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CSREES ANNUAL REPORT
FY 2005
Wyoming's Accomplishments & Results

Introduction:

Agriculture is at a crossroads and faces many challenges and opportunities in the 21st century. Agriculture, as well as land-grant institutions, is challenged to compete in a global economy while still responding to the needs of a diverse U.S. population. Ensuring that agriculture remains profitable and sustainable, while addressing environmental concerns, places new demands on the industry. Issues involving production agriculture, natural resource management, and quality of life generate diverse research and education directives. Stakeholders have been vital in identification and prioritization of needs.

The College of Agriculture has a mission to serve the educational and information needs of students, Wyoming citizens and communities, and the global community by providing and distributing unbiased, scientifically sound information on production agriculture, natural resource management, and quality of life issues. The mission of the University of Wyoming Cooperative Extension Service is to provide lifelong learning opportunities for the people of Wyoming and empower them to make choices that enhance their quality of life.

A. National Goals

Goal 1: Enhance agricultural systems that are highly competitive in the global economy

Overview:

Wyoming is a rural state where agriculture is a key component of most rural communities and towns. The value of the agricultural sector output annually approaches or exceeds one billion dollars. The Wyoming livestock industry is forage based with both private and public lands being used for livestock. It is important to note that these same private and public lands are important to the other two pillars of the states economy, energy resources and tourism.

Due to high elevation (average of 6,800') and arid climate Wyoming's agriculture faces many challenges. Stakeholder input suggests that all aspects of profitability and sustainability are important issues for research and extension.

The College of Agriculture conducts research and extension programs to provide knowledge and technology to maintain economically viable and sustainable forage, crop, and animal systems consistent with its resource base. Research and extension efforts in the college range from biotechnology to home lawn and gardening with emphasis on animal production efficiency, plant production efficiency, natural resource management, and profitability. Environmental and natural resource issues include water quality, rangeland health, biodiversity, and wildlife habitat.

The new Sustainable Agriculture Research and Extension Center (SAREC) at Lingle, WY will allow UW to integrate forage/livestock/crop systems that will be profitable while maintaining or enhancing natural resources. It provides a unique opportunity for reducing inputs, providing forage for livestock, and extending the grazing season.

The focus of research and extension efforts on production practices and production systems is to enhance profitability while maintaining the underlying resource base.

Key Theme - Adding Value to New and Old Agricultural Products

a. Seedborne diseases such as bacterial bean blight can seriously impact dry bean production in areas of the United States. While bacterial bean diseases do not have a serious impact on dry bean yields in the Big Horn Basin, a significant portion of the dry bean seed produced in Wyoming is marketed in areas where bacterial bean diseases can devastate a dry bean crop. It is critical that every possible effort be made to assist the Wyoming seed industry in producing clean, high quality seed. Well-trained field inspectors play a major role in the production of quality seed, and part of that training consists of the Bean Disease Training Nursery, planted at the Padlock Ranch near Ranchester, Wyoming by the Wyoming Seed Certification Service (WSCS). The nursery provides hands-on training for WSCS field inspectors as well as interested individuals in the bean industry. Bacterial bean diseases are a serious issue in the upper mid-west, so much so that Wyoming certified seed standards dictate a zero tolerance for those diseases in the field.

   Detection of the disease can have a significant financial impact on the value of the crop for the producer. In 2005, seed prices were significantly higher than edible bean prices, making the financial considerations associated with a positive test for bacterial bean diseases a costly one for the grower. One grower indicated that the difference between seed price and edible bean price on his 60 acre field was around $30,000. While it is easy to put a figure to the cost of seedborne bean diseases to the Wyoming seed producer, it is very difficult to put a price on the damage to the Wyoming bean seed industry if every effort was not made to produce disease-free seed.

   Eleven inspectors attended the training session, which included a slide presentation at the Sheridan R&E Center facilities covering disease life cycles, inspection techniques, and other pertinent issues. The training continued in the field where inoculated beans were planted in alternating rows with “clean” beans, which provided varying stages of disease development. The disease moved from the inoculated rows to the non-inoculated rows. Specific techniques were demonstrated for identifying the diseases in the field, such as shading leaves to identify the mottling of the leaf surface caused by Bean Common Mosaic Virus (BCMV), using the appearance of the underside of the leaf to identify bacterial diseases, and the affects of leaf venation on symptoms similar to the disease versus actual disease symptoms. Inspectors who are able to differentiate between symptoms similar to the diseases in question and actual disease symptoms will limit anxiety level of producers and contractors. Those same inspectors are also able to discuss the issues surrounding bean diseases with the growers, providing additional educational opportunities. The high level of training afforded to WSCS inspectors is a vital part of quality, disease free seed production in Wyoming.

b. **Impact -** Five inspectors for the Wyoming Seed Certification Service, the director of Seed Services at Colorado State University, two inspectors for the Colorado Seed Growers Association, and three inspectors for the Montana Seed Growers Association participated in the 2005 training. This is the only such training in the U.S. to our knowledge, and those

trained inspectors provide a level of service to the seed industry that is second to none. The training assisted in the recognition and eventual confirmation of bacterial wilt in a field near Powell, the first confirmed incidence of the disease in the state.

Dry bean seed production continues to be a significant part of production agriculture in the Big Horn Basin, with 10,319 acres of seed beans inspected in 2005. Using the state average of 22 cwt. per acre, production would equal 227,018 cwt. with a value to the producer of over $5.2 million. The majority of the bean seed is sold outside Wyoming, and quality dry bean seed is critical to maintaining that production opportunity.

c. **Source of Funding-** Smith-Lever, State

d. **Scope of Impact-** State Specific
Multi-State Integrated Research & Extension (WY, NE, ID, ND, MT)

Key Theme – Agricultural Profitability

a. The value of the agricultural sector output in Wyoming annually approaches or exceeds one billion dollars with cash income at $900 million in 2004. Economic profitability is vital to the sustainability of agriculture since no practice or agricultural operation is sustainable unless it is first profitable. Cooperative Extension Educators in Wyoming conducted 141 workshops, multi-day seminars, or classes reaching over 7,300 individuals. A sample of the topics ranged from Ag Profitability, Beef Marketing, Importance of Winter Forages, Plant Anatomy, Risk Management for Ag Families, and Living on a Few Acres.

Farm policy enacted since 1996 has punctuated the need for agriculture producers to understand and manage risk. Risk management is difficult to understand and teach, both because the concepts are difficult and the breadth of problems and solutions are great. The economy agriculture faces now is a higher-risk economic environment than agricultural families have seen since the 1930's (Fetsch, Bastian, Kaan, and Koontz, 2000). The need for further education is confirmed by a recent survey of producers (Kaan, et al., 2000). Improvements in technology translate into an increased power to teach complex risk management education that is more effective than we have seen in the past. In the face of declining state and Federal budgets, the Insuring Success for Wyoming Agriculture program was developed.

Wyoming agricultural producers encounter drought (below average precipitation at key times of year) half or more years. Anticipating drought would allow for adjusting stocking numbers before the resource is drought stressed and livestock prices fall. Long term precipitation records have been correlated with herbage yields at several locations to determine the temporal window when precipitation amounts will effectively predict the annual forage yield. This information has been conveyed to livestock producers and land managers in a variety of forums.

Rangeland forage yields and seasonal precipitation relationship models have been developed through an applied research project funded by United States Geological Survey (USGS) and Wyoming Water Development Commission (WWDC). These models were

developed from long term data developed near Saratoga, Cheyenne, and Casper. These models, while each are different, indicate with relatively high reliability that intervals of late winter/spring precipitation are the primary factors determining forage yields for the summer over most of Wyoming rangelands. The best model, from Saratoga data, indicates that late April precipitation is highly reliable in predicting summer forage yields. Lower elevation sites appear to respond to precipitation in a window extending from March to late May. These differences among models appear to be related to varying times of warming of air and soil, frost free soil, and ratio of warm season to cool season grasses. The variation among models suggests that localities around the state would be well served by developing their own model from local data to serve the interests of producers needing to proactively manage for drought or exceptional forage yields.

To foster the development of locally applicable models, forage yield sampling sites around Wyoming were developed through the cooperation of local resource managers or advisors. These 18 sites are located in a variety of soil and precipitation zones except montane areas. Assistance in sampling these sites and processing samples has been provided as time was available. These areas have been sampled two to three years so far.

Soil moisture data from around Wyoming has been lacking. Soil moisture monitoring probes have been installed to three depths at 19 locations, mostly adjacent to the forage sampling sites. While most of these installations have been functional for the 2005 growing season, there remains the need for calibration of the data logger to individual site soil properties. These data will provide much needed indications of growing conditions for the localities.

AGREN is an agricultural consulting company contracted by USDA to develop forage production profiles for ecologically similar regions of the Great Plains and western region of the U.S. where livestock ranching is an important enterprise. Forage production profiles are to be incorporated into a ranch stocking management model that promises to be useful in proactively managing for drought and efficiently utilizing available forage production. Recognition of the results of modeling efforts has allowed for accurate forage production for the Wyoming area to be available for this effort.

The important features of the forage yield profiles of this area are the sharp increase in standing crop of cool season species in spring, rapid maturity mediated by available moisture, and a lack of re-growth after plant maturity. The important message for producers is that timely decisions for de-stocking, finding additional forage, providing stock drinking water, or adjusting grazing management can and should be made in spring. Waiting until later is not appropriate. Summer rains in this region at best result in a greening of vegetation but little new growth.

Ground-based insecticide applications to control rangeland grasshopper infestations are becoming the main option to suppress incipient infestations. They are particularly important in the periods between grasshopper outbreaks, when high pest densities are confined only to limited areas. The All-Terrain Vehicle insecticide applications in the context of the Reduced Agent and Area Treatments (ATV-RAATs) are increasingly adopted for grasshopper

control by ranchers and farmers. The use of ATVs allow for optimizing the RAATs geometry because it provides a better ratio between the treated and untreated swath widths than the traditional, aerial spraying. Being a truly integrated approach, RAATs work through *chemical control,* meaning grasshoppers are killed in treated swaths and as they move out of untreated swaths, and *conservation biological control,* which allows predators and parasites preserved in untreated swaths to suppress grasshoppers.

b. **Impact** – Research and Cooperative Extension efforts resulted in the following impacts:

- **C**ES driven forage programs have resulted in an increased number of producers doing hay testing (over 50 percent increase in one county) which reduces gross costs, and increases net profits translating into a higher standard of living for the families.
- Attendees at a state hay meeting indicated they would make changes in their operations using value-added marketing as a result of the meeting.
- Noxious and invasive weed identification training reached over 300 people in 2005. Immediate impacts have included detection and reporting of two new serious weed problems in Wyoming. Eradication and containment efforts were implemented.
- Since late 2004, the Insuring Success for Wyoming Agriculture program has been offered at 14 sites across Wyoming. In total, just over 240 farmers and ranchers have attended the onsite offerings. Computer CD Rom materials were distributed to over 5,700 producers in Wyoming in cooperation with the Wyoming Agricultural Statistics Service. Another 100+ were mailed to sponsoring producer organizations, extension personnel in Wyoming and across the west, and UW College of Agriculture faculty and staff. A total of 60,000 newspaper inserts were printed, with fully 55,000 distributed via the state's larger urban newspapers. In addition, Barnyards & Backyards articles appeared in three separate issues of the Wyoming Livestock Roundup newspaper, which reports a subscriber base of 5,000. Evaluations of these efforts have reported increased knowledge and raised awareness.
- Numerous seed crops are produced in Wyoming. In 2005, the WSCS inspectors inspected alfalfa, red clover, crownvetch, cicer milkvetch, sainfoin, sweetvetch, barley, winter wheat, dry beans, oats, and 24 species of turf, forage, and reclamation grasses. The program also offers pre-variety germplasm inspections for wild land collections and cultivated selections of native plants. In 2005, inspectors examined 6,091 acres of alfalfa and miscellaneous legume seed, 10,319 acres of dry beans, 2,956 acres of small grains, and 990 acres of grass. The grand total for 2005 was 20,810 acres inspected, an increase of over 6,600 acres from the 2004 season. The WSCS office staff handles the documentation necessary to track inspection efforts and assure compliance with standards. The information from the field inspection and an analysis from an approved seed lab are reviewed by the WSCS to determine if a seed lot meets all standards. Seed lots meeting standards are issued certified seed tags, a symbol of quality recognized by knowledgeable seed purchasers.
- The Wyoming Seed Certification Service (WSCS) is an ongoing effort, with measurable short-term improvement difficult to identify. Changes in farm income and financial benefit to the state from seed production or certified seed acres are affected by many factors, not just this program. In the long term, a program that serves the seed industry is critical to the ability of the seed industry to provide certified seed to customers, and thus provide a value added product that pays the added value directly to the producer and provides production diversity.
- Two hundred producers participated in the CES sponsored Agriculture Profitability conference held in conjunction with Wyoming Stock Growers and Wool Growers

conference. Evaluations from the twenty sessions offered indicated participants increased their knowledge and over half indicated they planned to change management practices and incorporate the knowledge learned into daily practices.

- Program evaluations from the Agriculture Profitability conference indicated short term impacts were increased awareness of information on sustainability and profitability; long term results indicated that participants increased their knowledge, learned how to maintain and how to keep their cost down, learned new trends in agriculture, and to evaluate their marketing alternatives and choices.
- Reduced Agent and Area Treatments (ATV-RAATs) are increasingly adopted for grasshopper control by ranchers and farmers. This IPM strategy can reduce the cost of control and the amount of insecticide used by more than 60 percent. The human health and environment benefit from ATV-RAATs strategy for two reasons. First, the total acreage treated with ATV-RAATs programs is lower than in the conventional, aerial applications. Consequently, it lowers the negative contaminant impact on the environment. Second, during ATV-RAATs, lower doses of insecticides are used contributing to a further decrease of environmental pollution by pesticides. In 2005, a new insecticide belonging to the group of Insect Growth Regulators (IGRs), pyriproxyfen, has been tested using an ATV spray rig. The IGRs affect only immature insects and therefore they represent a better targeted way to control pest grasshoppers. Consequently, the non-target effects of grasshopper control program are reduced to a minimum.
    - Although the USDA subsidies for grasshopper control became recently available, the the expenses of a management program remain largely a producer's burden because of high insecticide and treatment costs. Therefore, an ATV-RAATs program becomes the preferred option for many land-users in the West. The use of RAATs reduces the costs of grasshopper control by approximately 50 to 60 percent, depending on the agent and swath width. If a standard insecticide application costs about $3.00 per acre, the equivalent RAATs program costs approximately $1.75 per acre *protected*.
    - Besides the economic advantages, RAATs strategy has tangible environmental benefits: using RAATs, 60 to 75 percent less insecticide is applied to the rangelands for grasshopper control. Less insecticide in the environment lowers the risk to non-target organisms including fish and wildlife, water quality, and humans. The untreated swaths provide refuges for non-target species, and even if those organisms move into the treated swaths they will be largely unaffected unless they feed on the foliage.
- Research results from studies on the profitability of individual production practices as well as crop and livestock systems ultimately influence the sustainability of the agriculture industry. Laboratory market research has contributed to the understanding of structural change issues in today's supply chain agriculture-market efficiency, buyer and seller earnings, and price bias compared to the competitive norm. This research also contributes to the development of methodologies (experimental economics) to investigate the impacts of structural change in agriculture. Annual losses attributed to Rhizoctonia Root and Crown Rot (RRCR) is estimated at two to three percent total sugar loss for 185,000 acres of sugar beet grown in the irrigated High Plains region (CO, MT, NE, and WY). This disease is reported to affect approximately 30 – 50 percent of Wyoming's acreage, depending on the district. A one percent decrease in sugar content is lost revenue of approximately $71 per acre (2003 values). Field results for 2005 indicated that under severe Rhizoctonia disease pressure, one application of trifloxystrobin (Gem®, Bayer) at the time of inoculum introduction was

essentially ineffective. A new product, JAU6476, significantly improved disease suppression (50 percent disease suppression) compared to the untreated check. Results from fungicide timings and efficacy are being utilized by regulatory agencies in developing label use.

