms. Several growers are also using the under-tree sprinklers for protection against late spring frosts--a serious challenge for local fruit growers.
- Research on medicinal herbs as alternative high value crops is based on traditions, culture, and expansion of markets. Results indicate that, depending on current prices, returns per acre can be quite substantial. Interest in fruit and medicinal herb production

has grown substantially.

- Agronomists at Tucumcari and Clovis have demonstrated that residual forage can be comparable and cattle gains and pasture productivity can be higher from medium or light stocking density, as compared with higher densities. If these results can be shown to be transferable to rangeland situations, they will support the use of lighter stock densities to maximize beef production per unit of area.
- A project conducted by NMSU forage agronomists, recently completing its second year, has demonstrated that forage sorghums can be grown more efficiently than corn; however nutritive value of the sorghums and corn under limited irrigation is still questionable as 2006 quality results are pending. The potential impacts from this project are great, considering the steadily increasing dairy numbers in this region of the U.S. and the amounts of water that can be saved if water use efficient sorghums are broadly accepted by the industry. The variety testing program is used to evaluate variety and hybrid adaptation to both irrigated and dryland growing scenarios in eastern New Mexico. Use of better-adapted varieties allows growers to utilize their resources more efficiently and leads to economic savings. Particularly, more efficient water and nitrogen utilization contributes to conservation efforts and sustainable agricultural production.
- Winter wheat grain trials, small grain forage trials, corn and sorghum grain trials and corn and sorghum forage trials are being used to evaluate variety and hybrid adaptation to irrigated and dryland growing conditions in eastern New Mexico. If proper variety selection results in a 62 kg ha⁻¹ increase in crop yield, the economic impact on eastern New Mexico exceeds \$2 million annually.
- Spectral reflectance of several crops has been measured under normal and stressed conditions. Daily satellite images of the Mesilla valley have been collected and processed to produce vegetation maps at various times during the growing season. Procedures are being developed to use the spectral reflectance data to classify the satellite maps for vegetation condition. The NMSU aircraft has been fitted with a belly pod containing a color infrared camera and a thermal imager. This platform will enable us to better link the spot measurements of spectral reflectance to the satellite images. Farms and ranches in New Mexico have \$1.4 billion in expenses for producing their crops and livestock. Site-specific crop and pest management technologies using remotely sensed data and computer-based-management systems will greatly reduce production costs.
- Correlation of weather station temperature data and satellite recorded land surface temperature data for 2005 has been completed and processing of 2006 data has begun. The satellite temperature data will be used to refine degree-day models.
- Results of experiments by NMSU turfgrass scientists will provide best management practices for turfgrasses grown in the arid southwest, will reduce overall turfgrass water requirements and will allow for the adoption of additional low maintenance turfgrasses. Developed Best Management Practices will reduce turfgrass water use in New Mexico by up to 20%.

- NMSU Extension Specialists conduct the Certified Crop Advisor (CCA) program. It is difficult to find individuals who can offer good consultant advice to the farming community on primary production, which includes knowledge of soil fertility, soil and water conservation, plant nutrition, integrated pest management, and regulatory requirements. CCAs adhere to a code of ethics and can have their certification revoked for conflicts of interest or poor performance. This assures New Mexico producers that they receive the unbiased, research-based advice for the price they pay. Most producers who use CCAs realize a net gain in farming profits from reduced inputs or higher yields.
- c. Source of Federal Funds — Hatch, McIntire-Stennis, and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Ornamentals/Green Industry

a. Description of Activity

This research program focuses on the drought tolerance, water use, and requirements of ornamental plants in managed landscapes and the human factors that influence water conservation in an arid environment.

b. Impacts/accomplishments

- An irrigation scheduling model for land application of treated industrial wastewater to Chihuahuan Desert soils and their mixed vegetation members, *Larrea tridentata* and *Prosopis glandulosa*, was implemented in 2004. By 2006, the model was disseminated through peer-reviewed literature. Because of high salinity of the industrial effluent, soil salinity has reached as high as 5 to 6 dS/m at average sampled depths of 0.75 to 1.05 m. Control (nonirrigated) plot salinity has remained stable and at or below 1 dS/m throughout all sampled depths and years of study. Research is in progress to determine the effect of salinization on both soil and vegetation. This research should be nearing completion by end of 2007.
- Findings from the field-grown specialty cut flower research should be of value to New Mexico small farmers considering high value water use options (e.g., specialty cut flowers) in their production diversification schemes. For the big bend bluebonnet research, with a 2-day extension of vase life resulting from 1-methylcyclopropene, cost-effectiveness of water and fertilizer inputs at the production stage will ultimately be improved. For example, a retailer would need 33% fewer shipments due to delayed spoilage, which would in turn require 33% less production inputs, including water and fertilizer in the greenhouse production environment. An additional impact of the big bend bluebonnet research is that our findings (involving resource retranslocation processes) are the first that we are aware to provide an internal resource supply and demand 'balance sheet', reflecting, quantitatively, the postharvest reallocation of invested resources from mature reproductive tissues to generative reproductive tissues during display life of a cut inflorescence. The latter finding will increase our knowledge of factors regulating senescence in perishable cut flowers.

- NMSU researchers have identified selected provenances of bigtooth maple that could be used to select plants for managed landscapes prone to drought and salinity.
 - More than 700 Master Gardeners were trained and active as volunteers assisting the NM Cooperative Extension Service, which is evidence of increased dissemination of gardening information. This has led to visible changes in landscapes throughout the state by using xeriscape principles taught by the Cooperative Extension Service.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

II. Animal Production

Reproduction

a. Description of Activity

This area includes research to enhance reproductive performance of agriculturally important animals involves factors that control reproduction or provide methodologies to improve reproductive efficiency, including efforts to control puberty, ovarian function and cycles, gamete formation and maturation, fertilization, establishment and maintenance of pregnancy, placental function, fetal development and growth, and parturition.

b. Impacts/accomplishments

- Reproductive failure of domestic livestock accounts for significant economic losses to livestock producers in the U.S. In the western U.S., grazing ruminants are prone to reproductive failure, which is exacerbated due in part to climatic extremes, variable forage quantity and quality, and extensiveness of ranching enterprises. In the ruminant female, the prevalent causes of reproductive failure include anestrus, embryonic mortality, fertilization failure and general infertility. The inability to precisely regulate ovarian events (ovulation, folliculogenesis, luteinization) impede the ability to implement procedures such as artificial insemination (AI), embryo transfer or, conversely, inhibit unwanted reproductive events such as estrus in feedlot heifers. The advantage gained by using AI or embryo transfer to increase genetic merit is not fully realized due to the imprecision of manipulating ovarian events. Basic knowledge of ovarian events including folliculogenesis, ovulation and luteinization and formation of the corpus luteum, are requisite for developing new technologies and adopting existing technologies that increase efficiency of reproduction in livestock. Blocking synthesis of PGF2 α from the corpus luteum affects luteolysis and return to estrus. These preliminary data indicate that luteal production of PGF2 α may be required, in addition to uterine PGF2 α for normal luteolysis. Heifer development and optimum pregnancy rates can be accomplished by

supplementing rumen undegradable protein to grazing heifers. Heifers supplemented with rumen undegradable protein achieve acceptable pregnancy rates below the traditional target weights. Pregnancy loss due to inadequate progesterone from the corpus luteum is estimated to approach 30% in ruminant females. Increasing calving rates by 5% (to 92%) would result in an additional 27,000 head weaned or approximately an additional 13.6 million lbs of calves weaned in New Mexico. Based on these figures, the increase of 5% in calving rate would increase economic return approximately 10 million dollars to NM ranchers.

- NMSU animal scientists have found that intravaginal progesterone application during early lactation in Rambouillet ewes appears to reduce lamb weights. Shortening the seasonal anestrous reproductive pattern of sheep could result in two yearly lamb crops and thus increase productivity and profits of sheep operations. Supplemental progesterone does not appear to increase lamb crop percentage in ewes.
- The biosynthetic pathways that result in L-Arginine being shuttled towards either polyamine or nitric oxide synthesis in the corpus luteum have been measured in ovine corpus luteum. Inducing a prenatal hypothyroid state in ewe lambs does not hasten puberty or alter seasonal cyclic patterns. Hastening onset of puberty and (or) reducing the tendency for seasonal cyclicality in sheep could have major impacts on improving reproductive efficiency and lamb production.

c. Source of Federal Funds — Hatch

d. Scope of Impact — Multi-state Research, with states AR, AZ, CA, CO, HI, ID, KS, ME, MI, MN, MO, MT, NE, ND, NV, OH, OR, TX, WA, WY

Nutrition

a. Description of Activity

Work in this area focuses on efforts to enhance the efficiency of nutrient utilization for improving animal productivity, including molecular and cellular biology of nutrient utilization, digestion, metabolic processes, and feed processing technology.

b. Impacts/accomplishments

- NMSU research is providing insight towards optimizing the utilizing of amino acids by growing sheep and cattle by identifying those essential amino acids that limit protein deposition and determining factors that affect amino acid utilization, thereby providing the opportunity to improve the efficiency of protein (amino acid) utilization through supplementation strategies. The findings of these projects demonstrate that methionine, and at least one of the branched-chain amino acids, may limit the growth of lambs. Further research has demonstrated that the branched-chain amino acid, valine, limits growth of lambs when fed a diet containing protein that is predominantly degraded in the rumen. Increasing methionine supply in the diet of sheep through a rumen-protected source increases

hepatic and splanchnic tissue uptake of methionine, leucine, threonine, and phenylalanine indicating the importance of methionine in the metabolism of essential amino acids. Acute infection may increase the threonine and histidine requirement for nulliparous ewe lambs. Energy supply decreases urinary nitrogen excretion even when valine was a limiting amino acid in growing lambs, which suggests that energy supply affects the efficiency of amino acid utilization in growing lambs. Research with growing beef steers demonstrated that supplemental dietary methionine does not alleviate the negative effects of bacterial lipopolysaccharide on nitrogen utilization, and that metabolic demands for other amino acids may increase following exposure to bacterial lipopolysaccharide. This research provides insight towards optimizing the utilizing of amino acids by growing sheep and cattle by identifying those essential amino acids that limit protein deposition and determining factors that affect amino acid utilization, thereby providing the opportunity to improve the efficiency of protein (amino acid) utilization through supplementation strategies.

- Preliminary data support previous work in NMSU laboratories that the ruminal microbes will produce detectable levels of methylglyoxal in response to nutrient imbalances in the rumen. This suggests that methylglyoxal can be used as a marker for effectiveness of protein supplementation under a differing diet protein supplementation regimes.
- Tallow supplementation appears to have positive effects on forage utilization when supplemented to cattle grazing wheat pasture only when is supplemented before the jointing stage of maturity of wheat grass. Increasing the quality grades of cattle backgrounded in wheat pasture could have a tremendous impact on producers income and also on producers expenses due to reduced day on feed at the finishing phase.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Physiological Processes and Genetics/Genomics

a. Description of Activity

This area includes work on the fundamental physiological processes within the animal at the organismal, organ system, cellular, and molecular level. Also, research in this area involves the application of new developments in molecular biology to map and understand the genome of agriculturally important animal species.

b. Impacts/accomplishments

NMSU researchers have evidence to suggest 1) frequencies of DNA polymorphisms in genes of the GH axis or its transcriptional regulators differ among Angus, Brangus, and Brahman cattle

and 2) DNA polymorphisms in genes of the GH axis or its transcriptional regulators appear to predict growth and or reproductive traits in Brangus bulls and heifers. Discovery of genetic markers will enhance the ability of the beef industry to select for more efficient and higher quality product. The GH-IGF-1 axis has a major role in regulating animal growth and reproduction; thus, discovery and implementation of markers in the GH-IGF-1 axis will contribute to genetic improvement programs. This procedure will be called marker assisted selection (MAS). This type of selection will involve panels of DNA markers. The markers evaluated in this project will be on these panels.

- c. Source of Federal Funds — Hatch
- d. Scope of Impact — Multi-state Research, with states AL, AR, CA, DE, GA, HI, IN, IA, KY, LA, MA, MI, MN, NC, NE, NH, NJ, NY, OH, OK, RI, SC, TX, UT, WA, WI

III. Plant and Animal Protection

Arthropods Affecting Plants

a. Description of Activity

This area focuses on yield and quality affected by indigenous and exotic insects, mites, and other arthropods (including bees and other pollinators). An understanding of arthropod biodiversity is important in the development of any ecologically-based management program for pest or beneficial insects and spiders in cropping systems or rangeland. The program is designed to document the known biodiversity of arthropods in agricultural and rangeland ecosystems and to supplement these data to provide a basis for research. The project also will focus on the application of biodiversity information in specific problems associated with cropping and rangeland ecosystem management.

b. Impacts/accomplishments

- A manuscript is been submitted on all of the important species of insects from woody snakeweed (over 300 sweep samples and dozens of root samples. The summarizing of data on snakeweed insects give land managers, ranchers, and researchers an important tool in the management of this range weed.
- Understanding of the constraints posed by native predators on the introduction of exotic biological control agents of tamarisk make the management of this pest tree more efficient.
- About 25,000 arthropod records from the Arthropod Museum have now been transferred to a modified Filemaker Pro© database and more records are in the process of transfer. It is estimated that well over 100,000 records will eventually be databased. The combined and revised arthropod database is continuing to be expanded. These data are invaluable for analysis, management or conservation of pest, beneficial and alien species of arthropods.

- Hundreds more specimens of species in the economically important families Noctuidae, Geometridae and Arctiidae were collected, mounted, labeled and data based. The filling in of blanks in the arthropod collection make the identification of pests and beneficials for the public, pest control operators, other researchers and government agencies more efficient. The reference collection serves as an important first line of determination for alien species.
 - NMSU Extension specialists coordinate with the United States Forest Service and the New Mexico Forestry Division in monitoring and recording current insect damage in federal, state and private forested lands. This survey also indicates movement of native pests and beneficial organisms within New Mexico. Survey data and pests status are reported on a national data base and used to inform other states and forests of current situations and historical reference data. This program supports a national effort to detect and suppress pests before they become economically damaging. State wide economic impact as a result of increased control of pests could amount to thousands of dollars.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Pathogens and Nematodes Affecting Plants

a. Description of Activity

This area focuses on yield and quality affected by indigenous and exotic bacteria, fungi, nematodes, viruses, and other pathogens.

b. Impacts/accomplishments

- The importance of NMSU researchers' previously-published (*Journal of Nematology* 36:131-136; 2004) discovery that yellow and purple nutsedge tubers protect the root-knot nematode *Meloidogyne incognita* from soil fumigation, thereby reducing the efficacy of this widely-used management practice in high-value crops, was recognized as a Research Breakthrough by the international journal *Phytoprotection* (vol. 85:115-117). These findings are the basis for the current work to identify alternative ways to manage the nutsedge-nematode pest complex rather than managing the individual pests.
- The root-knot nematode/yellow nutsedge/purple nutsedge pest complex described for *Meloidogyne incognita* host race 3 occurs with other host races of *M. incognita* and *M. javanica*, but not with *M. hapla*. Cultivars of sorghum, sudangrass, and sorghum/sudangrass hybrids grown in the southwestern United States do not appear suitable for use as rotation crops to suppress the root-knot nematode/nutsedge pest complex due to unacceptably-high levels of reproduction by *M. incognita* host race 3.
- Yellow and purple nutsedge and root-knot nematodes simultaneously reduce yields of

many crops grown throughout the southern and western regions. Management that targets the individual pests has not been successful or sustainable due to the beneficial interactions among these pest species. The purpose of our work is to develop ways to manage this pest complex, reduce the use of fumigant nematicides, and increase the profitability of crops affected by these pests. A three-year field study will assess the effectiveness of nematode-resistant alfalfa for providing economical suppression of all three pests in succeeding chile pepper and cotton crops. The research is in progress and only initial, tentative conclusions can be drawn. Our initial analysis indicates that nutsedge counts in the field may be a visual indicator of root-knot nematode populations, at least at some population levels.

- Research on curly top virus focuses on the ecology, epidemiology and predictive management of the disease caused by the virus in chile. NMSU scientists have worked toward a model for predicting disease based on fall precipitation. We had previously shown that the winter annual mustard weed, London rocket, plays an important role in providing a source of virus and a potential home for leafhopper vectors. We also found that precipitation influences the growth and survival of the weed host. We assessed vector leafhopper populations throughout the year at multiple locations.
- In our studies of fungal endophyte-locoweed interactions, we identified similar fungi from other continents and have shown that some locoweeds have very low toxicity. A better understanding of the role that the fungal endophytes of locoweed play in locoism, the genetics of the fungi, and the factors that influence toxin production will lead to new options to mitigate the disease locoism and its impact.
- Research was completed on assessing the distribution and causal agents of wilt symptoms on chile pepper in New Mexico. Results show that *Phytophthora capsici* and *Verticillium dahliae* are the causal agents of chile pepper wilt in New Mexico. Both microorganisms may be found in the same fields and the same plants.
- Research was also conducted on the effect of soil water saturation on infection of chile pepper by *Phytophthora capsici*. The study indicates that soil water saturation does not exert a significant predispositional effect on plant infection by *P. capsici*.
- *Phytophthora capsici* was reported for the first time on pumpkin in New Mexico. Isolates from pumpkin were found to be pathogenic on a susceptible chile pepper cultivar. From this study, it is recommended that chile pepper should not be rotated continuously with pumpkin since both crops are susceptible to *P. capsici*. The project provides information for crop producers on the pathogens associated with chile pepper wilt and enable them to take appropriate control measures including choice of rotational crops.
- Work on nematode resistance genes included the cloning and partial characterization of a collagenase from *C. elegans*. Collagen is the major structural protein of nematode exoskeletons and there has previously been a great deal of interest in using collagenase enzymes as anti-nematode genes. The diversity of collagen types has been a complicating factor in these past attempts. Collagenases previously examined (such as human) have

low activity against nematode collagen which may explain previously disappointing results. Using a bioinformatic approach we determined that the *C. elegans* genome contains a collagenase homolog, which makes sense since they need to remodel their exoskeleton as they grow. Characterization of this gene showed that it was indeed expressed as an active gene. A full-length cDNA was cloned and sequenced. Current work includes expression of this gene in *E. coli* and in-planta for biochemical analysis of its putative collagenase activity and testing it for anti-nematode activity when expressed in transgenic plants.

