

Colorado State University

COLLEGE OF AGRICULTURAL SCIENCES

ANNUAL REPORT OF THE STRATEGIC PLAN
2007-2008



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**THE 2007-08 REPORT of PROGRESS on the STRATEGIC PLAN
of the COLLEGE of AGRICULTURAL SCIENCES
COLORADO STATE UNIVERSITY**

Preface

The College of Agricultural Sciences at Colorado State University submitted its Strategic Plan to President Larry E. Penley and Provost/Senior Vice President Tony Frank on December 1, 2005. This is the second report of progress in fulfillment of the Strategic Plan covering project activities for calendar year 2007, financial activities for fiscal year 2007-2008 (July 1, 2007-June 30, 2008), and student and academic activities for 2007-2008 (August 15, 2007-July 31, 2008).

A useful Strategic Plan is a living document that guides major programmatic and resource allocation decisions and it continually adapts as strategic objectives are achieved and new challenges arise. In the College of Agricultural Sciences, strategic initiatives have been developed through a collaborative process involving faculty, staff and students. Each strategic initiative is led by an administrative advisor and a steering committee comprised of faculty, Extension agents and researchers. These individuals determine the paths to follow to achieve effective teaching, research and outreach. Twice annually, the administrative advisor and steering committee leadership of each strategic initiative meets with the Dean and Associate Deans of the College to review operations and accomplishments and to change, where necessary, the “strategic actions” and the “critical resource growth” areas. “Strategic Actions” are critical measures which must be taken to remove barriers to success in achieving desired objectives. “Critical resource growth” areas are resource constraints which must be addressed to permit progress toward goals. During the bi-annual meetings, the Dean, Associate Deans, Administrative Advisors, and Steering Committee leadership agree to strike strategic actions and critical resource growth areas which have been achieved, keep those still in progress, and add new actions and resource growth goals to maintain progress. These “strategic actions” and “critical resource growth” areas become the jointly accepted steps to be taken by faculty and administration over the following six months. Special thanks go to Cris Sexton, Manager of Strategic Initiatives for the College of Agricultural Sciences, who is responsible for keeping strategic planning actions on schedule and for composing most of this annual report.

The College has vowed to be accountable to its stakeholders for progress on the Strategic Plan. Imbedded in the Strategic Plan are the following output measures used to measure performance:

- Number of BS, MS, and PhD degree graduates and Post-Doctoral Fellows trained in the program.
- Magnitude of grant/contract/gift awards to the program.
- Number of refereed scientific publications published.
- Outreach products including non-refereed publications and participation in state, national, and international committees, programs, and task forces, and number of consumers, regulators, and industry personnel educated and/or served.
- Evidence of adoption of practices recommended through Colorado State University.
- A narrative summary of accomplishments toward goals which are not readily measurable in numerical terms.

Executive Summary

The College of Agricultural Sciences at Colorado State University submitted its Strategic Plan to central administration on December 1, 2005. This report of progress in fulfillment of the Strategic Plan covers project activities for calendar year 2007, financial activities for fiscal year 2007-2008 (July 1, 2007-June 30, 2008), and student and academic activities for 2007-2008 (August 15, 2007-July 31, 2008).

For Academic Year 2007-08, undergraduate instruction in the College resulted in the graduation of 256 bachelor's degrees from among the 1,226 students majoring in the College. The number of majors has declined slightly during the last two academic years. However, smaller graduating classes and a 20 percent increase in freshmen in the Fall 2007 class promises a turnaround for sustained growth in enrollment. The goal of the College is to raise undergraduate enrollment to 1,600 by 2012. To accomplish this goal, the College has embarked on the following actions: heightened recruiting effort in Colorado high schools; development of a greater effort to recruit and graduate Agricultural Education majors with the goal of filling all high school agriculture teacher vacancies in the state of Colorado; increased alumni contacts (the College has the highest proportion of alumni donating money to the university); continued development of attractive new degree programs (the interdisciplinary degree in organic agriculture started in fall 2006 and the viticulture/enology concentration started in fall 2007); focused additional emphasis on experiential learning to build maturity in the context and use of knowledge (in-class and out-of-class experiences and study abroad opportunities put students in a position to apply knowledge and skills); and pursued renovation of building facilities to provide improved and attractive learning spaces.

Annual scholarship distribution has grown to over \$590,000 (\$553,905 for undergraduate students) and experiential learning scholarships have been developed to support students to attend leadership conferences and study abroad. The National Western Stock Show remains the largest organizational donor to scholarships.