- Drought continues to be a major concern in Wyoming. Individual producers and state and federal agencies at 20 sites continue to cooperate in the productivity study to relate early spring precipitation with forage production on rangelands. Additionally, producers have been identified who were taking actions to address their animal number-forage relationships early enough to avoid future impacts on the resource base and forage supply. In addition, availability of this knowledge of forage production/precipitation relationships has changed the reporting of drought information to concerned citizens of the state. As an example, the state climatologist's Web site presented a Wyoming state map in late April with above, average, and deficit precipitation for the month outlined and identified the prospective forage yields. Actions by land management agencies have been more realistically tied to predicted forage yields and hydrologic conditions in the last couple of years.
- Cercospora Leaf Spot (CLS) affects 80,000 to 100,000 acres of sugar beets in the High Plains. If left unchecked, CLS can easily reduce sugar content by 2 percent, costing growers approximately $142 per acre. Costs of control are estimated at approximately $20 to $40 per acre (2003 values). The cost of fungicide in the SE Wyoming District is approximately $250,000 to $490,000, with great variability among years due to disease pressure. Surveys done by the Extension Plant Pathology program in 2004 in cooperation with Western Sugar revealed that approximately 68 percent of the sugar beet fields have fungus isolates resistant to a commonly used fungicide. Educational programs on IPM approaches for Cercospora management and the proper use of fungicide have been developed and are being delivered to growers. Increasing the efficacy of a single fungicide spray on 80,000 acres will have a potential annual impact of $1 million regionally. A five-year study in which high-elevation meadows have been harvested and forages left in windrows showed that nutrient value of hay in windrows is not significantly different from that of baled hay. Cows grazing from November through February perform similarly to those fed baled hay. Other studies show that one of the best crops to stockpile for winter grazing is corn. Foxtail millets have also been effectively used for winter grazing, however, swathing and leaving in windrows greatly improves nutritional value of winter forage. Brassicas, including turnips and rape, can produce very high quality early winter forage and can be a very inexpensive source of nutrients if grown as a second crop following cereal grain or forage harvest. Several opportunities exist, depending on land and resources available, for winter grazing of forages that meet animal nutritional needs. With 800,000 cows in Wyoming, saving just a few cents per cow per day can result in significant cost saving for the beef industry.

c. **Source of Funding** – Hatch, Smith-Lever 3 b&c, State

d. **Scope of Impact** – State Specific
Multi-state Integrated Research & Extension (W-1177)
(CA, CO, IA, NE, ND, OR, SD, TX, UT, WA, WY)
Multi-state Extension (MT, ND, SD, WY)

Key Theme – Animal Health

a. The Department of Veterinary Sciences researchers investigated a variety of animal health-

related problems. Brucella abortus infection in cattle and wild ungulates is of major concern for the State of Wyoming. During 2005, the disease had a major impact on animal health, the economic viability of domestic livestock production, and wildlife management. The Governor's Brucellosis Coordination Team was formed to address the issue of controlling and eliminating brucellosis from domestic animals and wildlife. A list of recommendations has been completed and sent to the Governor. Currently, there are no simple solutions to the problems of interspecies transmission of infectious agents such as B. abortus between wildlife and domestic animals. In cattle, vaccination of calves with strain RB51 has been the accepted practice for the industry in preventing and eradicating brucellosis from the cattle. As the experience with brucellosis in Wyoming during 2003 - 2004 would indicate, vaccination of calves is no assurance of protection from infection. Booster vaccination of adult cattle using the currently available vaccine strain RB51 has been proposed as a means to enhance protection from infection. At least two states are currently practicing adult vaccination of high risk nonpregnant cattle. There is little, however, in the way of substantive studies to show that adult vaccination is efficacious and safe for pregnant cattle. To address this gap in the current knowledge of B. abortus vaccinology, the Veterinary Sciences Department in collaboration with Dr. Steve Olsen (National Animal Disease Center) has submitted a CSREES research proposal to study in vitro parameters of the immune response and safety of RB51 vaccination in adult pregnant cattle that had received an initial vaccination as calves. In February 2004, a lichen called Xanthoparmelia Chlorochroa was implicated as the probable cause of close to 300 mysterious elk deaths southwest of Rawlins. Researchers in the College of Agriculture are undertaking studies to determine how it caused the largest recorded die-off of free-ranging elk in Wyoming. Chronic Wasting Disease (CWD) of deer and elk continues to spread in Wyoming and has been diagnosed in other states. Study of CWD is important because it may have detrimental effects on deer populations, it may change hunters' attitudes about and participation in hunting, it alters management of free-ranging deer and elk, it affects commercial production of farmed cervids, and there are questions and concerns about the possible susceptibility of humans, livestock, and other animals. In collaborative studies with the Colorado Division of Wildlife and the Wyoming Game and Fish Department researchers have found that horizontal transmission readily occurs among mule deer and transmission from doe to fawn does not appear to be very important in the epidemiology of this disease. Cattle do not appear to be highly susceptible to CWD by oral exposure after more than six years of study.

b. **Impact** - The impacts of these animal health investigations are both immediate and long-term. The immediate impacts have been to reduce the morbidity and mortality of ongoing disease problems by providing 24 hour access for veterinarians and producers to information on disease diagnostics, animal disease, and other animal health issues through the Web site "Wyovet."

- Documenting the modes of transmission of CWD is important in developing strategies for control of this disease. We know now that trying to block doe to fawn transmission will not control CWD. Lack of evidence of transmission of CWD to cattle or sheep so far is reassuring that CWD will not readily infect domestic livestock.
- During 2005, brucellosis has had major economic impacts on the state through livestock and wildlife losses and diagnostic and treatment costs. Recommendations made by the Governor's Brucellosis Coordination Team could lead to the eventual elimination of this

disease in the state. Adult vaccination of cattle for Brucella abortus may enhance protection in high risk cattle herds.

- UW researchers cloned a complete genomic DNA library from wild type B. abortus into a bacteriophage expression system. Recombinant plaques expressing bacterial proteins have been probed with immune serum from previously infected hosts (cattle and elk) which has been serially adsorbed with B. abortus grown in vitro to remove antibodies to constitutively expressed bacterial proteins. The role of selected genes and their products in Brucella virulence have been assessed, employing traditional methods of gene/protein analyses. The potential of selected Brucella proteins for use as new/novel vaccine candidates are being evaluated in a laboratory animal model (mice).

c. **Source of Funding** – Hatch, Animal Health, State

d. **Scope of Impact** – State Specific, but results have broad implications
Integrated Research and Extension

Key Theme – Animal Production Efficiency

a. Research projects impacting animal production are focused on ruminant nutrition and reproduction. Areas of emphasis in ruminant nutrition include optimal use of dietary protein and lipids to improve performance and quality of cattle and sheep. Research on forage-fed cows supplemented with vegetable oils has shown increased levels of vegetable oil fatty acids in the fat tissue of cows and calves. For example, conjugated linoleic and trans-vaccenic acids are greater in milk and fat tissue of cows, and fat tissue of the calves, when the cows are fed vegetable oils. Enhancing knowledge regarding the differential effects specific fatty acids exert on adipose tissue fatty acid metabolism may afford beef cattle producers the unique opportunity to use natural feedstuffs as nutrient partitioning agents.

In the High Plains and Intermountain West of the United States, much of the area is referred to as rangelands, which experience significant fluctuations in both the quality and quantity of forages throughout the year. Gestating ewes on rangeland with no supplementation often experience prolonged bouts of nutrition restriction of less than 50 percent of National Research Council requirements. In a recent three year study evaluating nutrient profiles of pastures in Montana, it was reported that the digestibility of forages declined markedly from May to October. To make matters worse, due to low protein content and high fiber content of poor forages, consumption may also decline. Thus, as the ewe is a fall breeding species, this poor nutritional environment often corresponds to the early gestational period. The fetal origins of adult diseases hypothesis proposes that alterations in fetal nutrition during critical periods of gestation can permanently alter fetal growth and development leading to persistent pathologic problems in postnatal life. Recently, however, reports on rodents have suggested that under different management conditions, within or between breed (or strain) differences exist in the susceptibility of their conceptuses to a variety of maternal stressors. We hypothesized that ewes born to mothers managed under markedly different nutritional and environmental conditions might differ in their ability to protect their fetuses from a bout of maternal under nutrition.

This study investigated if the management system under which a ewe was selected alters the

impacts of early to mid-gestational under nutrition on fetal growth and offspring equality. Ewes subjected to a nomadic existence and limited nutrition throughout the year from Baggs, WY (Baggs ewes) maintained normal fetal weights and circulating glucose and essential amino acid concentrations when subjected to nutrient restriction (50 percent NRC requirements; NR) from day 28 to 78 of gestation. In contrast, ewes of similar breeding, size, body weight, and age from the University of Wyoming flock (UW ewes), selected to a sedentary lifestyle and above adequate nutrition, exhibited a 30 percent decrease in fetal weight, under the same NR. The growth restricted fetuses of UW ewes exhibited reduced circulating glucose and essential amino acid concentrations, bilateral cardiac ventricular hypertrophy, reduced kidney nephron numbers, and fewer secondary myofibers and smaller fasciculi in skeletal muscle than fetuses from control fed (100 percent NRC requirements; CF) UW ewes. The ability of NR Baggs ewes to maintain normal fetal weights was associated with an early conversion from Type A placentomes to larger and more vascular Types B, C, or D placentomes by day 78 of gestation. In contrast, the uteri of both NR and CF UW ewes contained virtually all Type A placentomes. When NR UW and Baggs ewes were re-alimented from day 79 to term, size, viability and birth weights were similar for lambs born to both NR and CF ewes. At two months of age, male lambs born to NR UW ewes exhibited hyperglycemia and hyperinsulinemia to a glucose tolerance test (GTT; i.v. infusion of 250 mg/kg glucose). By eight months of age, while these same lambs again exhibited hyperglycemia to a GTT, insulin release was markedly depressed, suggesting pancreatic failure. Further, male lambs from NR UW ewes ate more, grew faster, were fatter, and had markedly higher blood pressures at nine months of age than male lambs from CF UW ewes. At slaughter on day 280, UW NR lambs exhibited a greater body weight, hot carcass weight, and kidney-pelvic fat than CF UW ewes, while exhibiting a reduced skeletal muscle mass. We observed no differences in postpartum growth rate, carcass quality, insulin sensitivity, or pancreatic function between lambs from NR and CF Baggs ewes. The abnormalities exhibited by the lambs born to NR UW ewes are consistent with a predisposition to health problems later in life such as obesity, type II diabetes, hypertension, and cardiovascular disease. We hypothesize that the ability of Baggs ewes to convert their placentomes to more efficient types during early-mid gestational NR alleviated the impacts of under nutrition on fetal growth and offspring quality.

b. **Impact -** These data suggest that the production system under which a female is selected may impact her future ability to produce healthy offspring under different nutritional and/or environmental conditions. This suggests that livestock producers should carefully evaluate the production system under which potential replacement females are selected before adding them to their flock or herd. These data suggest that sheep can be selected in a relatively short time (~ 30 years) to perform optimally under a particular production system, but this should not be extrapolated to other systems which employ markedly different environments and/or nutritional inputs.

- Livestock producers dependent on rangeland forage resources must develop strategies to maximize the use of the forage resources, minimize supplemental feed inputs as provision of supplemental feeds represents at least 60 to 70 percent of beef cattle production costs, and maintain acceptable levels of livestock production while ensuring ecosystem sustainability. The viability of livestock operations in the northern mixed-grass prairie region often depends on their ability to find economical alternatives to reduce supplemental feed needs. This

research has demonstrated that interseeding yellow-flowering alfalfa (Medicago sativa ssp. falcata) into native rangelands increased forage production and quality, increased beef cattle carrying capacity, and mitigated elevated atmospheric levels of carbon dioxide by increasing soil carbon storage. Therefore, interseeding yellow-flowering alfalfa may be an integrated range resource management strategy to reduce greenhouse gas emission and enhance productivity and quality of forage available for grazing livestock.

- It has been estimated that 336 million hectares of grazing lands in the U.S. are used for livestock and wild herbivore grazing. Native rangelands account for about 48 percent of that grazing land area. It has been estimated that 67 percent of the native rangelands in the U.S. could benefit from improved management or renovation. Assuming that yellow-flowering alfalfa was interseeded on one-half of the rangelands in the U.S., the practice has the potential to impact 54 million hectares of native rangelands.
- Dairy producers in western Wyoming who participated in monthly on-site visits from CES educators and specialists from Utah State University have implemented practices which have resulted in reducing the average number of days in milk per cow to a more profitable number. Dairymen involved in monthly on-farm visits have utilized or plan to utilize the dairy bulk tank monitoring system to get feedback when they make management changes.

c. **Source of Funding** – Hatch, Smith-Lever, State, County, Private

d. **Scope of Impact** – State Specific
Multi-state (AK, AZ, CA-D, CO, HI, ID, KS, ME, MI, MO, MT, NE, NV, NM, OH, WA, WY)
Integrated Research and Extension
Multi-state Extension (UT, WY)

Key Theme – Plant Germplasm

a. No renovation or restoration effort can be successful without addressing the threat of exotic invaders. In addition to examples such as the invasion of cheatgrass that has altered fire regimes and destroyed many native shrub lands, exotic weeds are a costly deterrent to many agricultural land uses. Because shrubs are a successfully competitive growth form (they often increase with herbivory) and are genetically variable in North America (many rapidly evolving shrub species occur in western U.S.) they offer a unique perspective in the study of invasion ecology. It is likely that western North American shrub species have unique characteristics that may make them especially competitive with weedy exotics. Yet field studies of the inherent variability in shrub populations have been primarily descriptive in the past. Additionally, research has seldom addressed the application of the flexibility of shrub gene pools to current management problems. This research can be valuable to managers and will inform theoretic ecology by providing a clearer view of evolution in action.