- NMSU researchers have worked on identification of novel Bt (*Bacillus thuringiensis*) toxin genes via collaborative informatics approaches which may have anti-nematode activity. Bt genes have proven highly successful as biotechnological solutions to several pest problems and have resulted in excellent crop protection with greatly reduced reliance on chemical pesticides. Work with novel Bt gene derivatives thought to be potentially active against nematodes continued. Specifically, three different Bt derivatives were cloned into plant transformation vectors and introduced into transgenic plants. Antibodies were also raised against these three Bt proteins. Plant transformation and analysis for nematode resistance is expected to be completed within the coming year.
- Ongoing work on development of resistance genes for pest transmitted diseases continued with further development of resistance genes for Gemini- and tospoviruses. These are particularly important concerns since there are insufficient natural resistance resources available to protect crops from these viruses and because there are no effective controls for the pests that transmit them.
- Progress was also made on development of multi-gene expression systems which will allow plant to be engineered with multiple genes simultaneously. This is a particularly important goal since adding a single pest / disease resistance gene at a time is unlikely to be effective in addressing the multitude of pest / disease problems confronting producers currently.
- NMSU researchers continued making progress on applying molecular techniques for accurate pest identification. Often times determining which pest is present is a crucial but difficult decision. Our work during the current year contributed to the development of a molecular diagnostic for fire ants which is capable of differentiating several closely related species that are virtually impossible to differentiate by morphological features. In addition to enabling precision agriculture, definitive tests like this will play an ever more important role as trade, quarantine, and security issues grow in the future.
- In fiscal year 2005-2006, a total of 475 plant samples were submitted to the Plant Diagnostic Clinic for diagnosis. The Extension plant pathology specialist conducted surveys and provided diagnostic services for the Cooperative Ag Pest Survey for sudden oak death (SOD); *Xylella fastidiosa*, an exotic disease to the state of New Mexico; Tomato Spotted Wilt Virus; and *Erwinia tracheiphila*, bacterial wilt of cucurbits, in pumpkins and cucumbers beetles. Data on disease occurrence in the state is uploaded to

the National Plant Diagnostic Network as part of our role as a state support lab for the Network.

- Significant improvements to the NMSU Plant Diagnostic Clinic webpage have been made. The website now has a user-friendly URL address (<http://plantclinic.nmsu.edu>). The website is still being designed, but should be fully operational by spring 2007.
 - The Extension plant pathologist helped plan and execute the Border Governors' Agricultural Workshop and Tabletop Exercise held in Las Cruces in February 2006. This conference involved participation from four U.S. and six Mexican states. The workshop and tabletop exercise involved both animal and plant biosecurity issues.
- c. Source of Federal Funds — Hatch & Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state Research, with states AR, AZ, CA, HI, ID, MI, NE, OR, WA, WI

Weeds Affecting Plants

a. Description of Activity

This area focuses on yield and quality affected by competition from indigenous and exotic weeds, including aquatic weeds and parasitic plants.

b. Impacts/accomplishments

- Researchers have been instrumental in the past 25 years in controlling troublesome weeds both grasses and broadleaf common to this area in agronomic, horticulture, and in rangeland with lower than normal use rates. We have also assisted the chemical industry, EPA, and NMDA in product registration. Some of these have included Raptor, Pursuit, Axiom, Callisto, Outlook, Steadfast, Option and hopefully Valor in the near future. In 2006, there were five herbicide studies, two concerning corn, one concerning roundup ready alfalfa, dry beans and sunflower. Off station herbicides test included, three in pasture grass grown for seed and two on Navajo Agricultural Products Industry poplar tree plantation.
- NMSU scientists screened African rue plants for their sensitivity to herbicides when grown with different levels of water availability. Even under extreme water-deficit conditions where most plants would not survive, African rue plants maintained functional photosynthesis; however, there were no major differences among moisture availability, herbicides, and seasonal application timing on chemical control of African rue. This information will provide greater flexibility in management strategies employed for this weed's control.
- Since nutsedge tubers serve as an overwintering host for root-knot nematode and protect the parasite from fumigation, a greater understanding of the biology of the three pests is

needed to identify alternative, sustainable management strategies for the pest complex. The research to determine the effect of pre-plant irrigation on nutsedge emergence and development of the three pests will enable us to develop a predictive tool for growers. The goal is to be able to suggest changes in management to reduce the impact of the nematode-nutsedge complex on vegetable production. The research to elucidate the life cycle of London rocket has provided important information to growers for managing beet curly top virus. In years of good fall rainfall, we are cautioning growers to control London rocket as a strategy to reduce the potential for beet curly top virus infection of chile pepper the following year. This, along with other management approaches such as delaying thinning, is reducing the problem in the field along with reducing the need for expensive insecticide treatments that are only marginally successful in controlling the insect vector.

- A weed garden was established in 2004 and planted with species common to the irrigation canals as well as weed species common to production fields. The weed garden continues to be used as an educational aid at a production field days and as a resource for irrigation managers, crop managers, and students. We have mapped some of the vegetation along the irrigation canals and are currently conducting water use studies to help us determine which species found along the canals use the greatest amount of water. This will help us understand the canal ecosystem and develop sustainable strategies for managing the canal system.
 - NMSU researchers are beginning to understand the response of plants that are common to the canals to soil/water salinity and to herbicide treatment. This will help them understand the canal ecosystem and develop sustainable strategies for managing the canal system. This Rio Grande Basin Initiative research project has developed into a broad, multidisciplinary research and extension effort that will provide pertinent information about important mechanisms of water loss from the water delivery system and will provide insight into strategies for targeted weed management on the irrigation canal system. The spectral decomposition techniques developed in the proposed experiments, the educational and extension materials about water loss due to weeds, and the strategies for assessing an irrigation district will be useful to other New Mexico and Texas projects under the Rio Grande initiative.
 - NMSU researchers and Extension specialists collaborated to produce an interactive weed identification tool to assist with weed identification in New Mexico, as well as the Southwestern United States. The database allows users to enter familiar traits (such as flower color) of an unknown plant and obtain a list of common New Mexico weeds that match the set of traits. Images are provided to assist the user in correctly identifying the plant. The website is located at <http://weeds.nmsu.edu>. Use will be documented.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state Research, with states CA, FL, HI, IN, KS, NV, NY, OR, UT, WA

Biological Control of Pests Affecting Plants

a. Description of Activity

This area focuses on classical, augmentative, or inundative use of natural enemies (including microbial biological control agents) to manage plant pests (pathogens, insects, mites, nematodes, weeds, vertebrates, etc.).

b. Impacts/accomplishments

- A study was initiated to integrate natural populations of the grasshopper, *H. viridis* and herbicidal control of *Gutierrezia*, broom snakeweed. Fifteen plots (40 acres each) were established in Union Co. near Clayton. The plots were delineated into five replicates of 3 treatments consisting of 1) Control-no herbicide, 2) 50% treated and 50% untreated in alternating strips and 3) 100% treated. Picloram plus 2,4-D was aerially applied at the rate of 0.25 ai./acre in November of 2005. Large damaging populations of *H. viridis* were present in 2005. Almost all of the *Gutierrezia* in the delineated plots died due to drought. As a result very low populations of grasshoppers remained in the area. Ample precipitation in late summer and fall allowed *Gutierrezia* to regrow. The response of the weeds and insects will be followed next year.
- *Aphthona* flea beetle insectary near Angelfire, NM continues to produce large numbers of beetles for redistribution on leafy spurge, *Spurgia esula*. In July 2006 several thousand beetles were removed from this site and released on expanding isolated populations of leafy spurge, both on private and public lands in northern New Mexico.
- The African rue, *Peganum harmula*, feeding insect, *Thamnurgis pegani*, was brought from Turkmenistan into the New Mexico State University High Containment facility in the fall of 2002. New permits to import more of these beetles into quarantine have been requested. A cooperator in Turkey has agreed to send specimens to the lab in the spring of 2007. Initial host range tests indicate that California poppy may be influenced by this beetle so further tests will be conducted to determine whether or not the insects can complete a life cycle on the poppy.
- Biological control agents (*Larinus curtus* and *Eustenopus villosus*) of yellow starthistle, *Centaurea solstitialis*, were released in Grant County in 2004-2006. No detectable population have been confirmed. The spotted knapweed root weevil, *Cyphocleonus achates*, is common in most stands of knapweed in Colfax Co. *Rhinocyllus conicus*, the thistle head weevil that has established in New Mexico on musk thistle continues to migrate south. Populations are expanding into new areas apparently without human interdiction. Large populations were found in the Sacramento Mountains. We will be monitoring the influence of these beetles on the endangered Sacramento Mountain Thistle in the coming year.
- Researchers maintain populations of all available ecotypes of the saltcedar leaf beetle, *Diorhabda elongata* in the New Mexico State University High Containment facility. The

beetles were released at several locations on the Pecos River and were supplied to cooperators in Wyoming, Montana, California, Oregon, Idaho, Texas, and Colorado.

- Herbicide use has been reduced and directed at higher value rangelands resulting in economic and environmental improvements. The important economic role that native insects (including grasshoppers on snakeweed and beetles on locoweed) can play in range management has been documented and well received both regionally and nationally.
- The NMSU High Containment Insect Facility provided services to many other universities and agencies in the western United States as well as supplying insects for use in New Mexico.

c. Source of Federal Funds — Hatch

d. Scope of Impact — Multi-state Research, with states AZ, CA, CO, DE, GU, HI, ID, KS, MT, ND, NJ, NY, NY, OR, UT, WA, WY

Integrated Pest Management Systems

a. Description of Activity

This area focuses on the integration of one or more control tactics into a system for managing single plant pests or pest complexes in an economically, socially, and environmentally sound manner.

b. Impacts/accomplishments

- Over 45 parasitoids and predators have been released for the control of a variety of harmful insects over the years in New Mexico. These releases result in long-term reduction of pest insects at no cost to producers. Benefits include reduced production costs, environmental pollution and human exposure to insecticides in air, food and water and N₂ in the ground water and secondary insect outbreaks. PNC is no longer an economic problem in unsprayed pecan orchards in the Mesilla Valley due to high parasitism rates of *Bassus acrobasidis*, a released parasitoid. Wide spectrum insecticides can be eliminated for pecan insect control in the Mesilla Valley without losing yield and quality if certain management practices are followed.
- Alfalfa weevil strain distribution was evaluated for New Mexico. Weevil populations were examined from five locations within the state in 2003 and 2004, representing the major alfalfa growing regions. Mitochondrial DNA from the weevils was extracted and sequenced to determine the strain. Results show that all three known strains of this insect are present in New Mexico the state. NMSU researchers have altered the theoretical map of strain distribution in the US to fit what is now known for NM and show a shift in strain movement, and are now working on the problem of hybridization among strains. Our understanding of the distribution of alfalfa weevil strains in the state is a critical component in developing an integrated pest management system specific to the unique conditions of New Mexico. Efficient management of cotton pests and utilization of

beneficial arthropods can result in a reduction in unnecessary control costs and potentially increase crop yields. This can translate into a significant increase in productivity and profit to New Mexico's growers. Also, fewer insecticide applications can result in reduced exposure of the chemicals to the environment.

- NMSU scientists are working closely with the USDA Cotton Ginning Laboratory to determine the impact of thermal defoliation on late-season insect pests causing “sticky” cotton. Two years of field research show that thermal defoliation results in a significant, near-immediate termination of silverleaf whitefly populations—the worst cause of sticky cotton in the US. Researchers are also conducting laboratory experiments to determine the thermal upper limits of silverleaf whitefly survival. Our understanding of the distribution and biology of alfalfa weevil strains in the state is a critical component in developing an integrated pest management system specific to the unique conditions of New Mexico. The impact of *Lygus* on cotton production in New Mexico remains poorly understood. Our research will give us a better picture of that impact as well as the proper timing and implementation of management for its control. Efficient management of alfalfa and cotton pests can result in a reduction in unnecessary control costs and potentially increase crop yields. This can translate into a significant increase in productivity and profit to New Mexico's growers. Also, fewer insecticide applications can result in reduced exposure of the chemicals to the environment.
- USDA /Aphis released a number of parasitoids of alfalfa weevil in the 1980s, but their success in controlling alfalfa weevil since then was unknown. We have determined that three species are established in New Mexico. Two species are responsible for virtually all of the biological control of alfalfa weevil in southern New Mexico. NMSU Extension specialist have determined that *Oomyzus incertus* is responsible for approximately half of the control of alfalfa weevil in the Mesilla Valley. *O. incertus* and *Bathyplectes* spp. typically produce 70-80% control. In the Pecos Valley, on the other hand, *O. incertus* is very rare and control of alfalfa weevil is highly variable. The success of *O. incertus* in the Mesilla Valley suggests that it could be successful in the Pecos Valley as well. Having a similar level of control in the Pecos Valley would save growers in the Pecos Valley approximately \$400,000 per year.
- NMSU researchers have determined that crop microclimate can have a dramatic effect on survival of insect pests in cotton and pecan in southern New Mexico. High temperatures and low relative humidity in the crop canopy produces extremely high mortality in some insects eg. boll weevil, and similar, albeit less dramatic, effects on other insects eg. bollworm. Row spacing, row orientation, N rates and plant architecture can affect crop microclimate and insect mortality. Other aspects of management are under investigation.
- Yield partitioning and compensation testing scientists in cotton by NMSU indicate that bollworm is rarely an economic pest in New Mexico. Late season bolls, which are those typically injured, have low value, primarily due to low natural retention, producing few bolls /acre on the later nodes. Also, compensation testing indicates that cotton can compensate for very high losses of squares late season by retaining bolls that could otherwise have been shed, and to a lesser extent, by increasing boll size of those retained.

- NMSU Extension Specialists have determined that alfalfa weevil in the Mesilla Valley is generally under good control by two species of parasitoids. Only one species is controlling alfalfa weevil in the Pecos Valley. Consequently, it is not well controlled and alfalfa needs insecticide applications each spring to prevent yield losses. Specialists are reintroducing the parasitoid *Oomyzus incertus* to the Pecos Valley to replicate the control seen in the Mesilla Valley. Alfalfa weevil causes \$71 million damage each year in the Pecos Valley alone. Approximately 40% of that acreage has insecticide applications for alfalfa weevil. Reducing applications by half would save about \$400,000 per year.
 - *Penstenus* spp. were released for *Lygus* spp. control. It is too early to tell if *Peristenus* spp. have reduced populations of *Lygus* spp.
 - An advisory group exists for the urban landscapes IPM program; commodity groups for cotton, pecan, alfalfa and chile also make suggestions for IPM activities, subject matter for presentations at annual meetings and general investigations. In addition to outreach programs on entomology and general pest management, training and certification programs and literature are prepared annually for licensed pesticide applicators.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Animal Diseases and Parasites, Toxic Chemicals, Poisonous Plants and Naturally Occurring Toxins and Other Hazards Affecting Animals

a. Description of Activity

This area includes work on animal diseases pests and external parasites, including insects, ticks, mites, and other parasitic organisms that reduce animal productivity and that represent a threat to the production of an adequate and wholesome supply of animal products from livestock, poultry, and fish. This area also includes work on more cost effective methods of control.

b. Impacts/accomplishments

- The seasonal dynamics of Stable Fly activity was determined using alsynite traps on New Mexico Dairies throughout the year. Traps were run from January to December on a semi-weekly schedule. Data collected was minimal during the 2006 season. Populations peaked under relatively wet/moist conditions when temperatures were <30 C. As a result, there appears to be only a unimodal population peak occurring in July/August. Information on Stable Fly development sites was collected in conjunction with the seasonal dynamics of adult Stable Fly activity. As a result of minimal adult activity throughout the season, primary producer sites of immature Stable Flies were not identified. Sources of spring populations of Stable Flies in New Mexico appear to be associated with long-term locales of animal feed and other organic materials stored on dairies. These projects will help develop biological, chemical and cultural control strategies for stable flies. Such strategies will reduce the impact of these flies on livestock producers and the resulting impact on neighboring residential areas. Accurate models of

fly population dynamics will permit livestock producers to economically implement appropriate control strategies before populations reach levels necessitating chemical controls.

- c. Source of Federal Funds — Hatch
- d. Scope of Impact — Multi-state Research, with states AZ, CA, CO, DE, GU, HI, ID, KS, MT, ND, NJ, NY, NY, OR, UT, WA, WY

Animal Welfare, Well-Being, and Protection

- a. Description of Activity

Work in this area focuses on developing effective animal care and use programs, and information related to and contributing to the welfare, well-being, and proper stewardship of food animals.

- b. Impacts/accomplishments

- In response to the proposed National Animal Identification System (designed to serve as an effective and rapid health trace-back system), the Tri-National Animal Identification Consortium was developed to evaluate rate-limiting steps as well as devise workable solutions in the proposed ID plan, specific to beef cattle producers in the States of NM, AZ, CO; the Indian Nations of the Navajo, Hopi; and Ute people, as well as the Mexican States of Chihuahua and Sonora. In the state of NM, the oversight authority of the ID plan is the Office of the State Veterinarian. This office has sought the assistance of the NM Cooperative Extension Service to assist in outreach efforts, and in determining the effectiveness of proposed animal identification systems proposed in the national ID plan. The NM Cooperative Extension Service has played an active role in the Consortium planning and development meetings, conducted at least one educational session in every county in northeastern NM, and wrote *The New Mexico Livestock Identification and Tracking System for Beef and Dairy Animals* to be used in educational sessions at the county level. NM CES specialists also oversee multiple pilot projects designed to test various methods of individually identifying and tracking cattle in scenarios commonly observed in NM.
- Northeastern NM is heavily dependent upon cash receipts from beef cattle operations. Its proximity to the cattle feeding center in the Oklahoma-Texas Panhandle and normally abundant forage has made northeastern NM an ideal location for wintering and summering stocker cattle before entry into the feedlot. This region of NM is also home to many cow-calf operations. Stocker cattle often arrive in this region of the country with: 1) little to no details of health and vaccination history, 2) high exposure rates to numerous pathogens during marketing and transportation, and 3) subsequent high morbidity and mortality rates. In recent years producers have reported diagnostic lab-confirmed positive cases of mucosal disease and persistent infections of Bovine Viral Diarrhea Virus in nursing calves and stockers, respectively. Economic losses for calves persistently-infected with BVDV have not been determined for this region of NM, nor have incidence rates been defined. NM Cooperative Extension Specialists initiated a

series of demonstration and replicated research trials to help address what they believe is a costly virus to stocker and cow-calf operations in northeastern NM. Data from these projects will be used in conjunction with other research being conducted at the Clayton Livestock Research Center on PI-BVD cattle to: 1) prepare manuscripts for appropriate publications in scientific journals and extension publications, and 2) used to develop educational outreach opportunities for stocker and cow-calf operators to address PI-BVD related health issues (initially in northeastern NM, followed by other parts of NM).