For Academic Year 2007-08, graduate programs resulted in 45 masters and doctoral degrees conferred by the College and completion of 13 post-doctoral students trained. The numbers of graduate majors increased to 226 for the Fall 2008 semester. The goal of the College is to raise graduate enrollment to 100 Master of Agriculture, 150 Master of Science, and 150 PhD students by 2014. Reallocation of existing College and Agricultural Experiment Station research funds, use of growing grant funds, and additional support from the Graduate School have been started and will continue until the goal is reached.

Total financial expenditures for teaching, research and outreach have grown continuously over the last three years to exceed \$31.5 million (growth of 5.2% in the last year). The Agricultural Experiment Station was merged into the College of Agricultural Sciences and the Director, Dr. Lee Sommers, was appointed Associate Dean for Research and Graduate Programs. With the merger of AES into the College, commitments to research in other Colleges relevant to agriculture continue to expand.

Facility improvements are a high priority on the College agenda. Conceptual drawings have been developed for renovation and expansion of the Animal Sciences and Shepardson Buildings. The program plans for these buildings have been approved by the President, Board of Governors and the Colorado Division of Higher Education. The University has allocated \$12.2 million in future building funds to the two projects and a fund-raising effort is in progress to finance the improvement of facilities so students and faculty can work and learn in modern, fully functional spaces. Additionally, the College and AES were able to join a campus bonding effort from which Agricultural Sciences gained \$1.55 million in long-term bonds to renovate greenhouse facilities to meet USDA-APHIS heightened regulations on plant science research and renovate the greenhouses at the Plant Environmental Research Center (PERC).

Indicators of productivity in research and outreach include the production and publication of 185 refereed journal articles and 835 other publications. The College of Agricultural Sciences values continuous interaction with citizens to transmit the results of applied research to those who can use it; faculty and students presented

information at 1,374 Extension and other meetings with more than 47,710 people in attendance. More than 1,000 FFA youth participated in the College-produced annual state contests and 2,000 local third graders experienced “where their food comes from” in the Agriculture Adventure program presented annually.

The full report identifies accomplishments for each of the 11 strategic initiatives. The following are just a few of the highlights from 2007-2008:

- The Center for Genetic Evaluation of Livestock provided genetic evaluation services for 14 beef breed associations with a total membership in excess of 50,000 breeders. As one of the two primary institutions involved in beef cattle genetic evaluation research and production, the Center continued its pivotal role in the National Beef Cattle Evaluation Consortium receiving over \$250,000 in research support for the last 2 years. (Ruminant Production Systems)
- Research by the meat science/food safety group resulted in NCBA Guidelines for Beef Aging and in USDA Agricultural Marketing Service approval of video image analysis (VIA) instruments for official measurement of marbling scores. Faculty delivered invited lectures on meatborne pathogens in 21 countries. (Meat Science and Animal Product Food Safety)
- The third annual Legends of Ranching Sale was held in March, 2008. Noted ranches consign young horses to the Equine Science program. Three classes are involved in preparing for the sale: students in the horse training class train the horses for sale, students in the equine exhibition class put on a cowboy competition for workhorses during the sale, and students in the equine marketing course produce and advertise the actual horse sale. Consignors appreciate the opportunity to have a sale in the east-central Colorado area and the opportunity to support the preparation of young people for the professional equine industry. (Equine Science and Business)
- A multi-disciplinary research project on ammonia Best Management Practices is testing BMPs on feedlots and dairies in Colorado and surveying producers regarding their current BMP use and barriers to further BMP adoption in order to optimize our recommendations. Our research on site-specific manure management is helping producers use manure to improve soil quality and protect water quality. (Animal Environmental Systems)
- In 2008, College of Agricultural Sciences faculty were integral parts of teams that received in excess of \$4.4 million in biofuels research and training grants; and CSU was one of 13 land grant universities to receive “Grand Challenge” awards from USDA at their Bio-Energy Awareness Days Conference. (Fundamental Biology of Plants and Plant Pests)
- Greatly expanded service to a wide network of small acreage fruit and vegetable growers delivered by the applied research and outreach of the Specialty Crops Program (SCP), made possible by a unique partnership with the Colorado Department of Agriculture (CDA). This involves multiple teams of CSU researchers, specialists and agents throughout the state, with grower-initiated projects guided by CSU technical advisors. There have been about 60 grower grants over the last five years, providing a strong foundation for innovation and increased profitability. The Rocky Mountain Small Organic Farms Project, which demonstrates optimum cultivar selection and crop production practices, as well as marketing approaches to small acreage producers, is another key element of the SCP. (Crop Improvement Extended Towards Crops for Health)
- Curriculum design for “Golf Management” as a new concentration in the Landscape Horticulture major. The golf industry has been engaged in this process, which integrates education in business, hotel/resort management and turfgrass science. Student interest and strong demand for graduates are expected to result in high enrollment. (Design and Management of Colorado Landscapes)
- All registered insecticides for onion thrips have shown repeated control failures, thus threatening onion production. Resistant onion varieties, the use of straw mulches to reduce thrips numbers, and the use of other cultural practices to manage the disease all show promise. Together, these tools may become important keys to sustainable and profitable onion production in the region, but much research remains if these two pests are to be successfully managed. (Science and Management of Pest Insects, Plant Pathogens and Weeds)