Several complementary projects have been initiated to examine the inherent variability of native populations inside and outside of weed invasions within the intermountain West and on other continents. Weed invasions considered in these projects include Russian knapweed, Rush skeletonweed, cheatgrass, and Canada thistle. Genotypes of native grasses in the intermountain west have been collected for analysis of competitive ability and genotypic patterns. Rush skeletonweed biotypes were collected in North America, Argentina, France,

Germany, and Kazakhstan to assess genetic origins of American populations. We have assessed the competitive ability of native grasses combined with biological control of Canada thistle via a stem mining weevil. Greenhouse studies were conducted of native forb and shrub species in formerly invaded soils to identify potential genotypes for revegetation efforts.

b. **Impact** - By identifying competitive native species, control of exotics will be more effective in preventing weed reinvasion following weed removal treatment. In this way the impacts of herbicides to non-target populations, the economic stressors and the continued spread of exotic species in Wyoming and the west can be addressed in a more sustainable manner. Long-term controls of weed reentry will facilitate sustainability of agricultural and wild land management efforts in the US and globally.

c. **Source of funding** – Hatch, State

d. **Scope of Impact** – State Specific
Integrated Research and Extension
Multi-state (AZ, CA-B CA-D, CO, HI, ID, MT, NM, OR, UT, WY)

Key Theme – Plant Production Efficiency

a. Researchers at the UW Agricultural Experiment Station conduct studies on all major crops, forages, and rangelands. Major research efforts in the plant efficiency area are: 1) biology and control of weeds, 2) plant disease recognition and control, 3) crop production practices, and 4) crop/legume production systems. Specific projects range from basic research to elucidate mechanisms of plants to long-term applied research on cropping systems. For example, the rapid adoption of Roundup Ready crops by farmers has made it important to have the capability to predict long term impacts this practice has on composition, density, and genetics of weed communities. Plots were established under irrigation at Torrington, WY in 1998 to determine if glyphosate use pattern in glyphosate tolerant crops influences weed control by placing selection pressure on weed species, alters weed population dynamics or leads to the development of glyphosate resistant weeds. A substantial amount of research has shown crop yields are increased when grown in rows less than 76 cm. In addition to improved yields, several researchers have reported the crop is more competitive with weeds. Row spacing trials have been conducted under both dryland and irrigated conditions at Torrington the last three years. Corn, dry beans, sunflowers, and sugar beets were grown in 38, 56, and 76 cm rows. Light interception readings were taken throughout the season and end of season weed biomass and crop yields were determined.

b. **Impact** – After eight years there has been no evidence that any species has developed resistance to glyphosate. However, common lambsquarters and wild buckwheat have increased in treatments receiving only the low rate of glyphosate. Rotating glyphosate with conventional herbicides was no more effective in slowing this population increase than the use of the high glyphosate rate. Growing crops in narrow rows (less than 76 cm) reduced weed biomass and light interception by the crop was increased especially early in the season. Sugar beet and sunflower yields were increased dramatically when grown in narrow rows, while row spacing had no consistent impact on corn or drybean yields.

c. **Source of Funding** – Hatch, State

d. **Scope of Impact** – State Specific
Integrated Research and Extension
Multi-state Integrated Research and Extension (NC-226)
(IL, IN, KY, MD, MI, MN, MO, NE, NY, OH, OK, SD, VA, VT, WI, WY)

Key Theme - Invasive Species

a. Weeds are a common problem for landowners both large and small throughout Wyoming and much of the West. While many people consider weeds to be an agricultural problem, the reality is that weeds also have serious impacts on rangelands, wildlands, roadsides, and suburban areas. The invasion of exotic species reduces habitat quality and forage availability for wildlife and livestock, strongly compete with native plants, inhibit recreational activities, increase wildfires, and use limited water resources. Extensive stands of Russian Knapweed were located in Wyoming, Idaho, and Colorado where native grasses remained after many years. Research is being conducted to assess the long-term potential of the few remnant plants to rebound following invasion of Russian knapweed. While certain weeds such as Canada thistle and field bindweed are well known throughout Wyoming and much of the Western United States, land managers often need training for proper identification of uncommon or new invaders. Training is crucial for early detection and rapid response to new invaders. Stopping new weeds before they become a problem is an effective strategy that may save millions of dollars in future weed control costs. With this strategy in mind, the UW CES Weed Specialist is working to train land managers on invasive plant identification not only in Wyoming, but throughout the Western U.S.

b. **Impact** - As Wyoming's exurban population continues to grow, noxious and invasive weeds will also continue to be problematic across landscapes fragmented by development. Noxious and invasive weed identification and control training with a strong emphasis on early detection and rapid response will save Wyoming millions of dollars in future weed control costs. The full impact of these training sessions will be increased awareness of weed issues and detection and prevention of new weed problems by many new small acreage land owners in Wyoming. In conjunction with this, the effects of last year's early detection and rapid response weed training are still going forward. The recently discovered (2004) viper's bugloss (Echium vulgare) and yellow starthistle (Centaurea solstitialis) infestations are currently under eradication and excellent progress is being made on these two new pests. In addition, awareness of them has greatly increased in Wyoming. Viper's bugloss was recently discovered just to the south of Wyoming in Colorado by a resident of Wyoming! The infestation was reported to the Colorado Department of Agriculture and mapping and eradication efforts will begin in the spring of 2006.

c. **Source of funding** – State, Hatch

d. **Scope of Impact** - State Specific

Key Theme - Plant Health

a. The total value of all Wyoming crops is estimated at $250 million. Plant diseases caused by viruses, bacteria, fungi, and nematodes cause significant losses in Wyoming's crop yield and

quality each year. Although actual plant disease losses for Wyoming are not available, annual U.S. losses to plant disease agents are estimated at $33 billion. In addition, indirect losses also are realized through avoidance (inability to grow high value crops due to potential disease risk), loss of certification status, and restricted markets due to quarantine issues. Economic losses attributed to plant diseases are significantly reduced by prevention, early detection diagnostics, and initiation of appropriate integrated pest management practices. These approaches to disease suppression compromise the main thrust of the research and extension efforts described below.

b. **Impact** - Annual losses attributed to Rhizoctonia root and crown rot (RRCR) are estimated at two to three percent total sugar loss for 185,000 acres of sugar beet grown in the irrigated High Plains region (CO, MT, NE, and WY). This disease is reported to affect approximately 30 to 50 percent of Wyoming's acreage, depending on district. A one percent decrease in sugar content is lost revenue of approximately $71/acre (2003 values). Field results for 2005 indicated that under severe Rhizoctonia disease pressure, one application of trifloxystrobin (Gem®, Bayer) at the time of inoculum introduction was less effective than a new product JAU6474, and Moncut which significantly improved disease suppression compared to the untreated check.

c. **Source of Funding** - Smith Lever, Hatch, State

d. **Scope of Impact** - State Specific
Integrated Research and Extension

Key Theme - Home Lawn and Gardening - General Horticulture

a. During FY 2005, over 22,342 contacts were made regarding horticulture. Forty-four educational programs were presented through Cooperative Extension reaching 1,048 individuals in group settings. In addition, over half the counties in the state trained volunteer Master Gardeners through a state curriculum involving 64 hours of class time which enabled educators to extend outreach to urban residents with horticulture questions and problems.

Cooperative Extension Horticulture Issue Team provides leadership for "From the Ground Up," a 70 second TV spot aired twice weekly, 36 weeks a year on a station with potential to reach 9000 households. The media spots provide information on horticulture topics ranging from IPM practices to strategies to increase 'home grown' food production.

The Master Gardener program is growing in the state of Wyoming. It is now available in more than 50 percent of the state's counties. One of the core subjects within the Master Gardener curriculum is Entomology. Gardeners encounter insect pest problems on a daily basis. The first step to address such problems is the accurate and reliable identification of pests. In Wyoming, there are over 12,000 estimated insect species, and many of them can become garden pests. In order not to be "drowned" in this "sea of bugs," Master Gardeners need to receive efficient training in the basics of Entomology, and in particular, insect identification. It was delivered to seven different Wyoming counties and to a group of Extension Educators in the framework of the Train-the-Trainer approach to Master Gardener education. In total, 92 Master Gardeners and Educators received this training. The program

has a variable duration of three to 12 hours. It includes presentations on the insect orders of horticultural importance and hands-on training on the use of insect identification keys. In addition, the students learn the basics of insect biology and ecology. This knowledge is instrumental in developing efficient, economical, and environmentally friendly methods of dealing with yard and garden pests.

b. **Impact** - Clients reported increased awareness and knowledge of horticultural skills as a result of educational efforts. Additionally, homeowners demonstrated better management of their properties. Media efforts including "From the Ground Up" increase awareness of CES as a resource for horticulture information and through follow-up calls increases decision making, horticulture skills, and knowledge.

- Twelve counties conducted Master Gardener training consisting of eight-10 sessions graduating nearly 150 new Master Gardeners. At a minimum, new Master Gardener graduates contribute 30 hours of volunteer time. In addition to new graduates of the program, Wyoming has over 200 active veteran Master Gardeners. New Master Gardener contributions, in addition to experienced Master Gardener volunteer time (7,814 hours), extend Extension's efforts with a value of over $117,210. Ninety-eight percent of Master Gardener participants showed an increase in knowledge from pre-test to post-test in the areas of water management, lawn care, and insect control.
- Feedback from participants indicated that the information presented was valuable and would help the attendees to address pest issues more effectively. In the short term, this education program allows the Master Gardeners to make informed decisions regarding insect pest problems. In the mid-term, the Master Gardeners will make the most efficient use of their limited resources for pest identification and control. The long-term impact is that more educated, knowledgeable Master Gardeners are of great value to Wyoming. The instructive aspect of this program is extremely valuable because gardening involves Wyoming citizens of all ages, professions, and educational levels. The demand for this class will increase and all of the participants found it valuable and stated they would recommend it to their colleagues. The UW Extension Entomologists make an impact on the counties and state by educating gardeners and homeowners to better deal with insect pest threats.
- The Wyoming nursery stock survey was conducted in July and August, as per USDA inspection priority guidelines. Sample collection exceeded that required to increase the probability of detecting latent infections.
- A total of 67 field samples were tested during the survey and additional check samples were processed. All samples were negative for the pathogen, and plant destruction/quarantine proved unnecessary. Counties surveyed were Campbell, Converse, Crook, Fremont, Johnson, Laramie, Lincoln, Natrona, Platte, Sublette, Sweetwater, Teton, Uinta, and Weston.

c. **Source of Funding** - Smith-Lever, State, County

d. **Scope of Impact** - State Specific

Goal 1 Summary:

The College of Agriculture conducts research and provides educational programs on agricultural systems and profitability throughout the state. A few of the college's on-going programs in the Goal 1 area are:

- Economics of farm/ranch systems with respect to profitability and risk
- Reproductive performance in domestic ruminants
- Improved legume species
- New and emerging animal diseases
- Extended cropping systems with emphasis on incorporating forages

In this program area, researchers have been active in 21 ongoing Hatch projects, and seven out of the 21 are multi-state projects. Ten of the 21 Hatch projects are integrated research and extension efforts. The approximate effort related to this program for the AES is 13.3 FTEs with expenditures of $.98 million Hatch and $4.5 million State.

Cooperative Extension Service FTEs 24.86
Goal 1 Allocated Funds $2,162,538

Goal 1: IMPACTS

Natrona County Master Gardeners Make a Difference
Situation:
Natrona County had endured approximately six years of drought heading into the 2005 growing season. The annual spring warm-up came three to six weeks premature, and then a typical spring storm and freeze further stressed the already weakened plants. Frantic homeowners began calling or visiting the Natrona County Cooperative Extension Service office for assistance to save precious trees and shrubs that increase property values and the aesthetics of the community.

An annual Master Gardener course designed by the University of Wyoming was taught by UW CES specialists, veteran Master Gardeners, and the local horticulture program associate. The curriculum includes a 13-session course totaling 64 hours of class time plus seven hours of additional sessions during an annual spring conference. Twenty volunteers assisted in various aspects of implementing these classes. Twenty-two Master Gardener trainees were recruited and educated. To handle the volume of horticulture calls, newly trained Master Gardener interns were oriented to the office in early April and began offering assistance and solutions to a wide array of garden problems.

Sixty-two Master Gardeners, including interns, donated 4,460 hours to disseminate research-based information to Natrona County residents. Natrona County Master Gardeners documented assistance with 1,665 clients who had questions, and volunteers with the program visited 213 yards to solve horticultural problems.

Impacts:
Many of the class participants are new to Wyoming and the local growing conditions. A variety of factors make growing plants or gardening in general difficult for the uninitiated gardener. The first night of classes one of the new trainees wrote: “I’m excited to become a Master Gardener. I can’t wait to learn more and more of what grows and does not grow in our area.” Another wrote: “I am excited to be involved in this program.”

During the final session of the formal training, participants go as a group to see problem situations first-hand. Master Gardeners continue the learning process by working in the

demonstration gardens around the Agricultural Resource and Learning Center, which houses the Natrona County CES office, helping develop new garden areas or improving existing garden areas. Following this session and as a part of the follow-up to the training process, a trainee wrote: "I enjoyed learning, and I'm looking forward to learning more by helping in the gardens, etc." The yard calls give the opportunity for the interns to use their newfound knowledge to help others. One said the best part of the instruction is "going out and looking at real situations to apply our knowledge." Participants may take the classes for their own gardening benefit but, once they get involved, they see the benefit of being an active Master Gardener. Another comment was: "My original intent in taking the course was solely for my personal knowledge, but I have decided to join the Master Gardener organization." Another said, "I highly recommend this program to those interested in Wyoming landscaping." And another commented boldly, "A great investment for me – I'm so glad I did it!!"

A leadership component was added to the training this year with help from the area community development educator. The initial comments relating to this indicated participants also learned communication skills. The development of leaders within the Master Gardener volunteer program has the potential to affect leadership roles in members' personal, professional, and volunteer activities.

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Getting the Message of Invasive Weeds Out to New Audiences in Wyoming

Situation:
Former University of Wyoming weed specialists Tom Whitson and Harold Alley spent many years educating ranchers about rangeland weed issues. There are few ranchers around the state who haven't heard a talk on Canada thistle, whitetop, or Russian knapweed by one of these outstanding retired extension specialists. While the impact of the talks by Whitson and Alley remains strong within the historic ranching communities, there is a rapidly growing number of newcomers moving into the state. Many are moving onto small-acreage tracts on subdivided ranches and are new to land-management issues pertinent to Wyoming. Noxious and invasive weeds are clearly one of the big issues that affect many newcomers, and there is a serious need to provide sound educational information and training to new landowners.

The UW Cooperative Extension Service weed specialist has partnered with several different groups to provide educational opportunities for new-to-the-land folks and others. In conjunction with the Wyoming Department of Agriculture, U.S. Department of Agriculture Animal and Plant Health Inspection Service, Wyoming Cooperative Agricultural Pest Survey program, and several county weed and pest control districts, three workshops were held in Jackson, Evanston, and Arvada. These outdoor classes were "hands-on" for more than 130 people. Live specimens of

dozens of noxious and invasive weeds were collected for identification. Additional training was provided about early detection, mapping, and control options available.

A second series of workshops was hosted by UW CES in Sheridan and Campbell counties. These also targeted new landowners about a number of land-management issues including noxious weeds. Weed identification and management were prominent topics. Purple loosestrife was highlighted as a key species to watch for in both counties. Purple loosestrife is an introduced European ornamental species that often escapes to aquatic sites, where dense infestations can impede water flow and reduce wildlife habitat. Another workshop hosted by the Cody Conservation District entitled "Living on a Few Acres" was held in Cody with more than 150 participants. This workshop highlighted invasive plant issues for the Cody area.

Impacts:
As Wyoming's exurban population continues to grow, noxious and invasive weeds continue to be problematic across landscapes fragmented by development. Noxious and invasive weed identification and control training with a strong emphasis on early detection and rapid response will save Wyoming millions of dollars in future weed-control costs. The full impact of these training sessions will be increased awareness of weed issues and detection and prevention of new weed problems by the many new small-acreage landowners in Wyoming. The effects of last year's early detection and rapid response weed training are still going forward. The recently discovered (2004) viper's bugloss (*Echium vulgare*) and yellow starthistle (*Centaurea solstitialis*) infestations are under eradication, and excellent progress is being made on these new pests. Viper's bugloss was discovered just to the south of Wyoming in Colorado by a resident of Wyoming! The infestation was reported to the Colorado Department of Agriculture, and mapping and eradication efforts will begin in the spring of 2006.