- c. Source of Federal Funds — Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state Research, with states AZ, CO

IV. Agricultural Markets and Economic/Business Development

Economics of the Production and Marketing of New and Improved Non-Food Products and Processes

- a. Description of Activity

Work in this area includes agricultural commodities used in consumer products such as paper, textiles, biofuels, adhesives, paints, and other biobased products. This area also includes work on animal byproducts as raw materials for the textile, leather, soap, feed, pharmaceutical, and other industries. Work also includes alternate, non-food uses for agricultural commodities and timber products to expand markets for these products, yielding new, improved, or less expensive consumer products and providing additional sources of income to producers, processors, and marketers.

Economics of Agricultural Production and Farm/Ranch Management

- a. Description of Activity

This work focuses on economic choices farmers and ranchers make to access and allocate resources for the production of commodities, services, and products. These resources help farmers and ranchers to minimize production risk and optimize farm income.

- b. Impacts/accomplishments

- Projected 2006 crop cost and return estimates were developed and released prior to the planting season. The set of cost and return estimates includes 49 representative farms. The set covers 39 geographical production areas, 22 different crops, several size classes, and 3 major irrigation types as well as dryland. All cost and return estimates, projected and historical are now exclusively published on the internet at <http://costsandreturns.nmsu.edu> and are posted in January / February for projected estimates for use prior to the decision-making season. Researchers also completed and uploaded a set of 2004 actual cost and return estimates for the same set of farms. Our

normal pattern is to release projected cost and return estimates in January for planning purposes. Then, once the New Mexico Department of Agriculture publishes crop-year statistics (usually about 11 to 12 months after the close of the calendar year), we release the actual estimates using reported yields and prices (as opposed to projected yields and prices). The primary economic impact involves improving the decision-making of farmers and ranchers and providing needed input data to the decisions made by lenders, and the analyses of appraisers and economic researchers.

- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-Specific

Agribusiness Management, Finance, Taxation, and Estate Planning

- a. Description of Activity

This work focuses on the management and administrative techniques applied to farming, agricultural business, and other businesses and enterprises to enhance planning, decision making, and resource use. These techniques help businesses make effective financial decisions, stay in the marketplace over the long term, and increase profitability. It includes the analysis of effects of taxation on profitability.

- b. Impacts/accomplishments

- Ranch value research has been ongoing in New Mexico and the Great Basin, including the states of Idaho, Oregon, and Nevada. The hedonic ranch value model and paper for New Mexico was finalized and published in the *Journal of Agricultural and Resource Economics*. A hedonic model for the Great Basin was finalized and, combining data from both the Great Basin and New Mexico, a symposium paper was presented at the Western Agricultural Economics Association Meeting in Anchorage, AK about the reasons why public land grazing permits have economic value. The symposium paper was published and revised with upcoming publication in the *Journal of Agricultural and Resource Economics* (April 2007). We continue to explore what factors contribute to the market value of western ranches. The same “bigger is better” finding for New Mexico holds for ranches with seasonal grazing and dispersed land parcels in the Great Basin. Results for the two areas are the same: grazing permit value apparently has little to do with income from livestock production as traditionally believed. It is the land acreage that adds the most to ranchland value.
- The Ganados Group, an appraisal firm in Phoenix, AZ, has provided sales data on several 100 ranch sales in Arizona. Ranch sales data from approximately 30 sales in Ontario, OR, were gathered. Approximately 300 new sales were added for New Mexico. More sales will be gathered for the Great Basin. Students have begun to code the data and ready it for statistical analysis. The data will be used to update and assess public and private rangeland values and recent ranch value trends. It will also provide the basis for future work that will assess the reasons for ranch purchase.

- Researchers and Extension Specialists developed a detailed survey to determine how to assist food business startup to succeed. The Status of NM Food Processors survey was distributed to 500 food processors through out the state summer of 2004. Summary results indicate that the food industry of New Mexico is mostly small businesses (less than 20 employees) but is a growing sector of the economy. Results will direct future programming efforts and extension bulletin development.
 - New Mexico is also dealing with increased population growth in some of the most agriculturally productive areas of the state. The long-term impacts of urbanization on agricultural land and water resources need to be evaluated to assist local policy development. Identification and quantification of the impacts of structural, policy, and technological changes on the state's production agriculture and agribusinesses will assist in sectoral adjustments. Research continued under this project, and new research was initiated in 2006. Research conducted under this project is in the areas of water conservation and irrigation efficiency, measurement of actual on-farm water use and crop yields through the use of remote sensing technology, technical and socio-economic determinants of irrigation practices and efficiency, environmental attitudes, structure of U.S. pecan industry, U.S.-Mexico live cattle trade, impacts of individual animal identification in the U.S. livestock industry, emergency indemnification within the U.S. livestock industry, and impacts of population growth and development on agriculture and natural resource use. The nature and character of agriculture is changing in New Mexico and nationwide. In the future, the farm sector's previously special status will likely diminish, and production agriculture will probably be treated and regulated as any other industry. New Mexico is dealing with increased population growth in some of the most agriculturally productive areas of the state. Environmental regulations, water allocations, public attitudes toward agriculture, and the structure of agriculture are changing. International trade is directly affecting many of the state's agricultural industries. Reliable assessments of economic impacts, benefits, and costs will help the state's population and agricultural industries adapt to the radically changing future.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state Research, with states AK, CA, CO, ID, NV, OR, UT, WY

Economics and Development of Specialty Crop Markets

a. Description of Activity

This work focuses on activities that foster understanding of markets, productivity, agricultural competitiveness, and interregional trade, and give insight to the role and function of markets and their regulation primarily from the macroeconomic (industry) perspective.

b. Impacts/accomplishments

- Through OASIS, we offered for sale this year from other producers, including organic sparkling apple cider, organic squash, and organic fruits. The CSA that we helped start in 2005 enjoyed a successful second year in 2006.
 - The organic plantings at the Alcalde Science Center continue in excellent condition and generate good research and demonstration results. Numerous groups of interested clientele visited the Center where they were instructed on organic growing techniques. Growers who have followed instructions from NMSU Extension specialists in the development of their orchards and the use of “soft” pest control techniques again had excellent results and harvests in 2006.
 - At the request of agriculture personnel from Tesuque Pueblo, we planned a 3 acre orchard and designed the micro-sprinkler and drip irrigation systems. NMSU Extension specialists also supervised the irrigation installation and orchard planting. There were 420 fruit trees, 100 grape plants, 500 raspberry plants, 50 blackberry plants and 2000 strawberry plants planted at the farm location in the Pueblo. This planting has generated a considerable amount of interest and optimism among Pueblo leaders and citizens. We anticipate over \$30,000.00 income will be generated for the Tribe when production begins in two or three years. Strawberries and raspberries will begin production in 2007.
 - CES specialists designed and supervised the installation of a drip and micro-sprinkler irrigation system for a small orchard we planned at the Jicarilla Apache Reservation. Specialists planted 54 fruit trees and 120 raspberry plants with the help of youth from the Tribe. This project is intended to help youth from the area learn about agriculture and the marketing of agricultural products.
 - NMSU Extension specialists designed an irrigation system for a seven-acre orchard in the Mimbres Valley area, and assisted the grower with his application for assistance from the NRCS EQIP program.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Marketing and Distribution Practices

a. Description of Activity

This work concerns the distribution of products, goods, and services, the practices of buying and selling, and the development and improvement of markets primarily from the microeconomic (firm) perspective.

b. Impacts/accomplishments

- Research continues on a number of fronts as illustrated in the products and publications section below. For example, a Chile Task Force publication outlining opportunities of geographical branding has been made available for use by producers and agribusiness

managers. A Southwest Agribusiness Conference was conducted where producers and managers in other industries across the United States were invited to discuss the challenges they have faced and to discuss with regional (New Mexico, Texas, and Arizona) producers and agribusiness managers strategies that they may use in remaining competitive. New Mexico's agricultural producers face an increasingly competitive environment. This competition is forcing producers to examine their production plans and processes as well as their business and marketing efforts. Some industries are taking information provided by the research described here and examining opportunities to use similar strategies in their own industries.

- Other research conducted under this project heading is in the areas of irrigation efficiency, measurement of actual on-farm water use, agricultural labor, technical and socio-economic determinants of irrigation practices and efficiency, global chile pepper chile pepper trade, the economic impacts of the New Mexico chile pepper industry, environmental attitudes, agricultural structure, U.S.-Mexico live cattle trade, imported cattle traceability in the United States, impacts of population growth and development on agriculture and natural resource use, and trends in urban fringe agricultural growth. Several publications and presentations of research conducted under this project were released during 2005. Other publications related to the project are currently in press, in review, or in preparation.
- c. Source of Federal Funds — Hatch
- d. Scope of Impact — State-specific

Goal 2: A safe and secure food and fiber system.

Overview

New Mexico is continuing work to ensure an adequate and safe food and fiber system. Researchers continue to address promotion of regulatory compliance, product process development, food safety (contamination and protection) and sanitation, and marketing of specialty food products. Target audiences include clientele in nearly every county along with Native American meat processors and many farmers' market groups. A challenge in programming is to deliver the same basic message at several different levels of complexity to non-technical audiences, multicultural, and multilingual populations, as well as scientists and industry clientele.

Research and education complement each other in the on-going efforts to control and reduce the introduction of pathogens into the food supply. While researchers are constantly seeking ways to reduce or eliminate contamination in the production and processing of food products, extension personnel are working with food handlers to ensure the safe delivery of food and food products from farm to consumer.

Even though New Mexico has a strong agricultural based economy, hunger issues persist for children and families. Extension efforts will continue to focus on improving the accessibility of food that is nutritious, safe, culturally acceptable, and affordable in both rural and urban areas. Food safety and security outreach will include strategies and programs aimed at both consumer and producer education. Extension specialists, agents and educators will continue to implement food safety programs targeted to food managers and handlers, as well as to home food and specialty farm producers, and consumers.

The New Mexico Agricultural Experiment Station and Cooperative Extension Service believe that they are meeting the short-term goals outlined under Goal 2 in the 5-year Plan of Work submitted in July 1999.

Total expenditures for Goal 2 were \$55,617 from Hatch Act funds. The number of full-time equivalents engaged in research for this goal was 0.8 FTE.

Total expenditures for Goal 2 were \$48,494 from Smith-Lever Act 3(b)(c) appropriated funds. The number of state-level full-time equivalents engaged for this goal was 0.80 FTE.

New and Improved Food Processing Technologies

a. Description of Activity

Work in this area focuses on development or improvement of methods, techniques, or processes to maintain or improve quality or functionality, stabilize or preserve foods, or prepare foods for further processing.

b. Impacts/accomplishments

- NMSU food scientists have working to characterize the fermentation process of fresh red cayenne pepper (*Capsicum annuum* cv. *Mesilla Cayenne*) as processed in the production facility. The fermentation of chile pepper mash is highly complex and affected by many variables. This is a natural process that currently has few controls. If this process can be fully characterized, then controls can be put into place to ensure a safe and uniform product.
- NMSU researchers have been testing various rinsing agents for meats. The major impact from this research could be a reduction in the risk of foodborne illness from contaminated meats which may be subsequently undercooked.
- The *Ideas* Newsletter for Food Processors was originally released in 1995 with a bi-monthly printing, and has been issued quarterly since November 2001. This newsletter provides updates on state and federal regulations, new technology and upcoming workshops and conferences. The newsletter has been distributed at least 3 times per year reaching close to 600 processors and each county office. The newsletter is well received and will continue to be distributed through mail and on-line for the last two years.

c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)

d. Scope of Impact — State-specific

Goal 3: A healthy, well-nourished population.

Overview

A healthy, well-nourished population can be a consequence of access to, safe processing of, and delivery of nutritious foods particularly in households that are economically and nutritionally at risk. Even though agricultural and commercial advances have resulted in abundant food at ever-lower prices, many New Mexico households continue to face obstacles in securing a healthy, well-nourishing diet.

Barriers include a lack of resources and a limited understanding of nutrition. NMSU works annually on strengthening food and nutrition programs and doing research designed to alleviate barriers and improve the nutrition, well-being, and food security of NM citizenry. Agricultural Experiment State researchers address the research needs of the agricultural products grown in NM. Cooperative Extension faculty deliver food preparation and nutrition education programs.

In this tri-cultural state, not all households choose to consume food in accordance with dietary recommendations nor is regular exercise part of a daily or weekly routine (47.2% are inactive). In recent years, the focus of nutrition and health policy has shifted, because for many Americans, the problem is now one of over-consumption of certain foods or components. In fact, 4 of the top 10 causes of death in the United States are associated with diets that are too high in calories, total fat, saturated fat, or cholesterol or too low in dietary fiber. Improvements in diet and health can reduce illness and productivity losses, improve educational attainment, and prevent premature death. Solutions center on education to improve consumer understanding, behaviors and food choices.

The New Mexico Agricultural Experiment Station and Cooperative Extension Service believe that they are meeting the short-term goals outlined under Goal 3 in the 5-year Plan of Work submitted in July 1999.

Total expenditures for Goal 3 were \$70,297 from Hatch Act funds. The number of full-time equivalents engaged in research for this goal was 0.85 FTE.

Total expenditures for Goal 3 were \$166,656 from Smith-Lever 3(b)(c) Act funds. The number of full-time equivalents engaged in activities for this goal was 3.0 FTE.

Nutrient Composition of Food

a. Description of Activity

This area is concerned with the determination of the quantities of nutrients and other food components in food; development of analytical methods; development and maintenance of data banks of information on food composition; development of software and other systems to facilitate use of data on food composition, including recipe calculations; development and evaluation of educational materials and strategies on food composition; and dissemination of information on food composition for professionals, students, and the public.

b. Impacts/accomplishments

- Osteoporosis is a major health problem in both the United States and other countries. India is the second most populous country in the world and it is the fourth largest economy in purchasing power and the second fastest growing large economy. There are many persons from India living and working in America. Because osteoporosis is such a debilitating disease that affects the ability to be productive and health care costs, it is important that we understand factors associated with all segments of our population that increase the risk of developing this condition. The gold standard for assessment of bone status is DXA (dual x-ray absorptiometry). However, in many countries like India, availability of this technology is limited. Therefore alternatives for assessment are necessary. One such alternative is Calcaneal Stiffness. The research conducted looked at the relationship of selected demographic parameters and physical activity to the Calcaneal Stiffness Index. Research by NMSU scientists shows a trend that is the antithesis of what is noted in America related to bone mineral density. Although participant numbers were small, the research indicates a need to ascertain the influence of cultural dictates on factors that impact bone mineral status.

c. Source of Federal Funds — Hatch

d. Scope of Impact — Multi-state Research, with states AZ, CA, CO, CT, IN, KS, MA, ME, MI, NE, OK, OR, WA

Nutrition Education and Behavior

a. Description of Activity

This area is concerned with assessment of food intake and dietary patterns, the factors that influence food intake and dietary patterns, the interrelationships among these factors, and with the assessment of food and nutrient intake in relation to nutrient requirements, dietary guidance, and food plans. The focus is frequently on population groups at nutritional risk and on the factors that promote or hinder healthful food choices in these groups. Programs on dietary standards, guidance, food guides, and behavior change are concerned with the development, evaluation, and dissemination of education activities and strategies for professionals, students, and the public.

b. Impacts/accomplishments

- In FY06, NMSU Extension specialists provided recruitment, one-time classes and series classes of Ideas for Cooking and Nutrition (ICAN) for New Mexico adults and youth who were Food Stamp participants or applicants. The goal of the classes was to provide educational programs that would increase, within a limited budget, the likelihood of all food stamp recipients toward making healthy food choices consistent with the most recent dietary advice as reflected in the Dietary Guidelines for Americans and the MyPyramid. Another goal of the program was to help the Food Stamp participants or applicants acquire knowledge, skills, and behaviors in the areas of basic nutrition, food safety, food preparation and food resource management. Paraprofessional Nutrition Educators recruited from the program's target population taught the classes. These

Nutrition Educators were trained and supervised by NMSU CES personnel. In FY06, the ICAN program was implemented statewide, and also served the Zuni Reservation. The ICAN program uses comments from program participants, nutrition educators and parents to evaluate the effectiveness of their programs. These comments were overwhelmingly positive in FY06. Success stories and impact statements were provided by the nutrition educators to show the effectiveness of their efforts

- Included in the Eat Smart. Play Hard™ “*Connections*” curriculum are evaluations that are given to the elementary students, the student nutrition aides, the elementary teachers and the Family and Consumer Sciences teachers. There is also a pre and post test given during the delivery of the curriculum.
 - Extension Specialists continued to develop radio spots in Spanish for parents related to healthy eating and physical activity to address childhood obesity. Radio spots have aired on over 100 Spanish-language stations nationwide. Each radio spot mentions the toll-free National Hispanic Resource Helpline. Follow-up evaluation of hotline callers was completed.
 - Children, ages 4-17, are referred to *Fit Families* by pediatricians or family practitioners if their Body Mass Index (BMI) is greater than the 85% percentile. At least one parent or guardian is required to come with the child, but the entire family is welcome to attend as well, including siblings and grandparents. *Fit Families* is implemented as a series of 6 classes, each lasting 2 ½ hours. Components of each class include nutrition, food preparation, physical activity, feeling positive, and goal setting. The classes are team-taught by a registered dietitian, certified physical activity instructor, and counselor. Children and parents are together for food preparation and physical activity and in separate groups for nutrition and feeling positive. Older and younger children are taught in separate groups. To date, the number of referred children, their siblings and parents who have completed the program is 170. A simple evaluation assessment of the program demonstrates generally favorable reviews by both the children and their parents with many participants requesting additional classes, post-program contact and stating that they enjoyed the class. *Fit Families* also has a strong track record of success as a model program. In 2005-2006, the Sandoval County Women, Infant & Children Services (WIC), worked in collaboration with NMSU to implement a *Fit Families* program based on the model developed in Dona Ana County. NMSU Cooperative Extension Service has and will continue to work with youth health providers and schools to develop the program around the state.
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Nutrition and Hunger in the Population

a. Description of Activity

This area is concerned with food insecurity, insufficiency, and hunger in the population. Included are the development of analytical methods and pro-active attempts at hunger reduction through food banks, communities organizing to gain farmers markets, community gardens, gardening, food buying clubs, food recovery, and gleaning.