- Precision agriculture research has improved the plant use efficiency of N fertilizer via the use of variable fertilizer application rate technology. CSU research has shown that net returns are increased by \$12-\$30 per acre using site-specific N management. Continually rising fertilizer N prices will greatly increase the benefits of precise use of N fertilizers. In addition to economic returns, nitrate leaching can be reduced by 25%, compared to uniform N fertilizer management techniques. (Managed Ecosystems)
- Faculty in the Department of Agricultural and Resource Economics provided presentations, programming and technical support to agricultural and specialty food producers in niche marketing, agribusiness management and distribution/retailing activities. These activities have increased the department's and Extension's impact among producers with non-commodity and alternative production and marketing interests, as well as professionals and businesses in specific segments of the broader food industry (chefs, small food processors, specialty retailers). (Economics, Management, Policy and Trade for Agribusiness and Communities)
- A lodging tax analysis, designed to assist growth in tourism, resulted in a ballot measure in Huerfano County, and a working group to further investigate a ballot measure in Custer County (which has now been authorized by the County Commissioners in Custer County). The Huerfano measure passed with a 70% vote in favor, having lost with only 40% in favor just 2 years ago. (Sustainable Community Development)

College of Agricultural Sciences 2007-08 Annual Report

Mission Statement: The College of Agricultural Sciences (College) and the Colorado Agricultural Experiment Station (AES) are committed to excellence, setting the standard for undergraduate and graduate education (resident and distance), basic and applied research, and public education related to agricultural, ornamental, and equine industries on topics of inputs, production, processing, merchandizing, management, finance, policy, food quality, landscape design, environmental impacts, and community development, using plant, animal, soil, ecological, and economic sciences.

Vision Statement: The College and AES will be recognized locally and nationally as leaders in developing professionals and generating and disseminating knowledge to keep Colorado agriculture competitive, food safe, the environment clean, Colorado green, and build food products which contribute to health and prevent disease.

Core Values: The College and AES base their activities on the following core values:

1. Develop and apply objective knowledge based upon the scientific process and peer review.
2. Provide open access for all to the university.
3. Provide open and timely communication of results to peers and the public.
4. Encourage and reward teamwork to solve issues.
5. Demonstrate respect for the unique contribution of each person.
6. Employ high standards of academic and scientific integrity.
7. Provide high value added performance in education and research for customers and the public.
8. Demonstrate respect and a collaborative and helpful spirit for people inside and outside of the organization.
9. Promote and reward excellence in teaching, research, outreach, and service.

Strategic Initiatives: The strategic planning process in the College and AES involved faculty and staff representing each department, researchers and Extension agents. As a result, 11 specific planning initiatives were identified which drive our focus and provide direction for the future. To implement these initiatives, a steering committee was established for each planning area comprised of faculty, staff, researchers and Extension agents. The steering committees have designated leaders who are charged with implementing various strategic objectives and ensuring success in the various areas. The strategic initiatives identified include:

- Ruminant Production Systems
- Meat Science and Animal Food Product Safety
- Equine Science and Business
- Animal Environmental Systems
- Fundamental Biology of Plants and Plant Pests
- Crop Improvement Extended Toward Crops for Health
- Design and Management of Colorado Landscapes
- Science and Management of Pest Insects, Plant Pathogens and Weeds
- Managed Ecosystems
- Economics, Management, Policy and Trade for Agribusiness and Communities
- Sustainable Community Development

Outcome Measures:

- I. **Majors:** The following table shows the history of the number of undergraduate primary majors in the College:

Fall 2005	Fall 2006	Fall 2007	Fall 2008
1,267	1,236	1,226	1,222

*The goal of the College is to increase enrollment of undergraduate primary majors to 1,600 by Fall 2012.