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Goal 2: Enhance a safe and secure food and fiber system

Overview
Researchers at the University of Wyoming (UW) seek to improve the quality of life through research and education that fosters a safe and secure food supply, promotes enjoyment of food that is nutritious and affordable, and supports Wyoming residents' health.

Given the public's varied avenues for access to food, reducing the risk of food-borne illness necessitates comprehensive educational intervention from the producer to the consumer – truly a 'farm to table to plate' approach. At all levels, the food safety activities implemented through

UW build on principles of HACCP, (Hazard Analysis and Critical Control Points), the prevention-based food safety system that identifies and monitors food-borne hazards. Research and extension professionals at UW are also involved in projects focusing on issues of safe and secure food systems.

A critical need was identified to address agro-bio terrorist threats and protect the food supply in Wyoming. A collaborative effort of the CES Profitable and Sustainable Agriculture and Nutrition and Food Safety initiative teams with representatives of the Wyoming Departments of Agriculture, Health, Homeland Security and State Livestock Board, State Veterinarian, and Wyoming Stock Growers and Wool Growers Associations planned and implemented the second annual statewide conference to address the issue. Twenty different topics were presented including food security, bio-security, plant bio-terrorism, domestic preparedness, and homeland security.

About 250 million tons of meat annually is consumed in the USA. On average, each person in the U.S. consumes about 85 kg of meat per year. Thus, the eating quality of meat affects the quality of life of most Americans. Research has focused on the improvement of the eating quality of meat and its production. It was found that the biological changes in the early stage postmortem muscle dramatically affected the quality of meat. Meat quality can be significantly improved by controlling postmortem changes. However, up to now, few studies were conducted to elucidate these changes. Research at UW is aimed at understanding mechanism controlling postmortem changes, which will allow development of strategies to effectively control these changes and, thus, improve the eating quality of meat.

Key Theme - Food Resource Management

a. The *Cent$ible Nutrition Program* (*CNP)*, CES's food and nutrition program for limited resource audiences that combines EFNEP and the Food Stamp Nutrition Education Program [FSNEP] helps families eat better for less. In FY 2005, CNP educators in all 23 counties and one reservation office enrolled 1,717 participants in a lesson series, and 15,548 persons participated in one-time lessons. Cent$ible Nutrition 1/2 hour television programs were aired twice a week for 48 weeks with a potential to reach 240,000 low-income contacts. Educators helped clients learn to plan meals, compare prices, use grocery lists, and provide food for the entire month.

b. **Impact** – Food resource management practices measured include planning meals, comparing prices, using grocery lists, providing food for the entire month, and monthly food costs.

- Eighty three percent of graduates showed improvement in one or more food resource practices.
- Families saved an average of $43.50 per month on food purchases for an average savings of $522 per year. This represents $896,274 saved by the 1,717 Wyoming graduates who completed the exit survey.
- Sixty one percent of the 6,794 youth participants in Grazin' with Marty Moose and WIN Kids curriculum increased their ability to select low-cost, nutritious foods.

c. **Source of Funding** - Smith-Lever 3-D (EFNEP), USDA Food & Nutrition Service with local and state matching (FSNEP)

d. **Scope of Impact**: State Specific

Key Theme – Food Safety

a. Microbial contamination of food is a serious health problem. Each year in the U.S., foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths. With approximately 60 percent of food borne illness outbreaks nationwide attributable to food-service establishments, food-service personnel are key to reducing the risk of foodborne illness. The Wyoming Food Safety Coalition (WFSC) is a multi-institutional, multi-disciplinary partnership that has become the primary source of food-safety education throughout the state. The heart of WFSC is a core of locally trained teams, most of which include a county-based UW CES FCS educator and a health inspector from the Wyoming Department of Agriculture or a local city/county health department or both.

   USDA grants helped establish WFSC and workshop registration fees now fund WFSC, along with supplemental grants (for example, from the Food and Drug Administration). Coalition team members trained 1,312 food handlers in the following workshops: Basic-177; Intermediate-579; Advanced-66; and ServSafe-490. In-house trainings reached 1,093 individuals. Consumer programs and displays reached 480 and 865 individuals, respectively.

   The CNP had 1,717 participants enrolled in the program and reached 15,554 clients through one-time presentations. CNP educators helped clients learn how to thaw and store foods properly, prevent cross contamination, and to wash hands frequently and thoroughly.

   The recognition of Escherichia coli 0157:H7 as a distinct serotype of pathogenic E. coli occurred in 1983 following two outbreaks of a distinctive gastrointestinal illness characterized by severe abdominal pain, watery diarrhea, bloody diarrhea, and little or no fever. This illness, designated hemorrhagic colitis, was associated with the consumption of undercooked hamburgers at a fast food restaurant chain. These initial observations led to the recognition of a novel and increasingly important enteric pathogen causing intestinal and renal disease. Since 1983, a great deal of research has been accomplished, and has led to many different methods for rapid detection and control of E. coli 3157:H7 in the beef processing environment. The collective sum of these interventions has been a downward trend in the number of contaminated food samples and foodborne outbreaks due to E. coli 0157:H7 during the past four years. The decrease in the production of contaminated meat may be due in part, to the fact that the United States Department of Agriculture (USDA) and Food Safety Inspection Services (FSIS) announced a series of new measures designed to reduce the incidence of E. coli 0157:H7 contamination of raw ground beef.

b. **Impact** – Thanks to the WFSC, including leadership from UW CES, hundreds of food workers statewide are handling food more safely.
   Medium Term
   Based on data from a 2001 evaluation project conducted by UW CES for WFSC, this year's 1,135 participants in WFSC Going for the Gold (intermediate and advanced) and ServSafe workshops are estimated to have made the following changes:
   - 1,101 (97 percent) made at least one change related to cleanliness, for example, washed their hands more often.

- 908 (80 percent) made at least one change related to cooling food, for example, put food into shallow containers or cut meat into smaller pieces before putting it in the refrigerator.
- 885 (78 percent) made at least one change related to food preparation, for example, prevented cross-contamination by keeping raw meats, cooked foods, and fresh produce separate.
- 851 (75 percent) made at least one change related to other miscellaneous areas, for example, monitored critical control points more closely.
- 795 (70 percent) made at least one change related to cooking food, for example, used a stove or microwave – not a steam table – to reheat food.

Long Term

- Improved food handling behaviors, such as those estimated to have been made by workshop participants, increase the likelihood that food served in Wyoming is safe, and therefore, decreases the risk of foodborne illness.

Cent$ible Nutrition Program

- Fifty-nine percent showed improvement in one or more food safety practices surveys.
- Seventy percent of youth involved in the school enrichment program improved practices in food preparation and safety.

Agro-Bio Terrorism

- Participants gained awareness, knowledge and training on recognizing potential threats. In an evaluation conducted at the close of the conference respondents stated:
  "I will pay more attention to my surroundings and what is going on."
  "I did the facilities security self test and we are adjusting our operation for greater security."
  "We will increase our surveillance and add more security to our facilities."

In a nine month follow-up survey participants reported changes in practices as a result of the conference which included: implementing increased security for stored pesticides and developing a plan for response to any focus of terrorism.

- In addition to the requirements mandated by FSIS, it seems that another logical area to control the spread of E. coli 0157:H7 would be in the live animal, prior to slaughter. The objective of this work is the development of a rapid method to detect E. coli 0157:H7 in cattle. The detection system consists of two components, including a reporter bacteriophage genetically modified to carry a ∃964;-galactosidase gene, and a luminescent substrate for the ∃964;-galactosidase. Both the bacteriophage and the substrate will be included in a single A snap-valve device. When the sample to be tested is added to the device, the reporter bacteriophage will infect any viable E. coli 0157:H7 present within the sample, and force the bacteria to make large amounts of ∃964;-galactosidase. Following the infection process (approximately one hour), the cap of the test device (containing the substrate) will be snapped, releasing the substrate into the main compartment of the device, where it will interact with the ∃964;-galactosidase. The entire device will then be place into a hand-held luminometer, which will record the photons generated from the interaction of the substrate with the ∃964;-galactosidase.

Alternatively, if a colorimetric substrate is used, there will be no need for the instrumentation, and the test will be read visually.

- The nature of this detection method is such that it will be effective at sensitively detecting E. coli 0157:H7, and also distinguish between viable and non-viable cells, since bacteriophages can only grow within living bacteria. Also, the assay will be rapid and easy to perform. This test method will allow identification of animals that are infected with E. coli 0157:H7 prior to slaughter, allowing for corrective measures to be taken, leading to the production of safer beef.
- In addition to the control of E. coli 0157:H7 at the slaughter/processing plant, it seems that another logical area to control the spread of E. coli 0157:H7 would be in the live animal, prior to slaughter. On the farm, effective E. coli 0157:H7 requires reducing the frequency and intensity of fecal shedding of this pathogen by cattle, in addition to targeting environmental sources of the organism. To that end, many research groups have focused on the control of E. coli 0057:H7 in cattle through the use of E. coli 0157 specific vaccines, and probiotic bacteria.
- Bacteriophage (phage) therapy represents another method that can be used to control shedding of E. coli 0157:H7 in cattle. Phage therapy is the application of phages (bacterial viruses) to bacterial infections in living animals with the goal of reducing the bacterial load. Phages can be delivered topically, orally, directly into body tissues, or systemically. The natural ability of phages to kill infected bacteria is exploited to reduce the amounts of bacteria present in the animal.
- The objective of this study is to use a model system to demonstrate the effectiveness of phage therapy to reduce or eliminate E. coli 0157:H7 in the bovine gastrointestinal tract.

c. **Source of Funding** – State, Hatch, Smith-Lever 3(d) EFNEP and USDA Food & Nutrition Service with local and state match (FSNEP), state agencies

d. **Scope of Impact** – State Specific

Goal 2 Summary:
The College of Agriculture provides educational programs across the state. Three of the ongoing programs are *Going for the Gold - Food Safety Training, Cent$ible Nutrition Food Safety Curriculum, and Agro-Bio Terrorism*. Research efforts focused on developing more effective means of protecting foods stored at low temperatures as well as improving nutritional value of beef and lamb, and improved dietetic techniques. Researchers in this area participated in one Hatch project. The research effort involves approximately 1.2 FTEs with an expenditure of .15 million state dollars.

Cooperative Extension FTEs	5.59
Goal 2 Allocated Funds	$486,266

Goal 3: Enhance a healthy, well-nourished population

Overview

Many Americans have eating and exercise habits that are not in keeping with recommendations for optimal health. A recent survey indicated that Wyoming residents tend to be too sedentary and eat too few fruits and vegetables.

To improve the health of Wyoming residents, research and extension programs focus on eating and exercise habits based on recommendations for optimal health. The College of Agriculture conducts research and provides educational programs to adults and youth throughout the state that enables them to make health-promoting choices. Wellness in Wyoming (WIN Wyoming) is one new approach to promote people feeling good about whom they are and motivating them to maintain healthy behaviors.

Key Theme - Human Health

a. The term "obesity epidemic" appears often in the media in relation to Americans' health, but a more progressive and precise term is an "epidemic of physical inactivity and poor nutrition." For example, over 20 percent of Wyoming adults report no leisure time physical activity, and 78 percent do not eat recommended levels of fruits and vegetables. Wellness IN the Rockies (WIN the Rockies), a USDA-funded health-improvement project, documented several factors as predictors of overweight and obesity among a cross-sectional sample of approximately 1,800 adults in Wyoming, Montana, and Idaho. These predictive factors included eating while doing another activity and ordering super-sized portions. Additionally, obesity and weight-related concerns are consistently ranked among the top issues in state and area needs assessments. A forward-thinking approach to weight and well-being focuses on development of healthy lifestyle behaviors and attitudes related to food, physical activity, and body image rather than trying to achieve a specific body size, shape, or weight.

   Steps to A New You is a 2-faceted healthy lifestyles program that combines a series of food/physical activity/body image classes (A New You) with a pedometer-based physical activity program (WIN Steps). A New You and WIN Steps were developed through the WIN the Rockies project with input from project coordinators, local educators (including Extension educators) in the six project communities, two Natrona County (WY) Family and Consumer Sciences (FCS) Extension educators who had been teaching A New You on a regular basis, and feedback from individuals who had participated in A New You or WIN Steps.

   - Project classes started in some locations in fall 2004; a second round of classes began in January 2005; a third round has started in fall 2005; and the remaining classes will start by the end of January 2006. All follow-up data will be collected by fall 2006. This implementation reflects the meshing of research (including control of key variables) with the realities of Extension outreach (providing the program through educators at a number of sites, scheduled at times that work best for the educators and community members).

   Type 2 diabetes is the most common metabolic disease in the world. In the United States alone, the associated health care cost exceeds $130 billion per year. Obesity is developing into a serious problem worldwide which is closely associated with type 2 diabetes. Fetal

nutrient deficiency in human pregnancy occurs due to a variety of situations, such as maternal malnutrition, reduced placental efficiency, adolescence pregnancy, closely spaced pregnancy, pregnancy with multiple fetuses and hyperemesis gravidarum, which has long-term consequences for offspring health, including high incidences of obesity and type 2 diabetes. Up to now, it remains unclear what causes this negative association. Since skeletal muscle is the main site for the utilization of glucose and fatty acids in the body and insulin resistance in skeletal muscle is the key step in the incidence of type 2 diabetes, we hypothesize that impaired fetal skeletal muscle growth due to nutrient deficiency plays an important role. Our goal is to understand how the development of fetal skeletal muscle affects the properties of skeletal muscle of adulthood, and to develop effective strategies to mitigate or avoid incidence of diabetes and obesity caused by impaired skeletal muscle development due to fetal nutrient deficiency. We have established a sheep model in which fetal nutrient deficiency was induced by applying maternal global nutrient restriction (NR) during early to middle gestation. This NR limits the amount of nutrients available for fetal growth. We showed that this NR affects fetal skeletal muscle development. Muscle fiber composition and muscle fiber diameter were altered and a reduction in mitochondrial density/function of skeletal muscle was observed in NR offspring. Further, insulin resistance was detected in NR offspring. Due to the essential role of skeletal muscle in insulin resistance and the importance of mitochondria in fatty acid oxidation, the reduction in mitochondrial density/function in skeletal muscle may explain the observed insulin resistance and obesity in NR offspring.

In an effort to boost the immune system, many nutritional products are being developed or promoted. The term that has been developed to describe these types of products is “neutraceuticals” where they have been demonstrated to have some biological benefit. One such product that appears to possess this capability is a compound known as beta-glucan, derived from yeast and mushrooms and some plants. Studies published over the past two decades, primarily in Japan, have demonstrated that glucans vary in their properties and that specific ones do indeed have this immune promoting potential. However, it is unknown if these benefits are uniform for all glucans or if they possess the same biological potency. Regardless, in our aging population, an immune booster has the potential to allaying disease development and could improve overall health. Cells were cultured and mice were fed with varying forms of glucans at differing doses to ascertain those that would promote health and to determine the biopotency.