b. Impacts/accomplishments

- The CES ICAN staffs worked very hard throughout the year to schedule, present and evaluate classes for food stamp participants and applicants on how to choose and prepare nutritious foods. Having the opportunity to conduct the lessons at sites throughout the counties which served low income audiences, in addition to the ISD offices, was very helpful. The increased participation and decrease of “no show” classes was very encouraging to the Nutrition Educators and very beneficial to the participants.
- During the year the CES ICAN staff provided the ISD staff with information concerning the ICAN nutrition education program. In many cases the ISD staff were very helpful to relay information on to clients, however, there were a few cases in some counties of a lack of communication in this area. The Nutrition Educators were fortunate to have the opportunity to conduct programs beyond the ISD office for the limited resource audiences, who met the guidelines. The CES ICAN staff were again willing in FY06 to recruit participation for the ICAN nutrition education program and were also willing to hand out the Food Stamp applications and refer people to the ISD office if they had questions concerning Food Stamps. In some cases, the ICAN staff assisted with the applications up to a point, and then referred them to the ISD office. The adult and youth waiver guidelines were followed very closely throughout FY06 to ensure that the ICAN program participants were indeed the target audience.

c. Source of Federal Funds — Smith-Lever 3(b)(c)

d. Scope of Impact — State-specific

Healthy Lifestyle

a. Description of Activity

This area concerns activities related to healthy lifestyles, including maintenance of social, emotional, and physical health. The focus is on physical activity, exercise, stress management, and health-related practices including screening, immunization, and preventive care. The work in this area frequently involves population groups at risk and the factors that promote or hinder healthy lifestyles in these groups. Work is also concerned with development of a theoretical basis for behavior related to healthy lifestyles. Education and extension programs on healthy lifestyles

and behavior change are concerned with the development, evaluation, and dissemination of education programs and strategies for professionals, students, and the public.

b. Impacts/accomplishments

- NMSU's Health Specialist met with school personnel or coalitions in seven communities throughout the state providing them information on, and a demonstration of, an evidence-based youth suicide prevention program for high schools called the Signs of Suicide (SOS) program. In Gallup, approximately 2700 students and 300 staff received the program. Among the Gallup students, approximately 350 students were referred for a mental health follow-up. The Health Specialist understands from the Gallup school district that 7 more schools (high and middle) will receive the program in 2006-2007. In Farmington, 166 students received the program. In the initial response by students regarding seeing a counselor, 6 students requested to speak with a counselor. It is anticipated that one or more middle schools in the Farmington area will also implement the program. Additionally, an Extension Guide was written entitled *Suicide Prevention & intervention in Schools*. More school districts will be contacted about the SOS program in the upcoming year.

c. Source of Federal Funds — Smith-Lever 3(b)(c)

d. Scope of Impact — State-specific

Goal 4: Greater harmony between agriculture and the environment.

Overview

New Mexico has a rich and diverse land and natural resource base that is arid and semiarid and, in many respects, extremely fragile. This natural resource base is a major contributor to the economic well-being of the state's residents. Its economic uses result in demands for various resources. In addition to direct demands for land and water, there is increasing pressure for recreation-related activities that represent a growing economic opportunity. Activities related to the state's natural beauty and its wildlife make a major contribution to the economy. The potential to develop, manage, and protect natural resources needs to be encouraged.

Both rural and urban human activities can pollute land, water, air, and food. Through teaching, research, and extension programs, the New Mexico State University College of Agriculture and Home Economics is committed to furthering our understanding of human impact on the environment, and to supporting environmentally-sound agricultural and natural resource practices. The College will continue its efforts to understand the interaction between the environment and production agriculture.

The New Mexico Agricultural Experiment Station and Cooperative Extension Service believe that they are meeting the short-term goals outlined under Goal 4 in the 5-year Plan of Work submitted in July 1999.

Total expenditures for Goal 4 were \$1,267,619 from Hatch and McIntire-Stennis Act appropriated funds. The number of full-time equivalents engaged in research for this goal was 16.5431 FTE.

Total expenditures for Goal 4 were \$574,250 from Smith-Lever Act 3(b)(c) appropriated funds. The number of state-level full-time equivalents engaged in activities for this goal was 7.9 FTE.

Management and Sustainability of Range Resources

a. Description of Activity

This area includes work on biological processes and ecological relationships, improved range management techniques, and better appraisals of range conditions for production of livestock forage, water yield, and wildlife habitat.

b. Impacts/accomplishments

- Thanks to completed systematic studies, botanists in New Mexico now have a fairly up-to-date listing of the plants of the state, with correct nomenclature, synonyms, common names, and indication of origin. This is being widely used by land managers, ecologists, ranchers and agriculturalists, professional botanists, and consultants throughout the state, even though the listing has not yet been formerly published (it is available on-line). Work progresses toward a full-fledged manual for the plants of the state, with identification

keys and geographic information. An accurate identification manual of the grasses of the state has been revised, adding numerous species and over 400 illustrations.

- Saltcedar are exotic trees that prevail in monocultural thickets and in mixed riparian communities along the Rio Grande on the Bosque del Apache National Wildlife Refuge, Socorro, N.M. A six-year study conducted by NMSU range scientists examined saltcedar recovery after herbicide-burn and mechanical clearing practices. Both treatments provided >90% saltcedar control, but cost for mechanical clearing were nearly 6 times higher than aerial spraying followed by prescribed burning. Saltcedar removal is an important first step in the process of riparian restoration. The ways saltcedar were removed in this study were shown to influence later riparian community development.
- Initial results from range livestock stocking rate research show higher cow and calf weights in conservatively stocked pastures than moderately stocked pastures. Forage production has been higher in conservatively than moderately stocked pastures. A model has been developed and published relating long term forage production to precipitation on the steady pastures. Perennial grass cover has been better maintained under light than conservative stocking. This research has the potential to reduce rancher/environmentalist conflicts by providing better technology to maintain and improve vegetation and wildlife habitat. Increased rancher income also could reduce rangeland losses to subdivisions and other development.

c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)

d. Scope of Impact — State-specific

Management and Sustainability of Forest Resources

a. Description of Activity

Work in this area focuses on the biology of forest plants and trees; ecology of forest ecosystems; tree breeding; forest nursery practices; silvicultural techniques to improve and regenerate forest stands; and assessing, modeling, monitoring, and forecasting forest ecosystems. Forest resources include both wood and non-wood products, often referred to as non-timber forest products or special forest products. Sustainable forest management criteria and indicators are outlined in international protocols.

b. Impacts/accomplishments

- Progress has been made on developing effective propagation protocols for many woody plant species which can be used in disturbed land restoration/ rehabilitation. Further, work has been conducted on identifying those species which are inherently adapted to various disturbance conditions including extreme alpine conditions and sites with low-productive soils. In 2006 much of the effort focused on long-term (20 plus years) effects of forestation treatments. Specifically, work integrated other efforts associated with inventorying and measuring mature forest attributes. Also, previously initiated projects on carbon distribution in piñon-juniper woodlands are being completed. The

environmental impacts of this research are several fold including developing more efficient reclamation/restoration/ revegetation practices and providing the necessary tools (plants) and techniques to improve reclamation success. The increasing occurrence of stand replacing fires in southwestern forests, further emphasizes the need to have both the plant material and technologies to mitigate fire effects and rehabilitate these sites. In terms of the piñon-juniper ecology research, the work performed here will assist land managers in their land management activities by reduce any environmental impacts. In terms of the horticultural nursery industry, the use of native plants is a well known aspect of a water conserving landscape.

- Seedling quality criteria were evaluated for *Pinus pinea* grown in containers and tropical hardwood grown in bareroot nurseries or polybag nurseries. Larger seedlings with better developed root systems had greater survival and growth following outplanting. Prescriptions for improved seedling survival and growth were developed for dry temperate forests (Spain), and deciduous tropical forests (Mexico).
- Wildlife habitat in forested landscapes across the southwest is under near-constant threat from stand replacement wildland fire. Moreover, wildlife habitat, by its very nature, has itself experienced unprecedented change. In turn, changes of this magnitude in wildlife habitat affect species composition, and habitat use patterns. An Extension wildlife specialist is investigating, within the framework of sustainable multiple-use management, the effects of silvicultural treatments (including prescribed fire) on wildlife habitat quality. Wildlife habitat quality is being investigated by assessing management practice effects on woody and herbaceous forage quality, biomass, and structure. Wildlife species diversity, habitat use, and habitat preference for areas exposed to the various treatments and management practices also are being assessed by monitoring animal occurrence in relation to differences in habitat attributes. Data garnered from this research are expected to help construct predictive models to identify the benefits and risks of various forest management practices on wildlife habitat and use.

- c. Source of Federal Funds — McIntire-Stennis and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Urban Forestry

- a. Description of Activity

This work concentrates on the use of trees to improve or maintain the quality of urban and suburban environments and to enhance natural beauty through tree plantings. Tree plantings for special purposes include: visual screening, noise suppression, air quality improvement, shade, and beautification. Identification and development of species capable of living under adverse conditions such as smoke, air pollution, compacted soils, deficient or excessive moisture, and other unfavorable conditions associated with urban environments is included in this category.

b. Impacts/accomplishments

- NMSU scientists have identified selected provenances of bigtooth maple that could be used to select plants for managed landscapes prone to drought and salinity. We conclude that such traits as the low transpiration rate and high shoot dry weight, and characteristics such as a high leaf area might cause such plants to effectively endure deficit irrigation endue New Mexico conditions. If plants and managed landscape systems are developed to thrive on restricted moisture budgets, then water can be conserved in the urban environment. Urban landscape water conservation is an important issue in New Mexico because many regions of the state must confront diminishing water supply, rapid urbanization and continuous drought.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Agroforestry

a. Description of Activity

Work in this area focuses on agroforestry practices that intentionally combine trees or shrubs with crop or livestock operations, or use trees at the agriculture/community interface to help create more integrated, diverse, and sustainable farms, non-industrial forests, ranches, and rural communities. Agroforestry practices are designed to incorporate the use of trees into agricultural settings to accomplish social, economic, and environmental objectives. The main types of agroforestry include alley cropping, riparian buffers, forest farming, windbreaks/shelterbelts, and silvopasture. Agroforestry practices often yield non-traditional tree and forest products such as mushrooms, boughs, medicinal plants, vines, and nuts.

b. Impacts/accomplishments

- The New Mexico legislature has mandated public power providers to increase their utilization of renewable energy sources up to 10% by the year 2011. Public Service of New Mexico (PNM) plans to build several power plants fueled by woody feedstock to meet the legislative mandate. A sustainable source of poplar biomass from farms located within proximity of PNM power plants would be highly advantageous compared with alternative sources because of lower transportation costs. With two power plants in the Four Corners area and a third under license review, an alternate strategy would be the use of poplar chips to be co-fired with coal. The Navajo Agricultural Products Industry (NAPI), a commercial farm enterprise of the Navajo Nation, has planted 60 ha of poplar plantation with clones selected from the NMSU Agricultural Science Center at Farmington research program.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Appraisal of Soil Resources

a. Description of Activity

Work in support of soil mapping is concerned with identifying the important soil parameters for use in crop production, site-specific management, forest and range resource evaluation, housing developments, zoning, waste management, environmental urban planning, and other land uses. Soil surveys can also be used to show soil characteristics such as spatial and temporal variability, susceptibility to frost heave or slippage, depth to water table, depth to rock or other impermeable barriers, bearing strength, flood hazard, and soil erosion potential that affect suitability of a site for specific uses.

b. Impacts/accomplishments

- Maps of the landforms and parent materials of the Jornada Basin Long Term Ecological Research Program were published in 2006. In addition, a compilation a 1918 and 1963 soil map were published in 2006. These maps are also available online via <http://usda-ars.nmsu.edu>. A model showing links among soil, climate, and vegetation in arid and semiarid climates has been developed and published.
- A landform map is being made of the entire Chihuahuan Desert to quantify broad-scale relationships between vegetation and geomorphology. An additional map is being constructed that shows how the boundary of the Chihuahuan Desert expands and contracts with past and future climate change.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Soil, Plant, Water, Nutrient Relationships

a. Description of Activity

This knowledge area is concerned with the chemical and physical nature of interrelationships among soils, plants, water, and nutrients. The objective is to improve, maintain, or restore the inherent production capability of soils.

b. Impacts/accomplishments

- An irrigation scheduling model for land application of treated industrial wastewater to Chihuahuan Desert soils and their mixed vegetation members, *Larrea tridentata* and *Prosopis glandulosa*, was implemented in 2004. By 2006, the model was disseminated through peer-reviewed literature. Research is in progress to determine the effect of salinization on both soil and vegetation. This research should be nearing completion by end of 2007.

- Land application of wastewater from an industrial park can effectively be applied to native vegetation (mesquite and creosote) without adverse affects to either the vegetation or soil. Furthermore, there appears to be little movement of salts or nitrate-nitrogen below the rooting zone of the native mesquite and creosote. Salt accumulation in surface horizon may require additional leaching. Land application of partially treated wastewater can reduce contamination of surface waterways, while providing alternative crops for small landowners.
- Pecan growers frequently irrigate later than recommended or skip irrigations entirely. Growers lose 200-600 pounds of pecans/ac because of poor irrigation practices. Furthermore, growers are reluctant to use computer-based weather monitoring models to schedule irrigation. Consequently, a hand-held calculator was developed and tested. The device will be distributed and field tested in 2007. Sophisticated irrigation scheduling using computer based climate data can improve pecan crop yield while optimizing water use.
- NMSU scientists have found that salts are transferred from the fallen litter of saltcedar trees to the soil, causing an increase in both soil salinity and sodicity. Understanding the influence of saltcedar duff on soil properties will contribute to management decisions on whether to remove the duff or leave it on the soil after saltcedar trees are killed. It appears that removing the duff or litter before the first rains would help remove the source of salinity and speed rehabilitation of soils under saltcedar stands.
- With regards to heavy metals in New Mexico soils, findings by NMSU researchers suggest that phytoextraction may not be the best method to remediate arid zone lead- and uranium-contaminated soils. While plants may not be highly successful in extracting lead or uranium from contaminated soils, plants could stabilize the surface soil and reduce soil lost by wind erosion, thus contributing to a healthier environment.
- Researchers have found that incorporation of shredded pecan wood had no effect on soil properties. Sufficient decomposition takes place during the summer such that the shredded pecan is not a hindrance to pecan harvesting. Little or no nitrogen mineralization occurred. The higher rates of pecan wood amendment repeated over several years can reduce soil bulk density, retain more soil moisture, and increase aggregate stability. More efficient use of nitrogen fertilizer may allow farmers to save money and reduce the fluctuation in yield between on and off years. Fertilizer added during the kernel fill stage helps to prepare the tree for the next season's production. An economical disposal method for the woody trimmings of pecans is needed because burning causes air pollution problems. Shredding of woody trimmings and incorporation into the orchard is an alternative method of disposal that appears to have no negative impact on soil properties.
- NMSU soil scientists have been quantifying the water storage and retention capacity of soil horizons under different locations, soil type and cover, their spatial and temporal variation and their relationship to net primary productivity. Their data analysis clearly

demonstrates that benefits of organic matter additions were undercut by conventional tillage in organic farms.

- c. Source of Federal Funds — Hatch
- d. Scope of Impact — State-specific

Conservation and Efficient Use of Water

- a. Description of Activity

Work in this area attempts to increase efficiency in collecting, storing, conveying, using, and reusing available water resources.

- b. Impacts/accomplishments

- Agricultural Economists from New Mexico State University completed an irrigator survey in 2005 that is being used to design a water transfer mechanism specifically for the Elephant Butte Irrigation District. Results from the survey indicates that farmers in the lower Rio Grande prefer a short-term water transfer mechanisms over more permanent transfers of water rights. They also seek greater flexibility in designing pricing arrangements unique to their needs. Overall, the evidence suggests that farmers are more likely to participate in water transfer mechanisms that provide them with control of on-farm resources and permit price negotiation on a case-by-case basis, especially, those farmers who were the most dependent on agriculture as an income generating activity. Currently, the project is in the final phase of execution, which entails the development of a water transfer mechanism for the Elephant Butte Irrigation District.
- A team of economists from New Mexico State University, Texas A&M University, and Sienna College (New York) continue working on the construction of an economic model that will assist decision makers to evaluate and identify the economic and hydrologic impacts of policy measures and court decisions when addressing severe drought. The hydro-economic model is being applied to evaluate the economic value of water in alternative uses during existing and potential drought-coping programs. Currently, the model runs using annual hydrological data, but efforts are being made to run the model with real time applications.
- Scientists are working together at NMSU to evaluate and quantify the effects of using several species of cover crops as killed mulches on chile production, including soil moisture, weed populations, and yield. The amount of water required to supply the chile crop with optimal soil moisture was not significantly different between the cover crop treatments.
- Model landscapes to compare the water use of contrasting management landscapes is being established at the NMSU Fabian Garcia Research Center, to compare three traditional landscapes to three desert landscapes. Early preliminary results show that water provided to the traditional landscape was one and half times more than the desert

landscape. Whether the effects of the water usage was caused by the plant species choices for the model or landscape related will require further testing.

- NMSU scientists are working with Elephant Butte Irrigation District (EBID) to develop irrigation canal maps showing the relationship between canal size, various soil characteristics and presence of primary weed species. Through spectral reflective analysis and an on-site survey results have shown that Bermudagrass is the most common weed found on the canals. Additionally, EBID's has expressed that their major concern for weed management issues on the smaller and intermittent canal is the thriving Horsetail. Scientist have hypothesis that the reason for continued establishment of Horsetail is due to the lack of continuous water on the smaller canals. Horsetail is one of the primary causes of interrupted water flow resulting in ponding and evaporation/infiltration losses of water. Additionally, we can relate salinity and presence of some plant species on the canals; sodium adsorption ratio and electrical conductivity are extremely high at certain locations. For future work on the project the high values of the sodium adsorption and electrical conductivity need to be determined.
- Researchers have identified important thresholds for hydrologic response to tree clearing. While typical water saving justification may not be warranted, research in conifer forests and piñon-juniper woodlands has shown that removing trees allows for increased grass growth, reduced surface runoff, and reduced erosion. The project is providing information that will help range managers justify rangeland improvements based on more than the value of added water. Increased forage has a direct economic value, and reduced soil erosion and sedimentation of streams has long term ecosystem and economic values.
- Increased understanding by NMSU scientists of surface water-groundwater interactions indicates that water from acequia and field seepage is stored underground for 1-3 months, before re-entering the river as groundwater return flow. This return flow provides water downstream when it is most needed after the peak runoff season, and may save water by reduced evaporation compared to scenarios with less seepage. Results of this study are critical to understanding irrigation management effects on river floodplain hydrology, and will greatly increase the knowledge needed by policy makers, water managers and the general public to make informed decisions on managing water.
- Low-cost, low-tech drip irrigation systems are capable of delivering adequate water for high quality vegetable production with outstanding yields. Farmers in the Four Corners region of New Mexico understand the mechanics of the system and are interested in continuing to use it for landscapes and vegetable crop production.
- A hybrid poplar experiment was initiated a Farmington New Mexico with the objectives of determining the water use and crop coefficient for popular under incomplete cover, and to determine the scaling factor for the ratio of the crop coefficient (kc) to the maximum crop coefficient (k_{cmax}) to scale down crop coefficients from complete to incomplete cover. The results can be used to schedule irrigation for hybrid poplar to maximize growth and wood yield with incomplete cover based on literature and the

measured scaling factor functions. The pecan model can be used to schedule irrigation for drip irrigated pecans used in landscape at NMSU university and other landscape environments.

- A drip irrigation volume balance model was developed and incorporated into a one dimensional volume balance pecan growth model. The pecan model can be used to schedule irrigation for drip irrigated pecans used in landscape at NMSU university and other landscape environments.
- NMSU researchers trained City of Las Cruces personnel in irrigation scheduling using computer models, which has improved water use efficiency in applications.
- Based on research and recommendations by NMSU Extension specialists, a subsurface drip irrigation system was installed in a lawn at a community garden in Los Alamos, NM. Several homeowners since then have expressed interest in applying this water conservation technology in their home lawn. Three athletic fields at the Rio Rancho high school, two soccer fields at NMSU's main campus, and 1 football field at Corona high school are currently under construction and will receive subsurface irrigation technology.
- "The Pecanigator" was designed to aid in the estimation of irrigation timing for pecan trees. The Pecanigator schedules an irrigation to accommodate consumptive water use, but does not account for critical stages of plant and nut development, such as the nut fill stage. Four prototypes of the pecan irrigation scheduling tool were developed and tested with various focus groups. The preferred version 'horizontal' was modified based on the focus group results. The Pecanigator was printed in English and Spanish languages and will be distributed at the 2007 Pecan Conference.
- Working with local farmers around the Clovis area, NMSU scientists are demonstrating how important it is to monitor crop root systems. Knowledge of root system and root architecture is essential in maintaining water supply. Farmers are learning how to identify the role played in sensing water stress through the root system on crops which in turn will allow them to regulate their water use. Farmers learn the important roles played by roots like acquiring water and other nutrients, abiotic and biotic stress tolerance, creating biodiversity for improved sustainability, and anchoring plants.
- Presently, thirty-two percent of the Mesilla Valley arable land in production is planted in pecans. Pecan water application in the Valley ranges from as low as two acre-feet/acre to as high as 7.2 acre-feet/acre. The wide variation in water application is due to the variability in tree age, soil, and ET. Working with local farmers in the area, agricultural engineers are more able to determine the proper crop coefficients through ET for climate changes on pecans and other row crops. With the lack of information on crop water use some farmers are over-irrigating or under-irrigating crops which in turn results in the loss of valuable resources and reduction in yield and/or crop quality. By determining proper crop coefficients through ET, farmers will be able to improve water management and optimize the use of water resources and ultimately benefit pecan producers by increasing their yields and economic return from farming.

- The Drought Monitoring Work Group of the Governor’s Drought Task Force generates products and information which identify and characterize the spatial extent and severity of drought conditions across the State of New Mexico. The Monitoring Work Group analyzes and depicts drought conditions at the local scale, which is crucial for water managers, decision makers, and other stakeholders who must plan for and react to continuously changing drought conditions to mitigate impacts in a and timely and cost effective manner. In addition to State and local governments, these products are distributed to and used by many groups and agencies. Growers and producers throughout the State of New Mexico consult these products to be used in their farming operations. These products are basis for a formal statement provided to the Secretary of Agriculture for use in his request for federal funding for drought/flood relief in 2006. Drought Status Reports are compiled and published via the internet at the New Mexico Office of the State Engineer (<http://www.nmdrought.state.nm.us/>) and at the New Mexico Climate Center (<http://weather2.nmsu.edu/drought/>).
- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state Research, with states AZ, CA, CO, FL, GU, HI, IA, ID, KS, LA, NY, OR, PR, TX, VI

Weather and Climate

a. Description of Activity

Work on the impact of weather and climate on agriculture and natural resources focuses on three tasks: (1) characterize existing climatic patterns and propose more effective ways of adjusting to these patterns, (2) specify modifications in management approaches that are desirable to farm, forest and rangeland managers, and (3) learn how potential modifications affect agriculture or natural ecology.

b. Impacts/accomplishments

- Climate data continued to be collected and displayed during 2006 for all the automated climate stations in the state. Software was written to collect and process the data from the federal climate networks into a common format. The daily use of the web site is 8000 requests per day. CoCoRaHS, the Community Collaborative Rain, Hail and Snow Network, is an example of a “Citizen Science” project where volunteers help collect data important to scientists and not readily available from other sources. As there are very few sources of reliable snowfall observations in the U.S. and very little quantitative data on hail stone properties, CoCoRaHS is quickly becoming a popular source of data to support remote sensing, weather forecasting and other atmospheric and hydrologic research, with 130 participants.
- Correlation of weather station temperature data and satellite recorded land surface temperature data for 2005 has been completed and processing of 2006 data has begun. The satellite temperature data will be used to refine degree-day models.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Aquatic and Terrestrial Wildlife

a. Description of Activity

This area focuses on invertebrate and vertebrate animal species that occur naturally in forest, range, and agricultural lands and waters, and marine environments. Work includes determining biological and ecological requirements of species, factors influencing population dynamics, interspecific relationships, methods for maintaining and enhancing habitats, and management approaches for sustaining wildlife harvests while maintaining population, species, and community viability.

b. Impacts/accomplishments

- NMSU scientists worked closely with the Middle Rio Grande Conservancy District to evaluate and select three sites for development of refugial fish habitats along the middle Rio Grande of New Mexico that can be maintained as wetted habitats during irrigation season by purposely "leaking" water from the irrigation system. That collaboration led to a separately-funded project to the conservancy district and the district is currently awaiting a favorable Biological Opinion from the U. S. Fish and Wildlife Service to initiate construction of the habitats.
- As a result of extended research, NMSU scientists will be better able to sustainably manage our native vertebrate fauna and desert and plains grasslands. The research will result in recommendations for grazing management that will incorporate measures of native biological diversity and ecological factors that influence diversity. Results will directly effect the management of the USDA Forest Service Great Plains National Grasslands. Data collected for this project can also help alleviate future entanglements related to the management needs and status of specific species, and will contribute to enhanced wildlife viewing.
- Research on prairie dogs should contribute to the debate regarding conflicts between conservation of this keystone species, preservation of endangered species, and livestock ranching. NMSU wildlife scientists believe that these goals are not incompatible and that all can be achieved with wise use of available resources.
- Research at Big Bend National Park will impact the conservation of natural resources there, thereby contributing to the preservation of our National Parks. This work also will lay the foundation for implementing more rigorous approaches, in this case risk-analysis, to the development of conservation strategies for resource protection in our parks.
- Work by NMSU researchers on carnivore movement patterns will aid the National Park Service in the development of management plans for conserving their lands and ensuring

connectivity among wildlife populations within the region.

- NMSU's oryx population study has already yielded necessary information in formulating a management plan for the White Sands National Monument.
- NMSU's jaguar research project will provide essential information in formulating a jaguar conservation and recovery program in the United States. In March 1997, the New Mexico Department of Game and Fish and the Arizona Game and Fish Department entered into a Conservation Agreement with other state, local and federal cooperators to conserve the jaguar along borderlands of Arizona and New Mexico and to stimulate parallel efforts in Mexico. The activities to be undertaken by interested parties include collection of biological information; consideration of relevant cultural, economic, and political factor; and monitoring. These activities are included in the jaguar research project in Mexico and the results will be invaluable to American and Mexican biologists in devising a jaguar conservation strategy.

c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)

d. Scope of Impact — State-specific

Conservation of Biological Diversity

a. Description of Activity

In a natural resources context, work on biological diversity (biodiversity) conservation focuses on the description, measurement, assessment, and management of plant and animal variation in nature. It includes diversity at the genetic, species, and ecosystem levels in forest, range, and agriculturally-influenced ecosystems. The objective is to preserve, enhance, and restore natural biodiversity to levels compatible with societal uses of natural resources.

b. Impacts/announcements

- Ongoing studies continue to examine the potential usefulness of Gap Analysis data for regional risk assessments. Methods of population viability analysis originating in the field of conservation biology are also applicable to plant health risk assessments and to management decisions for invasive species, in which extinction is a desirable outcome.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Natural Resource and Environmental Economics

a. Description of Activity

This work focuses on understanding economic relationships, decisions, and impacts relating to the management and use of public and private natural resources, and the environment. Work in

this area also focuses on the economics of improving the efficiency of agricultural, forest, and rangeland use while minimizing negative impacts on the environment

b. Impacts/accomplishments

- The recent drought is raising awareness of New Mexico's dependence on water. Available evidence of the economic effects of the drought on New Mexico's agricultural sector is limited and anecdotal. To fill this information gap, research is underway to examine the relationship between climate, weather, and events like drought on the agricultural economy of New Mexico.
- Climate change impact assessment is evolving in sophistication and complexity. A key area of research is the role of behavioral changes and the effects of these behavioral changes on the magnitude and distribution of impacts. Using developed water models, research can continue to investigate the development of specific coping strategies and their benefits in both water and agricultural systems.
- We have developed a working paper that examines the institutional frameworks of currently functioning water markets in the American West. Second, we undertook an extensive survey of farmers in the Elephant Butte Irrigation District this past summer to collect information on their agricultural practices and evaluate their preferences concerning different types of water transfer mechanisms. An Extension report documenting the results of the survey is in press and a manuscript has been submitted to a peer-reviewed journal. The ultimate goal of this research is the design of a water market prototype (including an institutional framework) for the Elephant Butte Irrigation District of New Mexico. Water is a vital resource in the Rio Grande Basin, and agricultural occupies at least 80 percent of the total supply. If water is allocated inefficiently, or farmers are not able to trade water amongst themselves to alleviate excess supplies and excess demands, then the inefficiency losses from poor allocations can be substantial.

c. Source of Federal Funds — Hatch

d. Scope of Impact — State-specific

Water Policy Analysis

a. Description of Activity

This work focuses on the economic and social impacts of domestic water programs and policies, including the effect of government actions on the U.S. The work in this area analyzes the long-term effects of government actions, which influences how the U.S. develops and implements policies.

b. Impacts/accomplishments

- In the Rio Grande Basin, water is over-allocated, demands are growing, and river flows and uses are vulnerable to drought and climate change. Currently the Basin is in the third year of severe drought; irrigation and municipal water diversions have been severely

curtailed; extensive diversions threaten endangered species; and reservoir volumes are nearly depleted. A central challenge is development of policies that efficiently and equitably allocate the Basin's water resources among competing uses across political and institutional jurisdictions. A basin-wide, nonlinear programming model was developed to optimize resource allocations and water-use levels for the upper part of the Rio Grande Basin to test whether institutional adjustments can reduce damages caused by drought. Compared to existing institutions, we find that future drought damages could be reduced by 20% to 33% per year through intra-Compact and interstate water markets, respectively, that would allow water transfers across water management jurisdictions. Results reveal economic tradeoffs among water uses, regions, and drought control strategies. Potential economic gains of several million dollars to Colorado, New Mexico, and Texas could result from instituting intrastate and interstate water banks as measures for reducing damages produced by severe and sustained droughts. NMSU researchers have developed an integrated basin-wide model of the hydrology, economics, and institutions for the Rio Grande Basin. The model's current scale ranges from the headwaters in southern Colorado, to the bottom of the upper basin just downstream of El Paso, Texas. Early versions of the model have been published in several peer-reviewed scientific journals. A simple version of the model should be posted soon on the NMSU web site. Our goal is for policy makers and others to use it for various water policy experiments. We also hope to apply the model to other basins in New Mexico, for example the Pecos Basin, which has been the subject of much controversy since the early 1980s.

- Significant water savings of 35% to 70% are possible from changes in residential landscaping and improved management of outside watering, which often accounts for more than 50% of total residential water use. NMSU researchers are examining the findings from a survey of New Mexico homeowners and their attitudes and preferences for residential landscapes and the factors that determine or limit their choices.

- c. Source of Federal Funds — Hatch
- d. Scope of Impact — State-specific

Goal 5: Enhanced economic opportunity and quality of life for Americans.

Overview

New Mexico's future is increasingly tied to regional environments and a global economy. Clearly defined regional and international perspectives are essential for the programs of the College. The University's traditional programs can be enriched by regional and international components and thereby better achieve their full potential. International activities enhance global understanding by incorporating international dimensions into the ongoing instruction, research, and extension efforts of the College. Graduates of the College need an education that will allow them to achieve success in a global economy. They must have the skills necessary to keep New Mexico a supplier of food and fiber throughout the world and keep New Mexico a destination for tourists from around the world.

Economic opportunity and quality of life vary greatly for New Mexican. New Mexico still suffers from some of the highest statistics nationally relative to families with children poverty levels, per capita retirement incomes, numbers of high school graduates, illiteracy, crime, unemployment in rural communities, teen-pregnancy and uninsured motorists among other unsatisfactory figures. Addressing the quality of life issues is a core piece in New Mexico Extension's educational efforts.

The New Mexico Agricultural Experiment Station and Cooperative Extension Service believe that they are meeting the short-term goals outlined under Goal 5 in the 5-year Plan of Work submitted in July 1999.

Total expenditures for Goal 5 were \$259,332 from Hatch Act funds. The number of full-time equivalents engaged in research for this goal was 3.17 FTE.

Total expenditures for Goal 5 were \$441,483 from Smith-Lever 3(b)(c) Act funds. The number of full-time equivalents engaged in extension activities for this goal was 7.13 FTE.

Human Development and Family Well-Being

a. Description of Activity

Work on family and human development provides an understanding of the social, cognitive, emotional, and physical development of individuals and families over the human lifespan. The focus is on family and life cycle studies. Work in this area also provides a better understanding of family systems, family performance, and well-being.

b. Impacts/accomplishments

- To prevent substance abuse and other risky behaviors, parenting education is needed to promote family bonding and teach discipline skills to high-risk families. Twenty-one parenting class series were offered for teen parents, single parents, grandparents raising grandchildren, families involved with the criminal justice system, and families dealing with substance abuse in 10 counties in New Mexico. 264 parents and 271

children participated. Parents showed significant improvements on all assessment tools. They had significant increases in empathy for children's needs, and knowledge of effective discipline techniques. They showed significant decreases in belief and use of corporal punishment, reversal of parent-child roles, and inappropriate expectations of children. Every \$1 spent on prevention of problems saves the state \$7 on intervention services. The families who graduate from the parenting classes are less likely to commit child abuse, and their children are much less likely to engage in risky behaviors during adolescence. Decreasing the number of youth in foster care due to abuse or neglect, and decreasing the number who get pregnant, abuse drugs, or commit violence saves the state money.

- NMSU Extension personnel have conducted Parenting Education classes for at-risk parents, many court-mandated participants, in cooperation with the State Corrections department, Family Court system, and the Department of Labor TANFF Works program. Departments are beginning to work together and most participants complete the class series. Evaluation of the program is underway.
- The Strengthening Families Initiative Southwest District conducted 21 intensive parenting class series at 18 community program sites serving 260 families. Evidence-based parenting class series were implemented in 6 southwest counties serving 10 cities in New Mexico. According to the most recent annual report (July, 2006), parents who completed the program showed significant positive improvements in the areas of 1) Parenting attitudes and beliefs; 2) Knowledge of positive discipline techniques; 3) Skills in self-nurturing, communication; 4) Parent-child relationship; and 5) Knowledge and attitudes related to money management and finding a job.
- NMSU Extension specialists implemented a functioning Just in Time Parenting (JITP) Community of Practice (CoP) Project with clearly defined roles, responsibilities, and strategies. The first 12 months of a core national newsletter was created and posted at the website. A core set of standard evaluation measures so that states adopting the national JITP resource can replicate and extend findings of past research were developed. The process to review and develop FAQ entries was developed. A system was developed for "Ask the Expert" questions. The development of marketing strategies that will give visibility and sustainability to eXtension Just In Time Parenting was begun. The working eXtension site that will include JITP content and an email reminder system, FAQ and "Ask the Expert" functions, and links to streaming video clips of parents talking about their experiences will be launched in March 2007.
- Baby's First Wish, an age based parenting newsletter for babies aged one month to 36 months, was mailed October 2005 to September 2006 to a range of 2,087 to 3,433 families in all 33 New Mexico counties every month to equal a range of 25,044 to 41,196 newsletters mailed annually. There is a range in the numbers participating because enrollment varies every month due to families with newborns enrolling and other families leaving the program because their baby turned 3 years old. Recipients represented an ethnic population which closely mirrors New Mexico's population. This percentage ranged monthly from 49-51% Hispanic; 40-41% Anglo; 6-8% Native

American; 2-3% African American; 0% Asian. The gender breakdown of babies ranged from 46-49% female and 51-54% male. Evaluations conducted in New Mexico and other states show that while one family member is listed on the mailing address label, as many as 4 other family members may read the age based newsletter. This means that the number of individuals reading the newsletter could range from 2,087 per month, with one person reading the newsletter at the lowest range of recipients, to 13,732 per month, which represents 4 people per family reading the newsletter at the highest range of recipients.

- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Sociological and Technological Change Affecting Individuals, Families, and Communities

- a. Description of Activity

Work in this area provides an understanding of the technological, demographic, and social changes occurring in society. Work also provides an understanding of the current and historic ways in which individuals, families, and communities cope with sociological and technological change, and includes activities that extend this knowledge to the population.

- b. Impacts/accomplishments

Despite substantial research on the gendered content of various media, few studies have undertaken an in-depth look at specific groups of women and their use of media materials for guidance in work and non-work life. We simply do not know whether the messages embedded in popular and local media (e.g., magazines, radio, internet, etc.) are applicable or helpful to our three sub-populations of interest. Our purpose is to identify the questions, issues, and needs of these three target populations; determine the media messages that they receive in the areas of work, family, and healthy lifestyles; and assess the extent to which these messages help or hurt in the struggle to achieve healthy work, family, and personal lives. By identifying the issues of these target groups and assessing the extent to which the media addresses these issues, the project will be of benefit not only to these women, but also the workplaces, families, and communities to which they so actively contribute. Moreover, this project will reach out to popular media, business, and extension to share these findings and achieve more applicable and helpful media messages.

- c. Source of Federal Funds — Hatch and Smith-Lever 3(b)(c)
- d. Scope of Impact — Multi-state research, with states CA, ID, MT, OR, UT

Individual and Family Resource Management

- a. Description of Activity

Work in this area provides an understanding of how individuals and families obtain and use resources of time, money, and human capital to achieve their standard of living and overall quality of life. This area is also concerned with factors affecting the decision-making process, such as availability of resources, life events, living patterns, values, goals, interests, and attitudes of families, and external forces such as public issues, policies, and programs.

b. Impacts/accomplishments

- The High School Financial Planning Program (HSFPP) is offered in every state and reached over 551,185 students in 6,493 schools in 2005. Thirty-nine New Mexico schools reported reaching 3,875 students in 2005. This specialist is the HSFPP Extension contact for New Mexico and participated via four conference calls in the revision of the curriculum. The new curriculum is to be available in the fall of 2007. A national evaluation of the program found that students showed statistically significant increases in all financial knowledge, behavior and confidence questions. About 60 % of the students increased their knowledge about the cost of credit, auto insurance and investments and about 40 % of the students began to write goals for managing their money, to save money for their needs and wants, to track expenses and increased confidence in making financial decisions. Three months after completing their study, it was found that students still showed statistically significant increases on all areas except the one about their investment knowledge. About 60% indicated that they had made changes in spending and savings patterns.
- Investing for your Future, an on-line investing course, has had enrollees from most states and several countries abroad including Germany, England and Korea. NMSU Extension specialist wrote Unit Seven, Tax-Deferred Investing, keeps it up to date and is available via email to answer questions. Investing for Your Future received the National Financial program award at NEAFCS (National Extension Association of Family and Consumer Sciences).
- Extension specialists assisted in adapting the Life Skills used in STEPS and developed the pre-and post test related to Life Skills for the Strengthening Family/Fatherhood Initiative. This program was offered in counties in the New Mexico Extension Southwest District and the Albuquerque area. Increase in knowledge and attitudes related to life skills were increased from the pre to the post-test measurements with a significance level of .0001.
- Approximately 430 high school and college students and adults in San Juan, San Miguel, Bernalillo, Lincoln, Curry and Roosevelt received wise use of credit information as a result of the *CreditSmart* training. Participants reported increased knowledge in how to read the information on a credit card application and how to understand their credit reports.
- The Family Resource Center, which offers Extension programming, serves all students on campus. Forty-two couples received family therapy. WIC serves approximately 400 families a semester and about 100 children received back-to-

school supplies. Approximately 2,000 persons participated in programs at the Family Resource Center, which is Extension's presence on the NMSU campus.

- c. Source of Federal Funds — Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Youth Development

- a. Description of Activity

Work in this area includes programs and activities that promote positive youth development, including 4-H. These activities extend knowledge to youth and convey a sense of belonging, teach life skills, and provide opportunities for mastery, competence, and independence. This work also includes a focus on the social and emotional development of program participants.

- b. Impacts/accomplishments

- Life skills are taught through a variety of methods. 4-H Competitive events are designed to give youth hands on training and a practical knowledge of various subject matters. In addition 4-Hers learn subject matter concepts through hands-on experiences, develop skills through project work, competitive events, real-life situations, and career exploration opportunities, practice informed decision-making when selecting consumer goods and agricultural products keep accurate project records which are submitted for project evaluation and completion, speak at club, county, and community events strengthening communication and organization abilities as well as self-concept, and participate in club, county, district, state and national 4-H events that develop leadership, teamwork, and citizenship potential.
- Last year New Mexico had 5,220 adult volunteer leaders in the 4-H Youth Development Program. These individuals served as organizational leaders for clubs/groups, project leaders, activity leaders, and resource leaders. These 4-H leaders provided a significant amount of direct contact with 4-H youth and are essential partners in the New Mexico 4-H Youth Development Program. Adult 4-H leaders provided leadership, encouragement, and guidance to 74,103 youth this past 4-H program year in 2,237 clubs, special interest groups/day camps, school enrichment groups, and after school programs.
- To prepare youth for a positive future, they must possess such life skills as communication, goal setting, decision-making, leadership and self-responsibility. These skills and others are components of the 4-H Youth Development program including "Expanded 4-H Programming". The delivery modes for this programming are primarily "Special Interest" and "School Enrichment". The audience is not limited to, but includes, higher at-risk youth. While all youth are at-risk, some youth have a combination of risk factors that create a higher risk environment for suicide, substance abuse, violence and other at-risk behavior. The "Expanded 4-H Program" in New Mexico is designed to involve youth, ages 5-19, in hands-on learning through

a variety of delivery modes. The New Mexico 4-H Youth Development Program has expanded its programming to reach youth that had not been previously involved in 4-H and may reside in higher-risk living situations. 9,904 youth have participated in 4-H through outreach efforts in eight counties funded by OJJDP grants during this past program year. The programs have occurred at schools, community centers, after school programs, special event day camps, summer day camps, military bases, tribal centers, teen court, and other youth agencies.

- State leadership programs are developed to establish a basis for retaining junior and senior 4-H members in continuing with 4-H opportunities through their 19th birthday. The programs provided instill leadership skills including but not limited to responsibility, self-confidence, self – esteem, communication skills, teamwork, decision making, educating communities on youth/adult partnerships, and service learning. Leadership roles that a member can partake in are offices ranging from president to song and recreation leader at the club, county, and state levels. The outcomes of Senior Leadership Retreat, Teen-Get-Away, and State 4-H Conference have been successful. Youth left Senior Leadership Retreat with a better understanding of what skills are needed to build a team as well as leadership experience. They also learned what teamwork is and how to apply it when working in a team environment, the best methods to determine and apply their communication skills, the importance of organizational skills, and appropriate decision making in individual situations.

- c. Source of Federal Funds — Smith-Lever 3(b)(c)
- d. Scope of Impact — State-specific

Curriculum Development

- a. Description of Activity

Work in this area includes diffusion, adoption, and efficacy in the state’s secondary agricultural education programs.

- b. Impacts/accomplishments

- The results a study on the diffusion, adoption, and efficacy of local program success in New Mexico secondary agricultural education will give direction for agricultural education program development efforts, and pre-service and in-service agricultural education teacher professional development efforts related to developing excellence in New Mexico agricultural education. The results will help validate the “Local Program Success” program as a model for achieving academic and other indicators of excellence in New Mexico secondary school agricultural education programs. The research will help state agricultural education leaders to diffuse the “Local Program Success” program to secondary school agricultural education teachers and programs.

- The purpose of the study was to describe perceptions of New Mexico secondary school principals and counselors on the implementation of the local program success model in their school. Additionally this study will explore the principals' and counselors' professional relationship with the agricultural education teacher. Relationships between selected variables will also be investigated as well as comparisons made between principals' and counselor's overall perceptions. Data collection and analysis was completed in Spring 2005. Program Success is dependent upon perceptions and support of key stakeholders. Recent legislation passed in New Mexico places more responsibility for hiring and termination of teachers in public schools on the school administrators. Many criteria exist when making these decisions, including the perception of the overall program and its effectiveness, the potential impact, the quality of instruction and their relationship with the agricultural education teacher. A clear understanding of principals and counselors perception of the agricultural education program in their school can assist with program planning & development, allocation of resources, and overall support.
 - Family and Consumer Sciences (FCS) is a career field that is experiencing a severe educator shortage across the United States. A shortage of Family and Consumer Sciences Education graduates limits the pool of FCS educators for the public schools, the Cooperative Extension Service, and other community agencies. NMSU researchers are assessing the projected need for FCS Educators in the area. Recruitment and mentoring strategies for attracting individuals to Family and Consumer Sciences Education as a career field are being implemented and assessed. The 2005 phase of this project was conducted in conjunction with the Dona Ana Branch Community College (DABCC). This included a one-on-one mentoring experience with Family and Consumer Sciences Education majors from NMSU serving as mentors for DABCC Education Program mentees. The impact of the project was that some of the mentees became Family and Consumer Sciences majors in the program at NMSU based on the mentoring experiences that took place in Spring 2004 and 2005. Long term impacts will include the recruitment of many individuals to the program with the projection of better filling the need for Family and Consumer Sciences educators for Extension and the public schools in the future.
- c. Source of Federal Funds — Hatch
- d. Scope of Impact — State-specific

B. Stakeholder Input

The New Mexico State University College of Agriculture and Home Economics receives input regarding research and Extension priorities from the following stakeholder groups: agricultural science center advisory boards during their regularly scheduled quarterly meetings, interim state legislative committees, general public during field days at the off-campus agricultural science centers, and various commodity commissions listed in the New Mexico State University 5-Year Plan of Work (1999). The College of Agriculture and Home Economics meets regularly with the New Mexico Extension and Research Support Council, composed of stakeholders from across the state, which gives guidance about research needs as well as Extension programs.

Each off-campus agricultural science center has an advisory board comprising area producers, research scientists, Extension state specialists, and Extension county agents. The advisory boards recommend areas of research to benefit the region's agricultural needs. The advisory boards include people regardless of ethnic/racial background, representative of the region the agricultural science center serves. For example, the Farmington Agricultural Science Center advisory board has representatives from the Navajo Nation, as well as Hispanic and Anglo members; the Alcalde Sustainable Agriculture Science Center advisory board primarily has Hispanic members, reflecting the ethnic composition of the region it serves. The advisory boards include non-producers (such as bankers) and representatives from state and federal agencies, in addition to agricultural producers, to better represent and serve the interests of the local region.

The Agricultural Experiment Station has a close working relationship with the Cooperative Extension Service. Not only do county Extension agents and state specialists serve on advisory boards for the agricultural science centers, the New Mexico Extension Support Council provides input to the Agricultural Experiment Station about research needs in the state.

A large and diverse group of stakeholders are regularly involved in helping the Cooperative Extension Service plan for the future. Across the state, more than 1,500 people serve on local county advisory committees, over fifty people serve on the statewide Extension Support Council and over five hundred producers, commodity group members, and community organizations contribute directly to the Cooperative Extension Service's planned program directions.

In addition, research projects and Extension state major programs are listed and described on the World Wide Web on the College's reporting database *New Mexico Resource Returns* (<http://www.cahe.nmsu.edu/nmrr/>). Anyone can view the projects and submit comments to the College regarding their utility. When this plan of work is approved, it also will be put on the World Wide Web.

More information on the Stakeholder Input Process can be found in pages 5 through 10 of the New Mexico State University Plan of Work 1999-2004.

C. Program Review Process

There have been no significant changes in the program review process for either the New Mexico Agricultural Experiment Station or the New Mexico Cooperative Extension Service.

D. Evaluation of the Success of Multi and Joint Activities

The multi-state, multi-institutional, and multidisciplinary activities, joint research and extension activities carried out by the New Mexico Agricultural Experiment Station and the New Mexico Cooperative Extension Service addressed the critical issues of strategic importance as listed in the 5-Year Plan of Work submitted July 1999, including issues identified by our stakeholders. The planned programs addressed the needs of under-served and under-represented populations in New Mexico. Although we believe that the programs will result in improved program effectiveness or efficiency, we do not yet have sufficient program data to determine the degree of effectiveness/efficiency being achieved in all programs.

E. Multi-state Extension Activities

**U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)
Fiscal Year: 2006**

Select One: Interim Final
 Institution: New Mexico State University
 State: New Mexico

	Integrated Activities (Hatch)	%	Multistate Extension Activities (Smith-Lever)	%	Integrated Activities (Smith-Lever)	%
<i>Established Target %</i>	6%	%	6%	%	8%	
<i>This FY Allocation (from 1088)</i>	1,511,266		1,785,524		1,785,524	
<i>This FY Target Amount</i>	\$90,676		\$107,131		\$149,627	

Title of Planned Program Activity

Crop & Livestock Enterprises	\$ 4,032.92				\$ -
Soil, Water, Agricultural Production	\$ 8,318.21				\$ 4,764.72
Food Safety	\$ 753.51		\$ 7,250.00		\$ 6,028.10
Biological Control of Rangeland Weeds	\$ 2,980.61				\$ -
Brush & Weed Control	\$ 10,500.61				\$ 3,466.50
Improving Dairy Practices	\$ 12,974.64		\$ 6,500.00		\$ 8,715.38
Vegetable Production	\$ 350.62				\$ 6,837.00

New Mexico Report of Accomplishments – 2006

Cotton Pest Management	\$ 5,541.05		\$ -
Systematic & Floristic Study of Plants	\$ 1,537.73		\$ -
Integrated Media Projects	\$ 4,116.32	\$ 15,000.00	\$ 16,222.22
Turfgrass Water Quality & Conserv.	\$ 1,020.48		\$ 9,184.29
Nutrient Management	\$ 2,279.28		\$ 4,505.08
Riparian Management	\$ 1,890.63		\$ 8,507.83
Integrated Pest Management	\$ 5,541.05	\$ 7,500.00	\$ 1,837.86
Risk Management in Ag & Natural Res.	\$ 5,131.59		\$ 4,430.41
Range Improvement	\$ 5,325.15	\$ 15,000.00	
Integrated Weed Mgt. for Range	\$ 3,951.65		
Peanut Research	\$ 3,376.30		
Water Quality	\$ 2,482.21		
Forage Fiber Woodlands	\$ 508.16		
Human Nutrition	\$ 3,182.03		
Family & Work Linkages	\$ 3,080.20		
Water Policy & Economics	\$ 3,306.54		\$ 5,254.72
Plant Genetic Resources	\$ 7,755.85		
Root Knot Nematode Genetics	\$ 4,340.97		
Cotton Genetics	\$ 3,846.28		
Invasive Weed & Brush Control	\$ 4,816.99	\$ 16,000.00	
Volunteer Development	\$ -	\$ 9,000.00	\$ 10,662.99
Profitable Livestock production	\$ 1,168.08	\$ 23,000.00	\$ 8,176.56
Life Skill Development		\$ 7,500.00	\$ 12,653.64
Financial Management Education		\$ 7,750.00	\$ 4,027.53
Plant Pathology		\$ 9,000.00	\$ 18,563.20
Wildlife Management		\$ 7,500.00	\$ 19,010.09
Total			
Carryover	\$ 114,109.66	\$ 131,000.00	\$ 152,848.12

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Director

Date

Descriptions of Multi-state Research and Extension Activities

Invasive Weed and Brush Control Management Programs

The New Mexico State University Invasive Weed and Brush Control Management programs are coordinated with management efforts in Arizona, Colorado, Idaho, Montana and Texas. The passage of the Noxious Weed Law in the 1998 legislative session signaled an increased awareness to this issue. Recently, data has shown that lands in the west are being taken over by these species at the rate of 200 acres/hour. Awareness, education, and management are the key components in addressing this problem. State-of-the-art management information and recommendations are provided to weed management groups, state and federal land management agencies and private producers in public meetings, training sessions and field trips.

Invasive brush and weeds are found in every county of the state and they are a serious problem on New Mexico rangeland. The purpose of this program is to demonstrate the most efficacious methods of controlling and managing noxious brush and weeds on rangeland. Historically, 135 demonstration-research trials have been in place throughout New Mexico. These trials are installed at the request of county Extension faculty, producers, governmental agencies or agri-business. Each trial demonstrates control of a specific species of brush or weed. Control measures are usually mechanical, chemical, biological or a combination of methods. Annually, all trials in place less than four years are evaluated to determine target species control and subsequent forage response. Data are then used as the basis for recommendations in educational programs.

These non-native plant species are impacting the southwest through increased production costs, reduced land values, elimination of biodiversity, reduced recreational opportunities, and a general reduction in state revenue. This issue impacts all citizens in the southwest, not just the agricultural producer.

A 6-year study examined saltcedar recovery after herbicide-burn and mechanical clearing practices. Both treatments provided >90% saltcedar control, but cost for mechanical clearing were nearly 6 times higher than aerial spraying followed by prescribed burning. Saltcedar removal is an important first step in the process of riparian restoration. The ways saltcedar were removed in this study were shown to influence later riparian community development.