Glucans were found to differ in their possible biological effectiveness with the soluble glucans being the most effective at immune enhancement. This knowledge can have effects that may vary. New products could be developed from the glucans, new farming systems to farm the yeasts and mushrooms could be developed, and diet and health can be promoted through either optimizing the nutrients in the diet or the consumption of developed supplements.
It is the intent of UW researchers to develop a butter/margarine that would be healthier than those currently on the market. It has been demonstrated that consumption of steric acid is neither atherogenic (contributing to heart disease or elevated blood cholesterol) nor does it compromise the immune system. Other dietary saturated fats have an effect by compromising one or both of these areas. When other margarine/butter substitutes have been developed,

they still utilize fats, e.g. palm kernel oils or coconut oils, that contain short-chain saturated fats that will still compromise health. Margarines are typically created by hydrogenating polyunsaturated fats to make them more hydrogenated. However, in this process, trans-fatty acids are developed. These trans fats are inducers and/or promoters of heart disease and cancer as well as reducing immune system function. By replacing the oils and fats typically used to make butter or margarine or healthier substitutes with one based on a Shea nut blended with oil from the rape seed, we will develop a fat substitute that has healthier saturated fats with a blend of these already shown to be healthy polyunsaturated and monounsaturated fats.

b. **Impact**: CES's *Dining with Diabetes* program was implemented in seven counties with over 500 participants. At the conclusion of each class, participants received copies of the recipes of the foods demonstrated and tasted. One of the most frequent impacts from the *Dining with Diabetes in Wyoming* program reported was participants making the recipes at home from the foods demonstrated during the class. A sample of comments from class participants included:

- The program helped me select the appropriate portion size for different foods by visualizing how they look on my plate.
- This program gave me easy to understand explanations of very complicated ideas.
- After attending the program, I discovered that eating correctly for diabetes isn't all that bad.
- I discovered that even though you have diabetes, you can still eat and enjoy food. The food was tasty.

One neutraceutical currently being developed is Shea nut, with its primary saturated fat being steric acid, will not have the deleterious effect on health. Further, consumption of diets high in the monounsaturated fats and containing the critical balance of the n-6 and n-3 polyunsaturated fats further promote optimal health and do not promote heart disease and reduced immunity. By blending Shea nut butter with Canola or Rape seed oil, it should become possible to develop a blended product (a substitute for margarine or butter) that is healthier than both and healthier than other substitutes that are now on the market such as Smart Balance and Smart Start. At this time a prototype has been developed with color, textural analysis and sensory evaluations completed as part of determining the blend ratios that will make the best Shea nut butter. Funds are now being solicited to support an animal feeding study to determine the relative health benefits of this new product versus butter, margarine, and the healthier products on the market, Smart Balance and Smart Start.

c. **Source of Funding** – State, Hatch

d. **Scope of Impact** – State Specific

Key Theme - Human Nutrition

a. The *Cent$ible Nutrition Program (CNP)* goal is to help limited resource families to improve nutritional well-being. Nutrition educators documented life changing behaviors with pre- and post-surveys, success stories and testimonials related to nutrition practices. Approximately 1,717 individuals enrolled in lessons and 15,548 individuals participated in one-time lessons as well as 6,794 youth in youth programs. Additionally, CNP is reaching underserved audiences state-wide through the use of public television. CNP 30-minute TV programs were aired two times per week for 48 weeks resulting in 240,000 low-income contacts.

Extension educators conducted 235 educational programs, classes, workshops, or health fair presentations reaching over 5,033 adults and 1,117 youth. Topics ranged from "Desktop Grazing," and "Preventing Diabetes" to "Basic Nutrition."

b. **Impact** - Cent$ible Nutrition – Nutrition practices measured include planning menus, reading labels, making healthy food choices, preparing foods without adding salt, and serving children breakfast. Overall there was an increase from 5 percent at entry to 34 percent at exit on nutrition practices of participants.

- Sixty-three percent of participants reported improvement in reading labels.
- Fifty-one percent reported improvement in selecting healthy foods.
- Fifty-eight percent reported improvement in planning meals.
- Fifty-four and fifty-one percent respectively reported serving more than one kind of fruit or vegetable each day.
- Results of 6,794 youth participants enrolled in Grazin' the Food Guide Pyramid with Marty Moose and WIN Kids curriculum:
  - Eight-four percent now eat a variety of foods
  - Seventy-five percent increased knowledge of human nutrition
  - Sixty-one percent increased their ability to choose low-cost, nutritious foods
  - Seventy percent improved practices in food preparation and food safety
- Participants in nutrition education programs conducted by CES educators reported making one or more changes consistent with the Dietary Guidelines. Short term outcomes showed 100 percent of participants indicated they had gained knowledge and a greater awareness of the subject matter.
  - Over 289 individuals participated in the Steps to a New You offered through CES. Based on three month follow-up data collected from 115 study volunteers (108 women and seven men) in six Wyoming sites and three Idaho sites:
  - Steps to a New You helps participants make many significant changes in their behaviors and attitudes related to food, physical activity, and body image. These changes are consistent with improved health and with helping participants achieve a healthy weight.

- The following were statistically significant changes among the 115 study volunteers:

  Food and eating

  Increased Intakes:

  - Green salad and carrots (P<.001)
  - Vegetables besides carrots, potatoes, or salad (P=.01)
  - Fruit (not counting fruit juice) (P =.002)
  - High-fiber cereal (P=.002)
  - Whole-grain bread (P=.01)

  Decreased Frequency:

  - Choosing super-sized portions (P<.001)

  Improved Eating-Related Behaviors:

  - More often: Quitting eating when starting to feel full (P<.001)
  - Less often: Eating while doing another activity (P=.017)
  - Less often: Eating with feelings of guilt (P<.001)

Physical activity:
Increased Frequency:
- Purposefully adding activity to daily routines (P<.001)
- Engaging in planned physical activity, that is, moderate- to high-intensity activities and/or strength training (P<.0001)

Decreased Frequency:
- Letting self-consciousness about body size or shape keep participants from participating in physical activity (P<.001)

Increased Enjoyment:
- Being physically active (P<.001)

c. **Source of Funding** -Hatch, state, Smith-Lever 3(d) (EFNEP), USDA Food & Nutrition Service with local and state matching (FSNEP).

d. **Scope of Impact** - State Specific
Multi-state extension (MT, ID, WY)
Integrated Research and Extension

Goal 3 Summary:
The College of Agriculture conducts research and provides educational programs to adults and youth throughout the state, enabling them to make health-promoting choices. Wellness in Wyoming (WIN Wyoming) is a continuing multi-state project to promote people feeling good about whom they are and motivating them to maintain healthy behaviors. University of Wyoming research in the area of human health has focused on intracellular bacteria pathogens and studies on human nutrition and health. Researchers in this area participate in a Hatch project and it is a multi-state project. The research effort in this area includes about .5 FTEs with expenditures of approximately $.03 million Hatch and $.1 million State.

Cooperative Extension Service FTEs 33.53
Goal 3 Allocated Funds $2,916,730

Goal 3 - IMPACTS

Cent$ible Nutrition Program Helps Families Eat Better for Less!

Situation:
The Cooperative Extension Service's Cent$ible Nutrition Program (CNP) receives funding to provide nutrition education to people living at or below the poverty level. Food resource management, food preparation skills, nutrition and lifestyle behaviors to improve health, feeding children, and food safety have been identified as the greatest needs for adult and youth low-income audiences in Wyoming. Wyoming has more than 10,750 households comprising 26,250 food stamp recipients. This comprises 55.3 percent of the eligible households in the state.

Seven nutrition and food safety area educators* and 26 CNP nutrition educators provide lessons

to preformed groups such as Head Start, WIC (Women, Infants, and Children), and POWER. They teach one-on-one in participants' homes or in small groups. In the past year:

- 1,717 adults participated in a series of lessons, averaging 8.3 lessons per person.
- 15,548 adults participated in one-time lessons with 79 percent reporting intended behavior change.
- 6,794 youths participated in a series of lessons in school classrooms, after-school programs, and camps.
- 7,384 youths participated in one-time educational programs.
- *Cent$ible Nutrition News* newsletters (10 issues) were distributed to English- and Spanish-speaking households resulting in 275,000 contacts with the target audience.
- 1,638 educational displays and media releases resulted in 698,936 contacts.
- 53 exhibits at health fairs resulted in 8,010 contacts with the target audience.
- Contacts with cooperating agencies produced 1,221 referrals.
- 4,788 people visited the CNP Web site resulting in 43,928 hits.
- CNP television episodes aired twice per week for 48 weeks on Wyoming Public Television resulting in 240,000 low-income contacts.

Impacts

Adult participants, totaling 1,717, made positive behavior changes in the following areas:

- Dietary quality and physical activity, food resource management, and food safety.
- 93.3 percent of graduates showed a positive change in any food group
- 89 percent of graduates showed improvement in one or more nutrition practices
- 83 percent of graduates showed improvement in one or more food resource management practices, and
- 59 percent of graduates showed improvement in one or more food safety practices.

Youths

Results of 6,794 youth participants in Grazin' with Marty Moose and WIN Kids curriculum:

- 84 percent now eat a variety of foods.
- 75 percent increased their knowledge of the essentials of nutrition.
- 61 percent increased their ability to select low-cost, nutritious foods.
- 70 percent improved practices in food preparation and safety.

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Steps to Healthier Lifestyles

Situation:

"Study Suggests Most in U.S. Will Be Fat" headlines an October 4, 2005, article in *The New York Times*. The article cites a new study that followed 4,000 people for three decades. The findings suggest that over the long-term nine of 10 men and seven of 10 women will become overweight. The media and the major food manufacturing companies are jumping on the "obesity" bandwagon with "new" or "healthier" products.

The public is left with the impression weight is the only measure of health. Wellness in (WIN) Wyoming, WIN the Rockies, and the research project "Steps to a New You" made significant finds suggesting that moving from a weight-centered mind-set to one that focuses on physical, mental, social, and spiritual well-being is a better indicator of long-term health.

"Steps to a New You" is providing a limited and intense outreach, but the demand for a condensed message to a larger audience was needed. The program "Steps to Healthier Lifestyles" was designed based on the "Steps" classes utilizing the most significant points of the classes. It was presented to 110 adults and a modified program was presented to 22 fifth-grade students.

Impacts:
In the words of one participant, "This session confirmed my previous attitude that wellness/health is one's own responsibility. To become healthier, we must take the steps necessary to achieve it." A second participant and former "Steps" participant stated in response to "*what single most important concept did you come away with*?" "It's common sense – you have to eat right and exercise to make a difference. Of course, these are easier said than done, but nevertheless, they have to be done, and it has to be a lifetime commitment. I know what I need to do; commitment has to be there to get the difference made and, thanks to this presentation, it was the shot in the arm I needed to get going again." Another participant said, "I learned you should slow down while eating and savor your food instead of eating fast like we all seem to do. Challenges I still face are eating smaller portions and only having one serving." This was confirmed by several other participants.

A slightly different approach was taken when presenting to a fifth-grade class. A basic underlying question was how relevant the program is for this age level. A pre-survey was taken with questions that were gender specific and divided between the girls and boys. Of nine males in the class, five responded, "*I would be much happier and my life would be better if I were more muscular*." Four responded, *"I worry about how toned and firm my muscles are and about how strong I am."* Three said, *"I am concerned about how much I weigh."* Of the nine girls, seven responded, *"I constantly worry about my body size, shape, and weight.*" Seven said, *"I completely exclude foods from one food group in order to manage my weight,"* and 10 said, *"I believe there are good foods and bad foods. "When I see a model in a magazine, I want to look like her,*" was supported by five girls.

Post-program, each student wrote a letter about what they learned. Common themes were surprise at learning about how models who are very thin maintained their stature and about the dangerous effects of yo-yo dieting.

Clearly, there is merit in providing this information for younger audiences. *Steps to Healthier*

Lifestyles has proven to impact lives not only at the adult level but also at a more crucial and impressionable level of fifth-graders as they move into adolescence.

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Goal 4: Enhance greater harmony between agriculture and the environment

Overview

Management of natural resources and associated environmental issues permeate nearly every aspect of life in the state. Public demand and expectations often conflict when determining appropriate management strategies for Wyoming's wide-open spaces, wildlife, and public lands. The need for science-based information and expertise in evaluating public policy and facilitating conflict resolution is ever increasing in Wyoming.

Wyoming's ecosystems, whether agro, range, or forest, have both plant and insect pests. The effective use and value of range, forest, and cropland resources depend on the appropriate management of noxious weeds, insect pests, and diseases. Research and extension education programs in integrated pest management, bio-control, and other environmentally friendly pest control techniques are important to the state's ecosystems.

A large share of the state's income is generated from extraction of mineral and fossil fuels. Coal, trona, and natural gas are examples of large extractive industries in the state. Research and education programs on improving rangeland and reclaiming disturbed sites benefit individuals, communities, and the state by enhancing the productivity and stability of reclaimed lands.

The integrity of Wyoming's natural resource base and the state's diverse ecosystems is a central focus of the UW's extension and research programs. Natural resource related research and extension programs are designed to foster an understanding of the functioning of Wyoming ecosystems as related to the people and economic viability of the state.

Key Theme - Pesticide Application

a. Federal and state laws require that individuals using restricted use pesticides become certified applicators. Private applicators must be recertified every five years, and commercial applicators must earn recertification every three years. The University of Wyoming Cooperative Extension Service provides training for both initial certification and recertification of private and commercial applicators. New training materials are needed annually. UW CES cooperates with the Wyoming Department of Agriculture in the certification program. One initial training session and one recertification session are conducted each year in January for commercial applicators. Training sessions for private applicators are on a county by county basis and are held as needed with each county holding one to two training sessions per year. County based educators provide training for private applicators. Training for private pesticide applicators consists of a two to four hour session concentrating on the safe and proper use of pesticides, environmental issues and calibration. Commercial applicator training takes place at the state level. Training for new commercial applicators consists of 24 hours of basic classroom instruction in safe and proper use of pesticides, environmental issues, weed science, entomology, plant pathology, small animal control and calibration. An initial certification school, consisting of 24 hours of training and a 12 hour recertification school were each held in 2005. Federal, state, and university personnel provide the training for commercial applicators. In 2005, approximately 383 private applicators received training to become certified and 492 received training to become recertified. In 2005, 381 commercial applicators received training to become certified and

741 received training to become recertified. Approximately 3,120 applicators in the state have a private applicators license and 2,893 have a commercial applicators license. Twenty-four Pesticide Education Program Fact Sheets (MP-93.1 through MP93.14) and other training materials that deal with various pesticide topics are available for both the private and commercial pesticide applicator training programs. These materials are available on line at: http://uwadmnweb.uwyo.edu/UWCES/UWPMC.asp

b. **Impact** - The response to applicator training schools continues to be very good. Of the various ways to become certified, many people elect to attend training schools, which indicate they are receiving training in the safe and proper use of pesticides. Based on surveys, approximately 875 private pesticide applicators and 1,122 commercial pesticide applicators adopted practices such as reading and understanding the pesticide label, wearing and using the proper safety clothing and equipment, applying pesticides only when needed, and using integrated pest management strategies. Due to the private and commercial pesticide applicator training programs, pesticide complaints to the Wyoming Department of Agriculture are minimal. Those that are reported are usually due to pesticide misuse.

c. **Source of Funding** – Smith-Lever, State

d. **Scope of Impact** – State Specific

Key Theme - Natural Resource Management

a. Watersheds in arid and semi-arid regions within the United States are increasingly at risk of impairment due to both competition for available water supplies and water quality degradation. The western region of the country is the fastest growing region in the country. Traditional land uses, such as livestock grazing and irrigated agriculture, have historically had significant impacts on watersheds, but today as rural areas are being rapidly developed, environmental and management issues that were once considered to be “Eastern” problems need to be considered.

   The U.S. Environmental Protection Agency has established criteria to evaluate pollutant contribution from land-use impacts and other non-point sources. Under section 303(d) of the Clean Water Act, water quality management decisions are to be watershed based. The state of Wyoming has recognized the most successful watershed and water quality programs are initiated and implemented locally. The vision for the Wyoming Water Quality Division’s Non-point Source Program states that it “intends to work through voluntary and incentive methods to preserve and restore the quality of Wyoming’s surface water and groundwater resources so they continue to be available for designated uses” (Wyoming Non-point Source Management Plan, Update March 2000).

   The University of Wyoming Cooperative Extension Service (UW CES) has been working closely with Wyoming Association of Conservation Districts (WACD) and the Natural Resources Conservation Service (NRCS) to rebuild the water quality monitoring training program and to develop a certification program. The new training program, which is now being run by UW CES, has been streamlined into three modules and updated and enhanced. Funding and support are being provided by the WACD. NRCS and Wyoming Department of

Environmental Quality (WYDEQ) are also working with them.

A two and a half day course specifically addressing the science of water quality has been added to the curricula; a significant expansion of the previous two hour class. In addition, a training of trainers program has been initiated. A difficulty with the previous training program was finding available and qualified instructors. As part of the current training program, University of Wyoming personnel are being trained to be future course instructors. The objective is to develop and maintain a reserve of fully qualified instructors to teach the three different modules of the training program as necessary. The trainees participate in the courses as they are taught and are updated in changes in water quality regulations and monitoring techniques.

One of the major environmental controversies of our time is in regard to the rapidly rising concentration of CO_2 in the earth's atmosphere and whether or not this is causing global climate change. Regardless of its impact on the earth's climate, there is a growing movement in the United States and the rest of the world to lower the concentration of CO_2 in the atmosphere. In the United States, the most widely accepted strategy for reducing levels of CO_2 in the atmosphere is to sequester (or remove) C from the atmosphere and store it in soil as SOC (the major component of SOM) where it has beneficial effects on soil properties and land sustainability. There appears to be a particularly large potential to increase C storage as SOM in disturbed and reclaimed soils including reclaimed soils on surface coal mine lands in Wyoming. In fact, our previous studies of SOM dynamics and C cycling in reclaimed mine land soils in our state indicate that these soils are accumulating C at a rapid rate.

CES educators and specialists conducted 52 educational workshops, classes or tours reaching over 2,191 individuals on topics ranging from Coalbed Methane, Range Monitoring, and Drought Management and Grazing. The Sustainable Management of Rangeland Resources (SMRR) Initiative Team created over 100 sixty-second natural resource educational spots over two years which air twice weekly on statewide commercial television reaching a potential 9,000 households.

b. **Impact** – Eighteen WACD and WYDEQ personnel had successfully completed Module I of the new training program. Module I consisted of two background courses over a five day period taught by University of Wyoming faculty: Watershed 101 and Water Quality 101. The two and a half day course on Water Quality has now been fully integrated into the training program complete with a training manual and homework problems. The relationship between soil microbial biomass and SOC (as a constituent of SOM) in reclaimed soils compared to nearby undisturbed soils.

A framework for integrating landscape ecology and stream channel sites has been adopted. Appropriate sites for model development and testing have been identified in Wyoming that are closely linked to emerging issues of concern (fecal coliform, actively degrading streams, and coalbed methane production). Field techniques for assessing stream channel stability have been developed using a high resolution portable LIDAR system, and computer-based algorithms constructed that interpret field data.

- Participants in CES educational programs reported increased awareness of natural resource

issues affecting their agricultural operations, environmental issues, regulatory issues, and the need for an integrated approach to problem solving.

- Over 150 producers, natural resource agency staff, and representatives from interest groups participating in the Wyoming Rangeland Management School reported they had gained knowledge. Thirty-five percent of evaluation respondents indicated they would improve range monitoring practices.
- Small acreage workshop evaluations showed that over 80 percent of participants increased their interest and awareness. One hundred percent reported they increased knowledge and 100 percent indicated they intended to change their practices as a result of information presented.
- Agriculture producers gained knowledge about the rangeland plant forage kochia that had the potential to benefit their operations by providing drought tolerant, weed resistant, quality forage. Several producers are planning to plant forage kochia. This plant will allow producers to graze cattle longer on pastures, reducing the time required to feed expensive hay during the winter. Forage kochia will also help stop the spread of noxious weeds by competing with them for resources, thus improving the quality of rangelands.

c. **Source of Funding** – Smith-Lever, Hatch, State

d. **Scope of Impact** – State Specific
Multi-State Research (AL, CA-B, CA-D, CO, CT, GA, IA, KY, LA, MA, MD, ME, MI, ND, NH, NY, ND, OH, OR, PA, RI, TX, UT, WA, WV, WY)
Integrated Research and Extension

Key Theme – Integrated Pest Management

a. Potential larval habitats of the mosquito Culex tarsalis (Coquillett), implicated as a primary vector of West Nile Virus in Wyoming, were identified using integrated remote sensing and geographic information systems analyses. The study area is in the Powder River Basin of north-central Wyoming, an area that has been undergoing a significant increase in coalbed methane gas extractions since the late 1990s. Large volumes of water are discharged, impounded and released during the extraction of methane gas, creating aquatic habitats that have the potential to support immature mosquito development. The West Nile Virus (Flaviviridae: Flavivirus) is a member of the Japanese encephalitis serocomplex. West Nile Virus affects the central nervous system and causes a serious threat to public health. Since West Nile Virus arrived in New York City in 1999, it has spread across the North America continent, and by the end of 2004, the total human deaths reached 374 cases nationwide. The state of Wyoming was hit heavily in 2003 with 375 human cases including nine deaths. In addition to posing a clear threat to human health the West Nile Virus poses a threat to native wildlife species. For example, the West Nile Virus is hypothesized to be responsible for the sharp decline of greater sage-grouse (Centrocercus urophasianus) in this region as the survival rate of this species has been reduced by 25 percent in recent years.

   CES implemented a competitive grant program for applied research in IPM. One sample of a project under way is: Control of annual bromes (*Bromus tectorum* L., and *B. japonicus* Thunb.) and longspine sandbur (*Cenchrus longispinus* (Hack.) Fern.) with Plateau (Imazapic)

herbicide and perennial cool-season forage grasses. Imazapic (Plateau) herbicide is promoted as a safe and effective herbicide for the control of cheatgrass on rangeland by the manufacturer. However, the manufacturer has limited the sale of this herbicide to government land management agencies. Thus use of this herbicide by private rangeland owners is limited. Results of this study may encourage the manufacturer to reconsider this decision, especially when Plateau is used to suppress cheatgrass to aid in the establishment of perennial forage grasses on degraded range and pasture lands. This practice may also be applicable for revegetation of pipelines, especially on private lands where the landowner is interested in the establishment of perennial forage grasses.

b. **Impact** – Mosquito control is a critical component of the arbovirus control programs, and one of the most effective ways to control a mosquito population is to reduce its larval (breeding) habitats. Previous studies have shown benefits of using remote sensing in the identification of mosquito breeding habitats. However, these studies have not targeted West Nile Virus or the intermountain west and plains areas in Wyoming where West Nile Virus risk is high. From an operational point of view, previous efforts used map resolution that was too coarse to implement local control strategies and not specific to larval habitat. With the increasing status of this emerging arbovirus, a more accurate and finer grain mapping system is necessary to aid the West Nile Virus prevention program. The classification procedure developed by this study can be used to efficiently create a spatially explicit distribution of C. tarsalis larval habitats at the large scale. Although ponds smaller than one acre will be overlooked in this assessment, the product is valuable for the regional prediction of the vector population. Given that permanent water stands are usually larger than two acres, results from this study are suitable for long term monitoring purposes. UW researchers are currently pursuing the use of higher spatial resolution images, to improve the resolution of spatial assessment and to better quantify the impact of coalbed methane discharge water on mosquito larval habitat for ponds smaller than the detectable limit with Landsat. Since Culex spp. mosquitoes are primary vectors of West Nile Virus, the methods and activities in this study may provide a tool to identify Culex species habitats in other regions of North America. The image classification can be easily repeated and adopted. With the wide availability of Landsat™ data, this classification procedure can be applied more broadly in the future.

- Plateau herbicide will reduce cheatgrass infestation and late summer application appears to be more effective compared to early spring application. Although two oz of Plateau per acre reduces cheatgrass infestation it appears that four oz is best and six oz may be more than needed. Minimizing the amount of herbicide used to suppress cheatgrass seed production and establishment saves in herbicide costs and may reduce the negative affect Plateau might have on germination of seeded grasses, especially those planted at the time of herbicide application. Suppressing cheatgrass appears to improve establishment of seeded grasses bringing a unit of land back into production faster. This is the second year that we have seeded grass data to analyze. Plots that had grass last year improved in stand and seeded grasses became established in additional plots this year. Additional work under non-drought conditions needs to occur to determine just how effective the use of Plateau herbicide is in suppressing cheatgrass and establishing perennial forage grasses.

c. **Source of Funding** – State, Smith-Lever (3d)

d. **Scope of Impact** – State Specific
Integrated Research and Extension

Key Theme – Sustainable Agriculture

a. Preservation of and continued improvement of the health and stability of all of our natural resources forms the basis for our survival and the survival of generations to come. Our natural resources provide the basic production potential for all food, water, recreation, energy (in the form of wood, coal, gas, oil, etc.) fiber, etc. that we as humans must have to sustain our survival and that of our future generations. In that regard we could say that future generations are actually our most important renewable resource and all other goes to sustain them.

   Research is currently evaluating grazing systems designed to maintain and optimize performance from a range resource by matching individual animal productivity (by stage and level of production) to the actual resource rather than attempting to modify the resource to match the animal and its respective nutrient needs. Educational programs and workshops to better acquaint young people with methods and systems to improve livestock productivity while working within the bounds of the available resource is critical for resource maintenance. Information provided to school age youth about production agriculture and how it affects their daily lives is critical if the general public is to fully understand the importance of domestic production agriculture. Taking this message to the elementary schools and providing "field trips" to the farm-type environments are vital if this educational process is to proceed. Providing producers, resource managers and others with the most current scientific information on natural resource management while demonstrating how animals can be used in the maintenance and improvement of the grazed resource is critical. Biting vectors such as mosquitoes have been shown to be major carriers of catastrophic diseases that affect human populations where these mosquitoes propagate. Better understanding how these afflictions such as West Nile develop and move through the environment is the only way that we will ever be able to interrupt the life cycle and provide protection and relief to the affected human populations.

b. **Impact** - Research on and matching the animal, based on its production status and subsequent need, to the available grazed resource has been useful in identifying alternative management strategies to currently accepted and used practices which help improve animal productivity and thus increase sustainability of the family farm/ranch unit. Not only do these activities provide increased potential for net return to management they also provide a positive impact on the improvement and subsequent preservation of the natural grazed resource. The best opportunity for providing timely information on natural resource management to the general public as well as producers and other land users in a relatively short time, is at public expositions. Presentation of scientific information and how to use this information for natural resource management at schools and workshops attended by producers, resource managers, conservationists and others interested in natural resource management provide participants a common basis of scientific material upon which they can make management decisions, based on the best and latest information available, as compared to making the same decisions on speculation or personal bias which has frequently been the

approach in the past. As a result of the resource management schools, clientele are requesting more information through more schools which provide more in-depth curriculum about the science of the biological systems present in the natural resource. The result of this need for further education will be the development of newly based schools designed to move the level of scientific knowledge to the next level. This will result in more consistent and concise decisions made by managers of both public and private native range resources. Better understanding of the biology of how catastrophic vector borne diseases move through the environment will better equip public health providers with the information and knowledge necessary to interrupt/disrupt the spread and perpetuation of diseases such as West Nile.

c. **Source of Funding** – Hatch, State

d. **Scope of Impact** – State Specific
Integrated Research and Extension

Key Theme – Water Quality

a. Arsenic (As) enters water supplies from natural deposits in the earth's crust and/or anthropogenic activities (e.g., mining, coal burning power plants). The U.S. National Research Council recently recommended lowering the human drinking water limit of 50 µg/L. Subsequently, the U.S. Environmental Protection Agency (EPA) proposed a new limit of 10 µg/L for As for human drinking water, effective January 26, 2006. High As concentrations in groundwater is known to occur in the western U.S. In a recent report, the EPA noted that Region 8 states lack suitable As data for compliance, particularly small communities which depend on groundwater wells for drinking water. To comply with the new As standard, a reliable dataset on As occurrence in drinking water supplies, particularly in domestic groundwater water wells is required. Also, an evaluation of available As removal technologies for drinking water supplies is needed. Current technologies suggest that the removal of both As species require pH adjustments, pre-oxidation of As(III) to As(V), and/or are affected by competing ions in water such as sulfates, phosphate, and silica. A regional assessment project is being conducted with the collaboration of CSREES Northern Plains and Mountains Regional Water Quality Coordinators, Bureau of Indian Affairs (BIA), Wind River Agency, and Wind River Environmental Quality, Fort Washakie, Wyoming. Over 50 samples throughout the Region 8 were collected in the summer of 2005 and analyzed for arsenic. Results suggested that 66 percent of the samples consisted of greater than 10 µg/L of As. The groundwater samples, which exceeded the 10 µg/L limit for As, were treated with ARTI-64TM particles and analyzed for As. The ARTI-64TM particles effectively removed As from groundwater, in the presence of other anions, to below 10 µg/L, without any pre-oxidation or pH adjustments.

b. **Impact** – This research project has high impact. Recent studies suggest that high concentrations of arsenic in drinking water are found in many countries throughout the world. High As concentrations in groundwater are known to occur in the western U.S. Two forms of dissolved arsenic exist in water, arsenate As(V) and arsenite As(III), with arsenite being the most toxic of the two; long-term exposure to arsenic contaminated drinking water, in excess of 50 µg/L, causes increased risk of skin, lung, bladder, and kidney cancer including skin-related problems such as hyperkeratosis and pigment mutations. Arsenic

consumption also promotes cardiovascular and nervous system malfunctions, eventually resulting in death. Project results along with the As fact-sheet explaining human health issues from the consumption of As through drinking water and other pertinent As information was distributed to the well owners and Region 8 coordinators to enhance education and awareness of As in drinking water.

c. **Source of Funding** – Hatch, State

d. **Scope of Impact** – State Specific
Integrated Research and Extension

Goal 4 Summary:
The integrity of Wyoming's natural resource base and diverse ecosystem is the focus of the College's extension and research programs. A few of the college's on-going efforts in the Goal 4 area are:
1. Integrated Pest Management
2. Natural Resource Management
3. Rangeland and Riparian Management
4. Water Quality
5. Carbon Sequestration
6. Wildlife Management

Researchers in this area participated in nine Hatch projects and three of the nine are multi-state projects and five are integrated research and extension. The research effort includes 3.9 FTEs with expenditures of approximately $ .13 million Hatch, $0.5 million multi-state, and $1.3 million State.