Improving Dairy Practices

The New Mexico State University Dairy Program has collaborated with several College of Agriculture and Home Economic departments and science centers including the Department of Animal and Range Sciences, Extension Home Economics Department, Artesia Agricultural Science Center, and Tucumcari Agricultural Science Center. The dairy program covers a wide range of aspects related to dairy farming and production. Information dissemination takes place through extension demonstration projects, experimental research projects and college courses pertaining to dairy science. Multi-state collaboration was established between the NMSU Dairy Program and Arizona, Oklahoma, Texas, and California. These Multi-state ventures included production management workshops,

extension fact sheets and monthly newsletters. Current work includes involvement in a project to use dairy manure effluent to grow algae to produce bio-diesel and collaboration with the Pecos Valley Initiative, a group of 25 dairy farmers in Roswell who soon will start a bio-digester and/or gasifier plant in Roswell to process dairy manure of 25,000 cows on a daily basis.

Western Region Volunteer Development

Adult volunteers provide a significant amount of direct contact with 4-H youth and are essential partners in the 4-H Youth Development Program for maintaining and expanding the New Mexico 4-H program. 4-H volunteer leaders must be recruited, selected, oriented, trained, supervised, evaluated and recognized for a sustaining volunteer program to exist. An increasing number of adult 4-H volunteers are being empowered to assume roles that, in the past, have been filled by Extension 4-H faculty and staff: This allows for more outreach to under-served youth audiences, the addition of new 4-H projects or activities and the on-going development of unpaid and paid 4-H staff.

Increased retention of volunteers is a challenge. Adult leaders need options of how and when to be involved, as their priorities regarding volunteer, personal and work commitments change over time. Volunteer leaders need orientation and education about the organizational structure of 4-H, 4-H delivery modes, affirmative action requirements, risk management efforts, enrollment procedures, youth protection standards, youth friendly attitudes, leadership styles, leadership roles, 4-H projects, and local, state, national and international 4-H opportunities. New Mexico is a member of the western region marketing committee which studies the issue of volunteer recruitment and is currently collaborating with western states serving on that committee. Last year more than three-hundred adult volunteer leaders and youth from across the State of New Mexico gained knowledge and skills related to involving and working with volunteers, having effective club meetings, and available opportunities in 4-H. Statewide 4-H Leaders' Forum was held in a central location and provided 20 workshops, a nationally known speaker, a showcase of new curricula, educational displays, two hands-on learning special events, a state update from the New Mexico State 4-H Program Leader and a report from the 4-H Leaders' Association President. This event drew 92 participants from seventeen counties.

To prepare youth for a positive future, they must possess such life skills as communication, goal setting, decision-making, leadership and self-responsibility. These skills and others are components of the 4-H Youth Development program including "Expanded 4-H Programming". The delivery modes for this programming are primarily "Special Interest" and "School Enrichment". The audience is not limited to, but includes, higher at-risk youth. While all youth are at-risk, some youth have a combination of risk factors that create a higher risk environment for suicide, substance abuse, violence and other at-risk behavior. The "Expanded 4-H Program" in New Mexico is designed to involve youth, ages 5-19, in hands-on learning through a variety of delivery modes. The New Mexico 4-H Youth Development Program has expanded its programming to reach youth that had not been previously involved in 4-H and may reside in higher-risk living situations. 9,904 youth have participated in 4-H through outreach efforts in eight counties funded by OJJDP grants during this past program year. The programs have occurred at schools, community centers, after school programs,

special event day camps, summer day camps, military bases, tribal centers, teen court, and other youth agencies.

Profitable Livestock Production

The basis of this major program is to address the variety of needs of livestock producers to increase the likelihood of profitability and to therefore maintain stability in this important contributor to the state economy. In cooperation with Texas A&M University, and USDA-NRCS offices in Texas, Oklahoma, Colorado, and Kansas, educational camps and Ranch-to-Rail programs are conducted. We do not have current impact information for this project.

Life Skills through Knowledge

In order to prepare New Mexico youth to become knowledgeable, productive citizens, they must possess basic life skills. Four-H is a proven informal, hands-on youth development program that can help youth gain knowledge in job skills, consumer skills, money management, nutrition and health, life skills, personal and family development, and communication skills. Youth development takes place in many different formats, such as livestock and horse schools, novice camps and workshops. The Life Skills through Knowledge program works to provide opportunities statewide for 4-H members to develop skills that can be used for a lifetime. Society as a whole, the state of New Mexico, multi-state program opportunities (especially with neighboring Arizona and Colorado) and individual communities benefit greatly when young people learn life skills that enrich their lives, now and in the future. Major program focuses include communication skills, resistance to peer pressure, community service, time management; drug prevention programs, problem solving, conflict resolution, and decision making. Many of New Mexico's current business and community leaders have recently emerged from the 4-H youth development program.

Extension specialists assisted in adapting the Life Skills used in STEPS and developed the pre-and post test related to Life Skills for the Strengthening Family/Fatherhood Initiative. This program was offered in counties in the New Mexico Extension Southwest District and the Albuquerque area. Increase in knowledge and attitudes related to life skills were increased from the pre to the post-test measurements with a significance level of .0001.

Range Management Education

Monitoring elk utilization on upland and riparian areas began in 1996 and continues in cooperation with the Gila Permittee Association. This project was initiated through a "Farmer- Rancher Grant" program in the U.S. Department of Agriculture (USDA). It is being continued with Cooperative Extension Service support. The data collected are being provided to the U.S. Forest Service, the New Mexico Department of Game and Fish and the Gila Permittee Association (including residents of Arizona). These data provide information on which sound management decisions can be carried out.

Financial Management Education

Wise financial management practices enhance the economic stability of families. How families use their money—whether they spend it or save it—affects the total economic picture of the nation. Educational programs that provide basic family resource management and financial planning are important to the well-being of New Mexicans. The Cooperative Extension Service seeks to provide research-based programs that will assist New Mexicans, both youth and adults, in developing effective money management skills and sound consumer habits. Programs offered include America Saves, 4-H Mini-Society, High School Financial Planning Program, and Investing for your Future.

The High School Financial Planning Program (HSFPP) is offered in every state and reached over 551,185 students in 6,493 schools in 2005. Thirty-nine New Mexico schools reported reaching 3,875 students in 2005. This specialist is the HSFPP Extension contact for New Mexico and participated via four conference calls in the revision of the curriculum. The new curriculum is to be available in the fall of 2007. A national evaluation of the program found that students showed statistically significant increases in all financial knowledge, behavior and confidence questions. About 60 % of the students increased their knowledge about the cost of credit, auto insurance and investments and about 40 % of the students began to write goals for managing their money, to save money for their needs and wants, to track expenses and increased confidence in making financial decisions. Three months after completing their study, it was found that students still showed statistically significant increases on all areas except the one about their investment knowledge. About 60% indicated that they had made changes in spending and savings patterns.

Investing for your Future, an on-line investing course, has had enrollees from most states and several countries abroad including Germany, England and Korea. NMSU Extension specialist wrote Unit Seven, Tax-Deferred Investing, keeps it up to date and is available via email to answer questions. Investing for Your Future received the National Financial program award at NEAFCS (National Extension Association of Family and Consumer Sciences).

Approximately 430 high school and college students and adults in San Juan, San Miguel, Bernalillo, Lincoln, Curry and Roosevelt received wise use of credit information as a result of the *CreditSmart* training. Participants reported increased knowledge in how to read the information on a credit card application and how to understand their credit reports.

Plant Pathology

The plant pathology program provides training for county agricultural agents, growers, and the general public on (a) the basic concepts of plant pathology, (b) the information required from the grower for accurate diagnosis, (c) pathogen and abiotic affects on plants and the subsequent response of the plant to attack by disease agents (recognition of plant disease symptoms and signs), and (d) specific plant diseases (recognition and management). In fiscal year 2005-2006, a total of 475 plant samples were submitted to the lab for diagnosis. This

number represents an increase of 55 samples (12%) over submissions the previous fiscal year (2004-2005). The only diagnostic services specially counted in 2005-2006 were plant samples submitted. The majority of the samples submitted were from within the state of New Mexico. Of these samples, 66 samples were submitted by the New Mexico Department of Agriculture. All samples were processed and a diagnostic report was created. The record discusses the diagnosis and treatment recommendations for the specimen and is given to the owner of the plant and to the county agent for their records. Data on disease occurrence in the state is uploaded to the National Plant Diagnostic Network as part of our role as a state support lab for the Network

Integrated Pest Management

Extension is helping in this area by reducing insect damage and insect control costs, particularly for cotton, chiles, alfalfa, and pecans. This program is addressing control in a number of ways including developing techniques that will dramatically reduce the cost of eradication. Extension specialists are also developing low-no cost techniques to reduce pests through modification of habitats and growing conditions to increase desiccation in this desert environment.

Wildlife Management

An under-tapped possibility for economic development in New Mexico rests with the landowners who could pursue a variety of wildlife enterprises. Through publications, workshops, presentations and individual contact, ranchers, farmers and the ecotourism industry have been provided with the information needed to utilize wildlife and fisheries as a means for primary or supplemental income. Improvement in the land is a possible additional advantage to wildlife enterprise. Information has been distributed through extension publications, published scientific studies, workshops, presentations and verbal communications with anyone interested in obtaining knowledge about wildlife, its habitat needs, and habitat improvement techniques. Research and demonstration studies have been conducted to investigate the interactions between wildlife and livestock on public and private land. Extension specialists have participated in meetings, serve on committees, and coordinate workshops and symposiums to arbitrate conflicts between natural resource managers, consumers, and producers. Teaching materials have been developed to be used in natural resource educational curriculums and conduct educational programs for youth in 4-H, FFA, and the public school system.

Food Safety and Nutrition

The nutritional needs of the residents of New Mexico are being met through a number of programs. To address food safety and nutrition programs are presented to homemakers, day care providers and school children, the Food Safety mobile visits the state fairs, brochures and publications are disseminated throughout the state. The high number of New Mexicans with diabetes, and at risk for diabetes, are offered classes on diet, cooking, and nutrition, as well as an opportunity to identify medical tests through “On the Road to Living Well with Diabetes.” At risk families are introduced to nutrition, and healthy eating through classes

coordinated with other federal programs, along with healthy snacks provided directly to participants.

F. Integrated Research and Extension Activities

Descriptions of Integrated Research and Extension Activities

Costs and Returns of Crop and Selected Livestock Enterprises in New Mexico

There is a definite need to examine the effect of costs and returns of crop and livestock enterprises on the structure of New Mexico farms and ranches and the resulting response to conservation policies, commodity programs, chemical restrictions (such as EPA Section 18 applications), water quality, and quantity problems, and other national and state policy concerns. This project draws on the combined expertise of all County Extension Agents, many state Cooperative Extension Service specialists, and many Agricultural Experiment Station researchers. We have successfully drawn on this combined expertise of the College each year over the last 15 years to publish a projected set of cost and return estimates as a Cooperative Extension Service release and an actual (after actual yields and prices have been established) set as an Agricultural Experiment Station research report.

Research–Extension Continuum for Soil, Water and Agricultural Productivity

The Agricultural Science Center at Farmington is located in the driest portion of New Mexico. Demand on water resources is great and increasing. Diverse groups, including rural, urban, municipal, industrial, Native American, and agricultural, have vested interests in water use. Approximately 60% of the surface water exiting New Mexico is within this system and downstream groups are also demanding their allotment of the river. For agriculture to continue in the Four Corners region and the rest of the State, management strategies and crop species must be found that more efficiently use this valuable resource. To address the conservation of soil and water in this semi-arid environment, a research project has been established to investigate subsurface drip irrigation (SDI) for several economically viable crops. The increased efficiency of SDI has translated into increased crop productivity. The Navajo Agricultural Products Industry has requested the Center to use the research results of this project to develop plans for the transition of abandoned rectangular side roll fields into productive SDI fields for high value crops. A Diné College (1994 Land-Grant Institution) demonstration farm is being developed in Shiprock, NM. The Center has been requested to provide input into the design of the proposed irrigation system, a sizable component of which is drip. Orchard managers and urban horticultural enthusiasts have requested the Center for advice on low water application technologies. These technologies were included in an irrigation workshop for farmers, ranchers, and other interested parties from the Four Corners region. The workshop was the second in a series of collaborative irrigation workshops being organized by Colorado State University, Utah State University, the University of Arizona, and New Mexico State University. Such activities are the deliberate streaming of information along the research – extension continuum. This Soil, Water and Agricultural Productivity project is designed to facilitate this sort of information exchange.

Food Safety

Our Food Safety program offers information, resources, and training in a number of important areas. Food processors are provided programs on producing safe food products. Food handling and safety workshops are offered with particular emphasis on restaurants and tourism facilities. In all arenas, state and federal regulations are emphasized and assistance in developing and maintaining compliance with these regulations. The testing facility, established earlier, serves as an important resource in this effort.

Biological Control of Rangeland Weeds

This is an AES/CES project to demonstrate that inundative biological control with *Aphthona* flea beetles can be used as a tool for eliminating small isolated populations of a noxious weed: leafy spurge (*Euphorbia esula* L.). By using early intervention techniques we hope to prevent the spread of leafy spurge, which could potentially become a serious problem impacting at least 50,000 ha in New Mexico alone. Knowledge gained from this project will be shared with the scientific community, the extension community, and private landowners. The primary beneficiaries of our efforts are landowners. Tours were conducted at each location throughout the lifetime of the project. Landowner involvement ensures there is producer-to-producer information exchange. Information on the projects outcome was disseminated through radio interviews, the popular farm press, scientific journal articles, and other means. The Extension State Weed Scientist organizes an annual noxious weed short course and provides talks to interested producers and land managers from New Mexico and surrounding states (Colorado, Arizona, and Utah). The PIs gave presentations at many different venues, including the New Mexico Vegetation Management Association annual meetings, Native Plants Society meetings, garden clubs, county agent training sessions, and New Mexico Soil and Water Conservation Districts annual meetings.

Scientists at NMSU have established saltcedar leaf beetles to sites where previous chemical and mechanical management techniques have been implemented to determine if they can control saltcedar re-growth. Beetles were established in half of the plots and compared to plots with no beetles and untreated areas. Data is being collected throughout the study to compare beetle establishment, expansion, and vegetative response in the different treatments. Cooperating land owners are excited about the possibility of continuous saltcedar suppression, and the resulting water savings, at little to no cost to them once biological control is successfully implemented. Information will be disseminated to increase public awareness of the role that saltcedar leaf beetles can play in the long-term management of saltcedar.

Brush and Weed Management

Noxious brush and weeds are found in every county of the state and are a serious problem on New Mexico rangeland. Data have shown that lands in the West are being taken over by these species at the rate of 200 acres/hour. The purpose of this program is to demonstrate the most efficacious methods of controlling and managing noxious brush and weeds on rangeland. Historically, 135 demonstration/research trials have been in place throughout New Mexico. These trials are installed at the request of county Extension faculty, producers,

governmental agencies, or agribusiness. Each trial demonstrates control of a specific species of brush. Control measures are usually mechanical, chemical, biological, or a combination of methods. Annually, all trials in place less than four years are evaluated to determine target species control and subsequent forage response. Data are then used as the basis for recommendations in educational programs. Awareness, education, and management are the key components in addressing this problem. These non-native plant species are impacting our state through increased production costs, reduced land values, elimination of biodiversity, reduced recreational opportunities, and a general reduction in state revenue. This issue impacts all citizens of the state, not just the agricultural producer.

Improving Dairy Practices

The Improving Dairy Practices program focuses on increasing efficiency of both human and animal production. Information is offered to producers through constant update of the website, newsletter, publications, and one-on-one communication. Workshops pertaining to employee management, reproduction efficiency, heat stress, milk quality issues, fitting/showing for 4-H heifer projects, and other pertinent topics are conducted in four general locations throughout the state: south of Albuquerque, Las Cruces area, and two sites in eastern New Mexico. Opportunities for interested students to acquire further knowledge of the dairy industry through distance education and internship programs exist through the extension dairy program.

Vegetable Production

The vegetable production program at NMSU integrates AES and CES functions. The target clientele is commercial vegetable producers. The focus is on drip irrigation, fertilizer use, pest management, and varieties. Some of the recent AES activities have been a field experiment on the effect of planting date and fungicide treatment on stand establishment of chile pepper at Leyendecker Agricultural Science Center and Pumpkin cultivar trials at Leyendecker and Artesia Agricultural Science Centers.

Pest Management of Cotton

The needs of extension clientele drive this research program. Over the past five years we have had research/extension programs that have addressed one of our most immediate problems-boll weevil establishment in New Mexico. We have operated monitoring programs in conjunction with, and funded by grower organizations, to detect early infestations as well as migration lines to determine the source of infestation. At the same time we conducted research trials that would develop pest management tools to suppress and help eradicate boll weevil. Boll weevil establishment and control in New Mexico is different than in other areas of the cotton belt that are more humid. We found, for example, from both our extension monitoring program and our research program that overwintering habitat particularly in urban areas had a major influence on the success of boll weevil establishment and subsequent yield losses. Implementing the resulting recommendations for weed control and delayed planting saved farmers in south Eddy County over \$50/acre in 1998 alone. A number of cultural techniques were tested that proved to be effective in boll weevil control that have also been recommended. We are also supporting eradication efforts by developing

techniques that will save programs Beltwide money, for example in developing better boll weevil traps and in testing experimental microencapsulated formulations that may reduce application intervals in half potentially saving cotton farmers in eradication zones over \$30 million per year.

Systematic and Floristic Studies of Southwestern Plants

This project continued plant identification services, as well as providing information about range plants and plant toxicity upon request. The PI edited the “The New Mexico Botanist” newsletter; four issues appearing, compiled and maintained “A Working Index of New Mexico Vascular Plant Names” on the web, maintained links to information sites about poisonous plants, copies of “The New Mexico Botanist” newsletter, and a list of identification sources for New Mexico plants, and presented plant identification workshops.

Integrated Media Projects

The NMSU University Communications Department does a number of media projects annually that integrate AES and CES functions. Recent projects include: a series of 22 web based games for outreach into remote and minority communities where youth might not experience a traditional 4-H club; Cybercamp educational songs and games; on-line resources for the Southwest Rangeland Invasive Plants initiative; national distribution of ‘Fight Bac!’ on CD-Rom. A number of additions have been made to our multilingual video and computer-based educational programs, including Sheep and Beef Meat Handling (Navajo) and Spanish Home Child Care.