Cooperative Extension Service FTEs 12.99
Goal 4 Allocated Funds $1,129,983

Goal 4 – IMPACTS

Moose Habitat in Wyoming

Situation:
Moose numbers have increased exponentially in the Snowy Mountain Range of southeastern Wyoming each year since reintroduction occurred in northern Colorado in 1979. However, moose habitat selection patterns and impact on forest vegetation is unknown. Resource managers must determine habitat selection, seasonal occupancy rates, forage utilization levels, and overall forest habitat conditions immediately to develop habitat management plans and harvest strategies before expanding moose populations negatively impact forest resources, and subsequently, habitat condition for other forest wildlife species. Over utilization of forest vegetation by moose can significantly influence wildlife species competition, nutrient cycling, soil chemistry, rate of forest succession, and ultimately the long-term structure and dynamics of the forest ecosystem. Research data will enhance management decisions at a multi-species level due to seasonal overlaps of several species within specified habitat types. Moose captured for fitting of GPS

collars will also be tested for chronic wasting disease, ectoparasite infestation, and general health. This research will provide baseline data to resource managers on habitat selection, occupancy, forage utilization rates, and habitat condition which will be used to enhance forest resource management plans. A GIS database of forest resources and human use impact (roads, recreational areas, etc.) in the Snowy Mountain Range has been developed. A predictive moose seasonal habitat selection model based on previous moose habitat studies using key variables (e.g., vegetation type, hydrology, elevation, roads, etc.) has been drafted and will be refined in the future from GPS-collared moose (documenting actual moose seasonal habitat use) and field sampling efforts of existing habitat throughout the forest. Last fall, 16 moose were captured using aerial dart tranquilizer procedures and fitted with GPS/VHS collars to monitor actual habitat selection patterns over the next year. Additional planned field work includes vegetation sampling to evaluate habitat condition and carrying capacity estimates, fecal analysis to determine dietary selection preferences, and analysis of GPS downloaded data from collared moose.

Impacts:
Project results will provide critical information on moose habitat use, particularly winter habitat, distribution, preferred dietary forages, and seasonal habitat condition. An estimation of potential carrying capacity for moose, based on the assumption of winter habitat as the limiting factor, will help biologists establish population management objectives from a habitat condition perspective. This information, along with moose population estimates, will allow the Wyoming Game and Fish Department to develop comprehensive management strategies for the Snowy Range moose herd. Project results will also help identify areas requiring future habitat enhancement projects and facilitate cooperative habitat and wildlife population management efforts between the Wyoming Game and Fish Department and the U.S. Forest Service.

Integrated Weed Management in Sugarbeets

Situation:
Sugarbeet crops are the number one cash crop in the state of Wyoming with a production value of over $45 million. Weed competition in sugarbeet is considered one of the major obstacles that prevent the achievement of maximum crop yield. Weeds not only reduce yield by competing with sugarbeet plants for light, nutrients, and water but also interfere with harvesting through increased harvest losses.

Several field studies have been conducted at the Powell Research and Extension Center and with sugarbeet growers in Big Horn and Wind River Basins to evaluate the effects of several weed species on sugarbeet yields. Several weed species have been investigated using full, half, and micro-rate systems. Both systems consist of the combination of desmedipham-phenmedipham-ethofumesate (Progress), triflusulfuron (Upbeet), and clopyralid (Stinger). Half and micro-rate systems consist of reducing herbicide rates by at least 50 and 65 percent, respectively and adding one to two percent v/v of methylated seed oil.

Impacts:
Many growers in the Big Horn and Wind River Basins switched to using half or micro-rate systems to control weeds in their sugar beet fields. By reducing the amount of herbicides and

adding methylated seed oil, growers are able to reduce their weed control costs by 20 to 35 dollars/A depending on number of applications. Since half and micro-rate are applied broadcast, the number of cultivations was also reduced by an average of one time per field. With both half and micro-rate systems, weeds are treated earlier, starting at sugarbeet cotyledon stage with a five to seven days interval between applications. The number of applications varies between three to five applications depending on weed species present in the field. Due to sugarbeet tolerance to half and micro-rate, growers have seen an increase in their sugar beet yield by at least two to four T/A.

Goal 5: Enhance economic opportunity and quality of life for Americans

Overview
Cooperative Extension is working to enhance Wyoming communities and the well being of households through relevant integrated educational and resource management programs. CES focuses on increasing the capacity of communities, enterprises and families to create communities in Wyoming that offer a sustainable future in which to live**,** learn and work.

The federal government manages a significant amount of the land area in the Western United States. In Wyoming the Forest Service, Bureau of Land Management, National Park Service, Bureau of Reclamation, and Fish and Wildlife Service control 29.8 million acres or about one-half of the surface area in the state. Due to its large land holdings, management decisions by federal land management agencies can have significant impacts on the economies and lifestyles of communities in Wyoming. Researchers are working with Wyoming communities, assisting them with identifying impacts of change, developing community network resources, and identifying growth opportunities for existing businesses. Multi-state projects interface retailers, small manufacturers, and home-based businesses; helping these businesses identify economic development and growth opportunities in their rural locations.

Key Theme - Family Resource Management

a. Cooperative Extension Community Development Education Educators in seven extension areas conducted 38 financial management classes reaching 1,022 individuals. Topics included credit, savings, using financial calculators, financial security in later life, and basic budgeting. Of the 1,022 total participants, 780 attended single topic workshops and 242 completed in-depth financial management courses that entailed three to five sessions.

b. **Impact** - Impact documented through evaluations on financial management programs included:

- 74 percent of participants indicated they had learned at least one new method for decreasing their expenses.
- 83 percent better understand the costs of credit and dangers of making only the minimum payment.
- 100 percent reported they learned new information in the classes.
- 45 percent have set a long term financial goal and have a written plan for managing debt.
- 82 percent reported they were making changes in their money management practices.

c. **Source of Funding** - Smith-Lever

d. **Scope of Impact** - State Specific

Key Theme - Community Development

a. The future of Wyoming communities depends, in great part, upon the sustainability of its economy, people, and environment. Forty-nine educational workshops, classes, and seminars reached over 2,461 individuals. Topics included facilitation skills, mediation training, conflict management, teambuilding, and leadership development. Leadership is an important foundation for effective community development. Studies and surveys repeatedly document

the need for leaders in rural communities. There are a few leadership programs in the state and very few exclusively locally based. The leadership program developed seeks to get communities involved in producing their own cadre of local leaders. This program differs from traditional programs in three ways: first, the programs are locally run with UW acting as a partner. The university helps guide the process of development, but community participants own the program. UW provides technical expertise when local expertise cannot be found. Second, the curriculum is defined not by outside experts but a local steering committee. Finally, university personnel assist in assessment. Leadership Institutes that meet monthly for six to nine sessions and run six hours in length have been initiated in seven counties in Wyoming with over 144 participants. In addition in 2005, UW hosted a Western Regional training, Extension Volunteer Organization for Leadership, Vitality and Enterprise (EVOLVE) with 19 participants from six states. Extension educators are also providing third party facilitation to community groups reaching 287 individuals in 12 facilitated sessions.

b. **Impact** - Impacts from the workshops conducted include: new skills were acquired and participants had a better understanding of using criteria for determining resolution. One hundred percent of participants felt they would use at least one skill learned in their workplace or desired to use them in community meetings. Specific outcomes include:

- Results from mediation training included conflicts resolved. Workplace mediation program evaluations indicated participants learned tips for calming unhappy customers and improved skills in conflict management.
- Leadership Institute participants reported the following short term outcomes: on a scale of 1-5 (1=no improvement to 5=greatly improved), skills improved in communication – 3.8, problem solving – 3.6, decision making – 3.7, building relations – 4.2, and leadership abilities – 4.3. Medium term outcomes measured six months following the eight month program included: 1) WLI graduates are emerging as leaders in the community; 2) participants reported becoming active on city and county boards; 3) individuals reported goals set during the program were achieved; 4) graduates are demonstrating leadership skills in community organizations. Long-term impacts measured from follow-up surveys with 2003 graduates include: 100 percent of graduates are implementing teambuilding tools and 90 percent of participants are using communication and managing change tools. One hundred percent of respondents are involved in the community at either the same level or more after the course.
- Facilitation training participants reported in a three month follow-up that the most significant things learned were: group stages are normal, facilitation tools, moving groups forward, valuing all points of view and being flexible, group dynamics, listening styles, and how to build consensus.
- Participants in the EVOLVE training indicated the curriculum was excellent and over 60 percent stated they planned to implement the leadership program in their state.

c. **Source of Funding** - Hatch, Smith-Lever, State, County, Private

d. **Scope of Impact** - State Specific
Integrated Research and Extension

Key Theme - Youth Development/4-H

a. Positive youth development is a process of growing up and developing one's capacities in positive ways. (Walker & Dunham, 1994). 4-H becomes part of the total contextual environment for positive youth development. Life skills were defined as communications, problem solving, planning ability, decision making abilities, striving for excellence, leadership, and interpersonal relationship building. Wyoming had 7,209 youth and 3,307 volunteer leaders enrolled in the traditional 4-H youth program. Over 367 workshops, camps and clinics were held in counties throughout the state reaching over 10,229 youth. Over 9,310 youth participated in 4-H school enrichment programs during the year.

b. **Impact** - Both formal and informal evaluations were used to determine success of program efforts in 4-H and youth. Participants reported skills had been enhanced after participating in 4-H judging programs including horse, livestock, meats, vegetable, and wool. Increased skills reported by youth included decision making, verbal communication, and team work. Ninety-five percent of youth indicated they had learned something new through clinics and workshops attended.

- County, state, and regional camps helped members to increase skills, knowledge, increase self confidence, and develop interpersonal skills. One hundred percent of members could identify one thing they had learned and how they can use the information in their project work. Traditional member's demonstrated new skills learned through hands-on camp activities which were documented through written evaluations, observation, and leadership of youth sharing skills with others.
- Junior Leader age members (13–19) who received training have conducted clinics and field days for club project members, and taken over adult leadership responsibilities. Members have become more involved in community service projects and demonstrated that they had learned the meaning of team work and cooperation. A major impact of the program is the skill demonstrated in organization, team work, communication, public speaking, time management, and critical thinking. Youth reported increasing their ability to accept responsibility as well as being more thorough in project completion.
- Project workshops and clinics held throughout the state resulted in members learning new skills, gaining knowledge, increasing communication skills, enhancing decision making, and the importance of following through on a project. Impacts were documented through pre- and post-test, written evaluations, follow-up contacts with participants, and informal observation.

c. **Source of Funds** - Smith-Lever 3 b & c, State, County

d. **Scope of Impact** - State Specific

Key Theme - 4-H Leadership Development

a. State 4-H Youth Specialists, Extension Educators, and 4-H Program Associates presented training to the 3,307 volunteer leaders in Wyoming. Methods of training included subject matter project training, risk management through two-hour workshops and home study courses, district, state, and regional meetings, and printed materials. Total attendance at leader training sessions was over two thousand for leaders attending project workshops. Counties utilized training to recruit new and diverse volunteers to fill 4-H committee assignments and increase participation of new leaders. Volunteer recognition on state and

county levels was completed through certificates, plaques, leader appreciation in newsletters, and 'leader of the month' program.

b. **Impact** - Over half of all volunteer leaders enrolled in Wyoming received formal training. Counties documented increased volunteer participation where training was conducted. One hundred percent of leaders completing the screening certification indicated they gained new knowledge and 89 percent reported they better understand the structure of 4-H.

   Volunteers participating in project workshops and training reported increased knowledge and skills in subject matter areas and a better understanding and confidence in teaching skills to youth. Leaders trained in the disciplines of horse and shooting sports increased volunteer efforts in counties by up to 75 percent.

c. **Source of Funding** - Smith-Lever, State, County

d. **Scope of Impact** - State Specific

Key Theme – Impact of Change on Rural Communities

a. The federal government manages much of the land area in the Western United States. In Wyoming the U.S. Forest Service, Bureau of Land Management, National Park Service, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service control a combined 29.8 million acres or about one-half of the surface area in the state. Due to its large land holdings, management decisions by federal land management agencies can have significant impacts on the economies and lifestyles of communities in Wyoming.

   In recent years, the management of federal lands has become much more contentious with a number of interest groups with divergent concerns becoming more involved in the planning process. One area of debate that is of particular importance to Wyoming is the economic implications for local communities of alternative Federal land management decisions. Often these discussions are based on emotion rather than solid economic information. As a result, federal management agencies, state government, and local governments in Wyoming and the West all have a need for reliable information on the effects of federal land management decisions on the economies of local communities.

b. **Impact –**An economic analysis of the Bighorn National Forest Plan Revision for the U.S. Forest Service. The analysis considers livestock grazing, timber, recreation, and USFS operations in Big Horn, Johnson, Sheridan, and Washakie Counties. In addition, an economic profile was developed for each county. This analysis will be used by the Forest Service in decisions regarding the future use of the Bighorn National Forest. This is a collaborative effort between the University of Wyoming, U.S. Forest Service, and the State of Wyoming.

- A survey of off-road vehicle (ORV) use was commissioned by the Wyoming Division of State Parks and Historic Sites-State Trails Program. The State Trails Program receives monies from the purchase of the mandatory ORV sticker. Little is known about the use and users of these vehicles, which mainly use public lands. This survey will attempt to categorize users and uses of ORVs as well as obtain some expenditure information. This information will be used by the State Trails in administering the ORV program in Wyoming.

- Payments in Lieu of Taxes (PILT) are an important source of revenue from the federal government for county government in Wyoming. However, the calculation of PILT payments is not well understood and may be affected by federal agency management decisions. To assist in the understanding of these payments a set of fact sheets have been developed annually for the last eight years for each of Wyoming's 23 counties.
- An economic analysis of the Kemmerer and Casper Resource Management Plan Revisions for the Bureau of Land Management. These two projects consider the local economic importance of livestock grazing, recreation, and mineral development on BLM lands. These analyses will be used by the BLM in decisions regarding the future use of BLM lands in the region. This is a collaborative effort between the University of Wyoming, the Bureau of Land Management, and various private consulting firms contracted with by the BLM.
- Creston/Blue Gap EIS analysis is a follow-up to the Rawlins RMP study that was completed for the BLM last year. This information will be used by the BLM in their decisions regarding natural gas development in the Creston/Blue Gap area. This is a collaborative effort between the University of Wyoming, the BLM, and a private consulting firm contracted with by the BLM.

  Economic analyses provide information on the significance of activities and policies on public lands to rural communities. For example, results from a recent study indicate that the economic activity associated with the Medicine Bow National Forest brings $75.7 million into the three-county economy (Albany County, WY; Carbon County, WY; and

Jackson County, CO). This economic activity generates a total of $119.2 million in total economic impact in the three-county region. This economic activity supports a total of 1,656 jobs in the region and generates $21.9 million in labor earnings.

c. **Source of Funding** – Hatch, State

d. **Scope of Impact** – State Specific (W-192) (AK, CA, CO, ID, NM, NV, OR, UT, WY) Integrated Research and Extension

Civil Rights – Diversity

Key Theme – Multi-cultural and Diversity Issues

a. The Extension Civil Rights coordinating committee conducted six county civil rights training reviews during the past year. During reviews comprehensive training is provided to assure that all Extension employees are committed to serving all clientele and targeting underserved audiences when identified or needed.

When developing plans of work, individuals include diversity within each plan. UW extension and research professionals were committed to reaching the total population of Wyoming including the under-served and under-represented Native American and Hispanic population. Such activities include staffing bi-lingual coordinators for the Cent$ible Nutrition Program (CNP), and preparing nutrition materials in Spanish and Braille. 4-H educators have developed programs to work with children with limited English proficiency (LEP) and programs specifically for children of migrant workers. In 2005 CNP expanded collaborative efforts with the Eastern Shoshone and Northern Arapaho tribes that enabled CNP to increase funding for nutrition education on the Wind River Indian Reservation. Two nutrition educators and a coordinator were hired to serve this area.

b. **Impact** - All 27 Cooperative Extension county offices have gone through a comprehensive training and assessment review on Civil Rights and Diversity. All county CES staff had written civil rights into their individual or county plans of work. Civil Rights are a component of annual performance appraisals. CES annually recognizes one staff member for diversity efforts.

c. **Source of Funding** - Smith-Lever

d. **Scope of Impact** - State Specific

Goal 5 Summary:

Wyoming residents identified economies of Wyoming communities, personal finances, and youth development as high priorities. University of Wyoming researchers are working with Wyoming communities, assisting them with identifying impacts of change, developing community network resources, and developing leadership capacity for community leaders. Researchers in this program area participated in one Hatch project, which is integrated research and extension. The research efforts include about .1 FTEs with expenditures of approximately $ 0.15 million Hatch and $ .25 million State.

Cooperative Extension Service FTEs 41.57
Goal 5 Allocated Funds $3,616,119

Goal 5 – IMPACTS
CES Teaches Basic Financial Literacy at Wyoming Women's Center

Situation:
A total of 6,703 adult females in 2004 were arrested in Wyoming for various crimes. Approximately 550 of the arrests related to theft, forgery, counterfeiting, fraud, and embezzlement. Not unlike female prisoners in other states, Wyoming's female prisoners have a significant need to develop skills to cope successfully in the world to which they will return.

Education directors at the Wyoming Women's Center in Lusk contacted the University of Wyoming Cooperative Extension Service and requested a financial literacy program for inmates at the facility. The program was designed to help them develop marketable job and life skills.

Wyoming Women's Center personnel screened, selected, and enrolled 16 students for the class. The curriculum taught by the area educator was Money Smart, an eight-session basic financial literacy program developed by the Federal Deposit Insurance Corporation.

Impacts:
After the final session, a qualitative interview session was conducted and participants were asked to evaluate the effectiveness of the program. The number of students completing the class and the level of participation in discussion were indicators of the class success.

At the first session, students were asked to write what their expectations of the class were. Better money management, budgeting, staying within a budget, spending habits, and self-dependency were listed as expectations by the students. The responses were kept during the course, and the final session was dedicated to having each student discuss whether the class met her expectations. Exit interviews indicated all of the students had fulfilled their expectations, but the one area in which they would like to have more instruction was self-empowerment skill development.

Sixteen students received instruction and demonstrated new skills in:

- Basic banking principles – students demonstrated their ability to write checks, make deposits, and balance accounts.
- Identity theft protection – students were instructed how to protect against identity theft.
- Credit card use and protection – students were made aware of the pitfalls of improper credit card use. An exercise in calculating compound interest was another result of students demonstrating new skills.
- Obtaining and interpreting credit score reports – most of the students obtained their credit scores, something most of them had never done. The results were surprising in certain situations but also very educational.
- Basic budgeting principles – students created a home budget.

- Basic investment, insurance, and loan applications were also discussed.

Comments from the final class session by students:

- "I learned how to choose a credit card and how important it is to read the fine print in the agreement."
- "The information provided regarding interest charges, looking for the fine print, how to choose the best card, and how to keep good credit were the most helpful."
- "Keep coming! This class helps a lot."
- "Information was clear and concise."
- "Bankruptcy and loan information was the most helpful."

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4-H Camping in the Desert West

Situation:
4-H mission states, "4-H empowers youth to reach their full potential, working and learning in partnership with caring adults." This is accomplished through a variety of delivery methods including traditional clubs, school enrichment, after-school programs, and more. One of the most intensive methods during the summer months is through the 4-H camping programs.

Learning life skills occurs with an educational context known as experiential education. In the camping delivery method, the overall goal of 4-H – life skills' development – can be enhanced by utilizing 4-H project curriculum in a fun, hands-on, active environment. This includes both day and overnight camping arenas.

Utilizing the teamwork approach and pooling of resources, an intensive camping program was offered in the Desert West Area during the 2004 and 2005 summers. Curriculums from 4-H, Cent$ible Nutrition Program (CNP), conservation districts, and the federal Children, Youth, and Families at Risk Program were the bases of the educational components of the camps.

The 2005 4-H camping program in the Desert West attracted 380 youths while the 2004 camps drew 206. Over two summers, two weeklong overnight camps were offered along with eight day camps. Themes included:

- The "Passports to Adventures," a two-day camp offered once in the Bridger Valley and once in Evanston for youths eight to 13 years old.
- "Around the World in a Day" was a day camp for youths enrolled in the 4-H Cloverbuds and Evanston Child Development summer program. Youths were introduced to the money and languages from eight countries.

- The “Desert West Horse Camp” was a two-day gathering that built on fundamental horseback riding skills.
- “Creating a Community” camps for eight to 12 years olds were in Evanston and in Green River. Each day young people learned a new aspect of what it takes to build a community.
- “Eating Your Way Through Wyoming History” utilizes the CNP’s youth curriculum. This camp included hands-on interactive activities focused around food and history.
- The “Desert West 4-H Camp” was a weeklong camp open to youths from Uinta and Sweetwater counties. They stayed in cabins and rotated through hands-on workshops.

Impacts:
During the weeklong 2005 “Desert West 4-H Camp,” youths participated in a food safety workshop where they were given pre and posttests. When pre and posttests asked when they should wash their hands, youths showed an increase in knowledge in the following areas: after going to the bathroom, 9 percent; after playing with a dog or pet, 8 percent; before feeding your baby sister, 16 percent; after playing basketball outside, 8 percent; before making a snack, 15 percent; how long should you wash your hands for, 67 percent; when you wash your hands, use soap, 9 percent; and, how long can leftovers be left out before putting them in the refrigerator, 90 percent. At the conclusion of the 2005 “Desert West 4-H Camp,” a random sample was taken of the youths attending; combining all sub-parts of the camp on a three-point scale, 61 percent of the youths ranked the camp excellent.

Participants in “Creating a Community Camp” were given pre and posttests to measure knowledge gained. Between the two camps, youths showed a 22-percent increase in knowledge.

Youths and parents at the “Desert West Horse Camp” completed a comprehensive post-test ranking each area of the camp and, when averaged together on a three-point scale, 78 percent rated it a 1 (Excellent), 11 percent rated it a 2 (good), 11 percent rated it a 3 (poor), and 88 percent identified a new skill/riding technique they learned.

At the conclusion of the 2005 “Eating Your Way Through Wyoming History Camp,” youth test scores showed an 18-percent increase in knowledge based on cooking skills.

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B. Stakeholder Input
The UW CES is continuing implementation of the strategic plan. Two AES sites have gone through a planning process similar to strategic planning. As a result of that process, a new combined southeast experiment station is under construction to replace two existing stations. Stakeholder input comes to the College of Agriculture Cooperative Extension Service and Agricultural Experiment Station through a variety of methods. A joint research and extension

needs assessment process was completed as outlined in the Plan of Work written for Wyoming 1999-2004. A stratified sample was used to determine program and research needs in the state. In addition to the mail survey, a phone survey was conducted with a random sample of Wyoming residents. Both surveys also addressed preferred delivery methods by Wyoming citizens. Stakeholder input gathered through all methods is shared with CES initiative teams comprised of field educators, extension specialists, UW department heads, and administrators. Information is used in development of CES programs and applied research. This needs assessment is also guiding development of the 2007 – 2011 plan of work.

CES advisory committees have formed in the nine Extension areas. These area advisory committees meet at least once annually to provide input on issues and program direction for CES. Advisory committee members are nominated by extension staff by subject matter interest. Selection to serve on advisory committees is based on gender, geographic representation, race, national origin, and underserved audiences. In addition, the Director of CES has formed an advisory committee of county commissioners who will meet during quarterly meetings of the Wyoming County Commissioner Association.

All counties have had targeted advisory meetings to gain stakeholder input on reaching limited resource audiences in the Cent$ible nutrition program (EFNEP and FSNP). County 4-H staff has established 4-H Expansion and Review committees to specifically address outreach efforts toward underserved youth audiences. Training has been provided for staff to encourage diversity in representation on advisory committees. County personnel also utilize collaborative partners to learn needs within communities of the state. In the past year CES has partnered with the Natural Resource Conservation Service (NRCS) with representatives meeting quarterly to assess joint needs and work cooperatively in development and delivery of programs. Each of the three Research & Extension Centers has an advisory committee that meets annually. These advisory committees provide information on existing research and outreach programs and input regarding priority needs for research and outreach. In 2005, meetings were held across the state asking for input on research priorities for the new Sustainable Agricultural Research and Extension Center located in SE Wyoming. The College of Agriculture maintains a separate statewide advisory committee. The committee meets annually to exchange information on the college's programs and to seek input of future concerns and issues. Three departments, Animal Science, Family and Consumer Sciences, and Veterinary Sciences, have separate advisory committees that provide input on programs in those departments.

C. Program Review Process

The merit review process for extension programs covers all programs conducted by UW CES. A team leadership model is utilized to review program plans and direction for CES programs as outlined in the 2003 UW CES Strategic Implementation Plan. Program initiative teams develop and review programs on an annual basis. Teams make decisions to maintain, modify, or create new programs to meet the needs identified through external and internal stakeholder input.

Projects supported with formula funds (Hatch, Multi-State, McIntire-Stennis, Animal Health) must be approved projects. The project proposal is transmitted to the department head and the head appoints a minimum of two scientific reviewers who are knowledgeable in the field to review the proposal. After a proposal is revised based on the above review, it is transmitted to

the Experiment Station Director. The director's office assigns three scientific reviewers who are knowledgeable in the field to review the proposal.

The Wyoming Agricultural Experiment Station administers an internal competitive grants program using a portion of its federal dollars. Proposals are reviewed by a ten member university-wide committee. Each proposal is also sent to external reviewers. The committee submits recommendations for project funding to the AES director.

D. Evaluation of the Success of Multi and Joint Activities

As outlined in the Stakeholder input section, the UW CES and two of the R&E Centers went through a strategic planning process. AES has closed one station and will be closing the Torrington station and completing construction of one in a new location that will accomplish the necessary research for the region. The CES strategic plan has identified five initiative areas which provide greater focus for extension personnel. Those initiatives redefined by stakeholders are Profitable and Sustainable Agriculture, 4-H/Youth Development, Nutrition and Food Safety, Rangeland Resources, and Community Development Education.

The programs identified in the College of Agriculture's 5-Year Plan of Work address the critical issues of strategic importance for the state and region. These issues were identified through extensive input from research and teaching faculty, CES personnel, and college stakeholders during the college's strategic planning process. The five program goals listed in the 5-Year Plan of Work are consistent with those at the national level. Over 50 percent of the research projects identified in this report reflect an integrated effort between research and extension. Researchers at UW's College of Agriculture are involved in approximately 18 multi-state projects. These projects cover all but one of the identified program goals (goal 2). The college's researchers have also been successful with research involving multi-institutions. There is also on-going multi-institution research programming through the R&E Centers. In addition, researchers have been successful in integrating research programs with various federal and state agencies and organizations. These linkages, as well as campus wide multi-disciplinary research programs, are encouraged through the AES university wide competitive grants program.

There are a limited number of on-going multi-state/multi-institution research projects involving University of Wyoming researchers that address the needs of under-served and under-represented populations, including NC-223, and WIN the Rockies. However, researchers need to continue to seek ways to better address the needs of these population groups in their future efforts.

The programs described the expected outcomes and impacts. Each of the educators and specialists wrote impact statements, some of which are used for the impact reporting to CSREES and others for county commissioners, state and national legislators, university administration, and clientele.

The College's 5-Year Plan of Work describes the expected outcomes and impact for each of the five goals. Information concerning the outcomes and impacts is presented in an evaluative manner so that expectations have been made clear. Within each goal outcomes concerning work with external agencies including multi-state and multi-institutions are also addressed and

encouraged.

By focusing on specific outputs and outcomes as identified within the plan, there was more consistency in reporting program effectiveness. Through the college's strategic planning efforts there appears to be a more concerted effort to streamline research programs to address one of the identified goals. Research and extension personnel are seeking ways through the Plan of Work to work more closely together in order to address the needs of the state and region. As these efforts continue, the college can anticipate an improved effectiveness in its research and extension programs.

E. Multi-state Extension Activities

Cross-discipline activities, multi-state, and joint research have been common in the past, so these requirements are not new to Wyoming. Joint research can be audited through the projects that were at one time called regional projects. In the supplemental report to the Plan of Work 1999 - 2004, Wyoming suggested that 25 percent of its Hatch funds would be devoted to the integrated activities; but Extension listed zero (0 percent) of its Smith-Lever funds on integrated activities. The contradiction comes from the fact that Hatch funds can be audited, whereas the Smith-Lever funds could not be audited. Because of that concern, Wyoming added an auditable tracking of the Smith-Lever funds that are both multi-state and integrated with Hatch through an on-line reporting system utilized by all CES employees. In addition, CES specialists report multi-state and integrated activities through the UW College of Agriculture faculty update, which are submitted annually. In 2005 CES conducted a survey of field educators to document multi-state activities.

F. Integrated Research and Extension Activities

The strategic plan for the College of Agriculture calls for collaboration in all three functions, instruction, research, and outreach. To encourage multi-disciplinary and collaborative research efforts, the Wyoming Agricultural Experiment Station established a competitive grants program that emphasizes research across disciplines and colleges.

Multi-disciplinary and integrated research efforts are quite common in the College of Agriculture. Over half of the research projects are integrated and the majority of those are multi-disciplinary. This is particularly true of the research efforts dealing with Goal 1 on competitiveness and profitability of agriculture.

Research efforts in areas under Goal 3 have been enhanced through projects on human nutrition and health. This has been most apparent with the increase in projects in the Department of Family and Consumer Sciences.

Initiative teams formed as a result of the CES strategic plan have members representing CES educators, state specialists and faculty members, and UW College of Agriculture department heads. The intent of the initiative teams is to build communication and develop a more integrated program for research and extension.

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: 2005

Select One: ☐ **Interim** ☒ **Final**
Institution: University of Wyoming
State: Wyoming

	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Established Target %	%	25 %	25 %
This FY Allocation (from 1088)		$ 336,811.00	$ 336,811.00
This FY Target Amount		$ 336,811.00	$ 336,811.00
Title of Planned Program Activity			
Goal 1: Enhance Agricultural Systems that are highly Competitive in the Global Economy		$ 128,422.00	$ 152,350.00
Goal 2: A Safe & Secure Food & Fiber System		$ -	$ -
Goal 3: A Healthy Well Nourished Population		$ 39,779.00	$ 58,952.00
Goal 4: Greater Harmony Between Agriculture and the Environment		$ 100,921.00	$ 96,329.00
Goal 5: Enhnaced Economic Opportunite & Quality of Life for Americans		$ 67,809.00	$ 60,961.00
Total		$ 336,931.00	$ 368,592.00
Carryover	$ -	$ -	$ -

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.

3-29-06

Director **Date**

Form CSREES-REPT (Revised 09/04)

ATTACHMENT D

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: 2005

Select One: ☐ **Interim** ☒ **Final**
Institution: University of Wyoming
State: Wyoming

	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Established Target %	25% %	%	%
This FY Allocation (from 1088)	$ 520,261.00		
This FY Target Amount	$ 520,261.00		
Title of Planned Program Activity			
Goal 1: Enhance Agricultural Systems that are highly Competitive in the Global Economy	$ 75,871.00		
Goal 2: A Safe & Secure Food & Fiber System	$		
Goal 3: A Healthy Well Nourished Population	$		
Goal 4: Greater Harmony Between Agriculture and the Environment	$ 429,938.00		
Goal 5: Enhnaced Economic Opportunites & Quality of Life for Americans	$ 14,452.00		
Total	$ 520,261.00		
Carryover	$ -	$ -	$ -

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.

Stephen Miller — **Director**

3/31/06 — **Date**

Form CSREES-REPT (Revised 09/04)

ATTACHMENT D