Turfgrass, Water Quality, and Soil and Water Conservation

There are numerous places throughout the state that are covered by Turfgrass and require management strategies to achieve and maintain optimum quality. There are approximately 90 golf courses in New Mexico, numerous athletic fields (baseball, soccer, football fields), and parks and home lawns. Water is the biggest concern in turf management as quantity and quality can rarely be maximized for optimum growth and maintenance. Especially for athletic fields, such as high school football fields, the resources are not readily available to provide adequate turfgrass maintenance. Therefore, the conditions on these fields range from very poor to average. Homeowners spend a great deal of time and resources to achieve the perfect looking lawn and are often prevented from reaching their goals because of water quality, quantity, and species selection. Golf courses range in quality from the top fifteen nationwide for public golf courses to poor quality due to water restrictions.

Nutrient Management

Plant nutrients are found in both synthetic and organic materials such as farmyard manure and composts. Animal feeding operations in New Mexico have increased since 1982 resulting in a 56,000 head increase in dairy cows alone. Commensurate with this increase is increased manure production that can be utilized for crop production. However, repeated and excessive applications of manure to cropland can cause nutrients to buildup and cause negative environmental and livestock health implications. Unique soil properties found in

New Mexico offer some degree of protection against many of problems found in the eastern U.S. However, permits issued to animal feeding operations require some form of tracking and accounting for the nutrients applied to cropland. Nutrient management is a best management practice suitable to all persons utilizing the land for economic plant production. Managing nutrients for sufficient plant growth, animal nutrition, and environmental compatibility will assure a safe and reliable source of food and fiber in New Mexico. Additionally, proper nutrient management practices will maintain economic viability of New Mexico's cropland and livestock producers.

Riparian Management

A manuscript was published in the *Journal of Range Management* presenting results of the 1st phase of the study addressing vegetation changes as a result of grazing at different intensities during different seasons of the year. A second manuscript is currently in press presenting the results of streambank changes in response to grazing. Preliminary study results have been presented at several workshops designed to educate County Cooperative Extension Faculty, natural resource management agency personnel, and agricultural producers. Results of this study continue to be presented in appropriate outreach venues and information from this research continues to be used in workshops and presentation addressing other, but related, topics to help guide livestock management in southwestern riparian areas. Audiences for outreach efforts include agricultural producers, Cooperative Extension Service personnel, university faculty, staff, and students, range management professionals, state and federal land management agency personnel, and the general public. On site tours for the research project/demonstration area are being planned and will include new USFS District personnel, the recently hired NMSU Sierra County Cooperative Extension Service Agricultural Agent, and member of a local watershed working group. Information from this research is also disseminated among stakeholders at local groups and organizations. No publications were produced directly from this project during the last year but information from the research has been included in several Cooperative Extension Service review papers. In addition, a two-day NMSU Animal and Range Science class laboratory was held at the research/demonstration site in Fall 2006.

Integrated Pest Management

Ranked by annual cash receipts, alfalfa, chile, pecan nuts, various fruit (apple, cherry, grape) greenhouse/nursery crops, cotton, corn and small grains are the leading plant crops for New Mexico producers. The boll weevil, pink bollworm, cotton bollworm and cotton aphids resistant to various insecticides have become key pests for the state's cotton crop; while genetically engineered cotton cultivars are now available to the state's producers, the added *Bacillus thuringiensis* genes protect the developing bolls only to a point from caterpillar problems. Alfalfa weevil, three species of aphids, and occasional caterpillars continue to plague the alfalfa crop; cyclic populations of grasshoppers and blister beetles cause occasional crop losses and, in the case of blister beetles, subject growers to legal liabilities and additional economic losses. Several species of aphids plus additional arthropods, diseases and weed pests are annual problems for corn, small grain, nut and fruit crop producers. In the last five years, European corn borer has been detected infesting corn in two

additional counties (total now of seven infested New Mexico counties), kernal bunt-infested wheat seed has brought new regulations to the south-central part of the state, sorghum ergot has invaded the milo fields of eastern New Mexico, and pecan nut casebearer has become well established in pecan groves and yard trees throughout Dona Ana County. Pepper weevils, various caterpillars and whiteflies are major threats to both the fresh and processed chile markets in the state. Chile and other vegetables generated over \$163 million in New Mexico farm income during 1997; over 1 million acres of these crops are irrigated.

Approximately 70 million acres in the state are devoted to livestock grazing; nearly 10 million acres of non-federal land are forested. Range caterpillars, grasshoppers, and various forest pests (bark beetles, tussock moths, mistletoes, etc.) are periodic pests in these rangeland or forested areas; in addition, invasive, exotic weeds (musk thistle, various knapweeds, yellow star thistle, etc.) are continuing to spread in various parts of the state, out-competing native plants and replacing them with less desirable, less palatable and even toxic species for livestock and wildlife.

Of the approximately 1.5 million people in the state, nearly 75% live in urban centers with 2500 or more people. Consequently, pests of urban ornamentals affect the greater percentage of clientele. Surveys continue to indicate severe over-reliance on commercial pesticides by homeowners and pest control operators to control major and nuisance pests in the state. Urban ornamentals and turf have been attacked by ash whitefly, ash bark beetle, tomato spotted wilt virus and other pests; on-going drought has further weakened landscape plants, making them more susceptible to an assortment of arthropods borers and defoliators. The nursery and greenhouse industries have been shaken by invasive red imported fire ants and Japanese beetles in Dona Ana and Bernalillo Counties, respectively.

An advisory group exists for the urban landscapes IPM program; various crop commodity groups for cotton, alfalfa and chile make suggestions for IPM programs in those commodities. New Mexico also participates in the USDA-APHIS-PPQ Cooperative Agricultural Pest Survey Program. Data from agricultural, rangeland and forest pest surveys are gathered and entered into the National Agricultural Pest Information System data base. The program documents the occurrence and movement of various pests within and between states and tracks exotic pests introduced from other countries.

Risk Management in Agriculture and Natural Resources

The risk that prices can move enough to cause major economic damage to agricultural producers has long been a significant problem. Likewise in the new era of deregulation, other industries such as finance, utilities and energy face the same risks that agriculture faces. Tools exist, such as futures, options, and swaps, that can help manage the risks of price changes and thus be helpful to industries. This project looks at each industry and the tools that can help provide economic benefits to those that choose to use them. Projected 2006 crop cost and return estimates were developed and released prior to the planting season. The set of cost and return estimates includes 49 representative farms. The set covers 39 geographical production areas, 22 different crops, several size classes, and 3 major irrigation types as well as dryland. All cost and return estimates, projected and historical are now exclusively published on the internet at <http://costsandreturns.nmsu.edu> and are posted in

January / February for projected estimates for use prior to the decision-making season. Researchers also completed and uploaded a set of 2004 actual cost and return estimates for the same set of farms. The normal pattern is to release projected cost and return estimates in January for planning purposes. Then, once the New Mexico Department of Agriculture publishes crop-year statistics (usually about 11 to 12 months after the close of the calendar year), we release the actual estimates using reported yields and prices (as opposed to projected yields and prices). The primary economic impact involves improving the decision-making of farmers and ranchers and providing needed input data to the decisions made by lenders, and the analyses of appraisers and economic researchers.

Range Improvement Task Force

The Range Improvement Task Force (RITF) seeks to extend the Agricultural Experiment Station and Cooperative Extension Service's efforts by investigating impacts to federal lands, focusing at the ranch-unit level. It provides objective information to ranchers and governmental policy makers, and offers solutions to rangeland issues/disputes based on science. The RITF includes a Western regional perspective and greater emphasis on policy analysis in an ecosystem context as both legislation and litigation rapidly evolve and affect Western rangelands. Policy research and impact assessment needs have increased much faster than capabilities for providing objective scientific evaluations and recommendations.

Integrated Weed Management for New Mexico Rangelands

This project studies weed establishment, persistence, and interference within rangeland ecosystems by evaluating fire and herbicides in different seasons and application procedures to produce desired vegetation mosaic. The scientists are developing low-input, sustainable approaches utilizing integrated control methods to achieve desired vegetation response. The results are disseminated via Extension workshops.

Peanut Research Program

Peanuts are a mainstay cash income commodity for Eastern New Mexico. With approximately 18,000 acres and income of approximately \$15 million, peanuts average more than \$800 per acre. This is the single largest income-producing crop for producers. As peanuts are sold primarily in shell, quality is a major factor related to price received. Maintaining this quality through control of diseases such as Web Blotch, Southern Blight, *Rizoctonia*, Pod Rot, Blackhull, and *Fusarium* becomes extremely important. The breeding program is also designed to maintain quality through development of disease resistant varieties. Other production variables include fertility management programs and irrigation. Drip irrigation studies relate to water consumption and lowering input costs. Four other projects for the year included herbicide studies for weed control. Other minor projects are conducted to evaluate control of early season insects such as thrips and worms. Late season insects include beet armyworm and grasshoppers. All of these programs focus on research-based information transferable to producers through publications, news media, field days, and quarterly meetings with the Peanut Research Board and annual meetings with the New Mexico Peanut Growers Association.

The new breeding lines that are under testing has shown an yield increase ranging from 6 to 22% higher yields than the local check Valencia – C across five locations for two years covering eastern New Mexico and west Texas. A collaborative research between New Mexico State University, Texas Tech University and USDA – Plant Stress lab at Lubbock were able to characterize mini core collection for heat and water stress using chlorophyll fluorescence, total sugars, specific leaf area, leaf density and water use efficiency. We were also able to characterize entire peanut mini core collection consisting of 72 genotypes using 72 SSR markers. Markers on various chromosome groups were characterized within mini core collection and were able to recognize the pattern on the “A” genome of the peanut. We are planning to register these two new material this year in Crop Science. This project was in collaboration with Institute for Plant Genetic Resources – IPGR, Sadovo, Bulgaria funded by USAID-Peanut CRSP project.

A Valencia mini core collection is developed from 720 accessions from USDA-Plant genetic resources. The idea of mini core collection is to enhance exploitation of peanut genetic resources. As the mini core accessions have reasonably good agronomic value, they can be used in breeding programs without adversely affecting the speed of improvement program resulting from epistatic effects.

Water Quality

Population growth along New Mexico’s river valleys is among the fastest in the nation, resulting in a greater demand for domestic use of surface and groundwater supplies. Conflicts between urban use and irrigated agriculture are becoming critical issues. Population concentrations along the rivers also threaten water quality by increasing pollutants from septic tanks, household hazardous waste, and lawn and garden practices. There is a general lack of knowledge about the impacts to water supplies from land use and waste disposal practices. Educational programs designed for Extension agents, the general public, municipal water and wastewater managers, and garden hobbyists will increase awareness of the need to conserve and protect water resources.

Forage Fiber Tradeoff — Piñon-Juniper Woodlands

The purpose of this project is to analyze the impacts of dispersed recreation on public lands to test whether income from recreation can offset losses of extractive industries (livestock grazing, timber, and mining). This project shows where and how industry (ranches) expenditure patterns affect the New Mexico economy by sectors. Long run databases are now available (up to 24 years) for tree growth response, forage growth by species, and seedling growth and ingrowth. Ingrowth is defined as a natural seedling germination that will impact upon the expected life of the treatment. This study is currently in the last stages of data collection and will be completed over the next two years. Twenty-five years of data will allow the expected life of various thinning practices to be determined which will then enable the net present value of treatments to be calculated and the following objectives to be accomplished.

Integrated Weed Management for NM Rangeland

This project's goal is to determine the relationship between changes in mesquite densities and soil textures and depths. Because of the native plant and animal changes occurring in the desert regions due to increasing human populations, natural reserves will be established to protect this fragile ecosystem from further development. This project has established which methods of salt cedar control are most efficient and cost effective.

Human Nutrition

There is a well-established connection between diet and health. Spiraling health care costs have catalyzed a change in emphasis toward preventing chronic diseases (e.g., heart diseases, cancer, osteoporosis) instead of treating them once they develop. Growing evidence indicates that increased intakes of vitamins A, C, and E, the B-vitamins, carotenoids, calcium, selenium, magnesium, zinc, chromium, phytochemicals and foods rich in these and other nutrients may help prevent such diseases and improve the health of Americans. These purported benefits have led to the widespread consumption of these nutrients in the form of diet supplements (e.g., vitamins, minerals, botanicals and other phytonutrients) and the emphasis on increased intake of fruits, vegetables and grains.

The information derived from this multi-state, interdisciplinary research project and the dissemination of information to both the scientific community and lay public will provide part of the framework on which future nutrient recommendations can be based. Research indicates a trend that is the antithesis of what is noted in America related to bone mineral density. Although participant numbers have been small so far, the research indicates a need to ascertain the influence of cultural dictates on factors that impact bone mineral status.

Family and Work Linkages

Communities and businesses are struggling to adapt to change in the workforce. This project investigates how individuals regard themselves in their multiple roles, determining to what extent issues of identity and sense of self are key components of the well-being of individuals and families as they respond to social and economic changes. In the past year, researchers have developed a protocol to use for the focus groups involving three target populations. Focus groups will be conducted in Year 2. In Year 3, researchers will determine the media to be analyzed and finalize the template to be used for the media content analysis. The actual content analysis and evaluation will take place in Year 4. During Year 5, researchers will develop recommendations sensitive to the needs of our target populations and editors, and disseminate our recommendations to relevant media outlets.

Water Policy and Economics

Two major issues that impact on the effective and efficient allocation of water among multiple uses and users have emerged to the forefront of the policy debate. First, a growing body of evidence indicates that water conservation acquired through traditional cost-share conservation programs such as those implemented by USDA, 74% of whose participants are

small farms, will likely be insufficient to meet the needs of growing non-agricultural water demands, particularly for environmental purposes. In this connection, nearly 81% of irrigated farms in the 17 western states are small farms, while large farms (farms with \$250,000 or more in total farm sales) apply 66% of agricultural water. Clearly, the studies suggest that farm-size characteristics, economics, and institutions are central to the design of more effective federal and state water conservation policy. While traditional cost-share conservation policy likely contributes significantly to small farm policy goals, integrated conservation/institutional policy may have an even larger conservation/reallocation impact and provide for a more effective balance between small farm and environmental policy goals. Second, the historic method of reducing agricultural production risks through subsidized federal crop insurance (e.g. crop insurance and non-insured crop assistance provided by USDA) does not cover water shortfalls in irrigated agriculture. Even if federal crop insurance were extended to cover water-supply restrictions, it is an open question whether such a program could effectively mitigate the risks of reduced water supplies, because several concerns arise related to the feasibility, effectiveness, and participation level within such a program.

Plant Genetic Resource Cultivation and Utilization

In response to the negative impacts of biotic and abiotic variables on crop production, a broad genetic base is critical for U.S. agriculture in the development of new cultivars or the improvement of existing ones. These genetic resources are readily recognized as important and crucial in the agricultural production system as water, air, soil, and minerals. NMSU scientists are characterizing and evaluating germplasm by using morphological characteristics and molecular marker technology to enhance conservation management, increase utilization of the germplasm collections, and to incorporate the resulting genetic data into publicly accessible databases. They also are evaluating interactions of key associated pathogens, and/or symbionts to improve management and utilization of plant germplasm collections, and conducting research on selected germplasm collections for response to, or relationship with, close organismal associates such as microorganisms, pathogens, and saprophytes.

Private industry has expressed concern that yield loss may accompany utilization of unimproved germplasms, such as many USDA-NPGS plant introductions. Our field experiments have demonstrated, however, that after only one cycle of selection the forage yield of many plant introductions and their hybrids can equal, or exceed, that of the best commercial cultivars. Also, many commercial populations have very broad genetic bases, limiting the potential to capitalize on heterosis. Our results, however, demonstrate the importance of heterosis effects on yield potential. Since many NPGS populations have much narrower genetic bases (i.e., have relatively greater genetic purity), their utilization should offer unique opportunities to capitalize on heterosis to improve alfalfa forage yield. The introgression of multiple pest resistance traits into more than 45 NPGS plant introductions, that have performed well under limited and optimum irrigation management, offers the potential to develop alfalfa cultivars with greater yield stability/environmental adaptation.

Root-Knot Nematode Genetics

The cyst and root-knot nematode genera are the most important groups of plant-parasitic nematodes in the United States. The management of these nematodes during the past four decades has largely been via the application of broadly efficacious, non-discriminating nematicides. Alternative nematode management involves combinations of crop rotation, host plant resistance, cultural manipulations and biological control, all of which may have specific genotype-level interactions with nematodes. Hence, the genetic variability existing in the target nematode populations must be considered to successfully develop and deploy alternative nematode management strategies. This regional project was initiated because the membership recognized the increasing importance of characterizing the genetic variation in nematode populations and understanding how that variation influences the success of alternative management strategies.

Researchers have established that the root-knot nematode/yellow nutsedge/purple nutsedge pest complex described for *Meloidogyne incognita* host race 3 occurs with other host races of *M. incognita* and *M. javanica*, but not with *M. hapla*. Also, cultivars of sorghum, sudangrass, and sorghum/sudangrass hybrids grown in the southwestern United States do not appear suitable for use as rotation crops to suppress the root-knot nematode/nutsedge pest complex due to unacceptably-high levels of reproduction by *M. incognita* host race 3.

Cotton Genetics

Large germplasm populations are utilized to select via pedigree breeding elite lines possessing improved agronomic and fiber quality traits. The best genetic stocks are released for further development by the cotton industry.

NMSU scientists developed and released the first public transgenic Bt (insect resistant) cotton cultivar (1517-99W) in the United States in 2005 which was grown in more than 13% (8,417 acres) of cotton acreage in New Mexico in 2006, according to the “2006-2007 Variety Planted” report by USDA. The new cultivar 1517-99W increased cotton production by 70-140 pounds per acre, totaling >600,000-1,200,000 pounds (\$300,000-600,000) in increase for New Mexico in 2006 alone. The figure is expected to increase substantially in the years to come. Recently, New Mexico growers reported more than 3 bales (>1,440 pounds) per acre production from growing Acala 1517-99W in 2006. This translated to 25,251 bales (12,120,480 pounds) cotton fiber production by 1517-99W, totaling >\$6 millions gross income for New Mexico cotton growers. We are targeting ~50% acreage coverage by our new Acala 1517 cotton cultivars including this one (1517-99W) in our state in the next several years. Therefore, the economic impact of this cotton breeding program will soon be >\$25 millions for our state.