The following table shows the history of the number of graduate primary majors in the College:

Major Type	Fall 2005	Fall 2006	Fall 2007	Fall 2008
M.S.	152	136	133	136
PhD	67	72	81	90
Totals	219	208	214	226

*The goal of the College is to increase graduate enrollment to 250 for MS students and 150 for PhD students by Fall 2020.

- II. **Degrees:** The following table shows the history of the number of undergraduate degrees conferred by the College:

AY 2004-05	AY 2005-06	AY 2006-07	AY 2007-08
285	300	276	256

The following table shows the history of the number of graduate degrees conferred by the College:

AY 2004-05	AY 2005-06	AY 2006-07	AY 2007-08
62	59	55	45

The following table shows the history of the number of post docs trained in the College:

AY 2004-05	AY 2005-06	AY 2006-07	AY 2007-08
10	14	14	13

- III. **Student Credit Hours:** The following table shows the history of total undergraduate student credit hours for faculty and staff in the College:

AY 2004-05	AY 2005-06	AY 2006-07	AY 2007-08
26,938.7	27,035.0	27,708.6	27,334.9

The following table shows the history of total graduate student credit hours for faculty and staff in the College:

AY 2004-05	AY 2005-06	AY 2006-07	AY 2007-08
2,719.5	2,783.5	2,519.4	2,624.8

- IV. **Student/Faculty Ratios:** For Academic Year 2007-08, the student to faculty ratio was 26.5 students per every 1 resident instruction faculty member. For Academic Year 2007-08, the faculty to student credit hour ratio was 1 resident instruction faculty member for 648.2 student credit hours (includes both undergraduate and graduate).

V. **Financial Resources:** Expenditures from resident instruction, state and Federal Agricultural Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with all strategic initiatives were evaluated to determine the level of financial resources dedicated to these areas throughout the College. The following table shows the relevant expenditure history within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
Res. Instr.	\$4,383,973	\$4,780,753	\$396,780 (9.1%)	\$5,421,304	\$640,551 (13.4%)
AES					
State	\$5,315,547	\$5,309,303	-\$6,244 (-0.1%)	\$3,745,254	-\$1,564,049 (-29.5%)
Federal	\$1,700,753	\$1,710,153	\$9,400 (0.6%)	\$1,694,637	-\$15,516 (-0.9%)
Extension					
State	\$1,791,452	\$1,814,260	\$22,808 (1.3%)	\$1,927,653	\$113,393 (6.3%)
Federal	\$97,504	\$93,032	-\$4,472 (-4.6%)	\$96,685	\$3,653 (3.9%)
Grants/Contracts	\$10,392,697	\$11,353,595	\$960,898 (9.2%)	\$11,554,881	\$201,286 (1.8%)
Cash	\$2,858,440	\$4,147,642	\$1,289,202 (45.1%)	\$6,229,761	\$2,082,119 (50%)
Gift	\$811,226	\$1,017,972	\$206,746 (25.5%)	\$1,123,611	\$105,639 (10.4%)
Totals	\$27,351,592	\$30,226,710	\$2,875,118 (10.5%)	\$31,793,786	\$1,567,076 (5.2%)

VI. **Scholarships:** The following table shows the history of the number and amount of undergraduate and graduate scholarships in the College:

AY	Undergraduate	Undergraduate Amount	Graduate	Graduate Amount
2004-05	227	\$419,850	8	\$27,268
2005-06	237	\$468,308	8	\$34,938
2006-07	287	\$567,516	10	\$35,000
2007-08	282	\$553,905	17	\$36,434

For academic year 2007-08, 202 undergraduate students (16.5%) and 16 graduate students (7.5%) received scholarships to assist with the cost of attending college. Also, the average undergraduate scholarship amount was \$1,964 per student and the average graduate scholarship amount was \$2,143 per student.

VII. **Publications:** For calendar year 2006, faculty, staff and students published 195 refereed journal articles. For calendar year 2007, faculty, staff and students published 185 refereed journal articles, a decrease of 10 (5%) from 2006.

In addition, for calendar year 2007, faculty, staff and students in the College produced 835 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

VIII. **International Opportunities and Experiences:** Currently, the College has International Memorandums of Understanding (IMOU) with several universities: Mendel University of Agriculture and Forestry (Brno, Czech Republic), L' École Supérieure d' Agricultur (Purpan, France), Lincoln University (Canterbury, New Zealand), Instituto Tecnológico y de Estudios Superiores de Monterrey (Mexico), Banaras Hindu University (India), University of Pretoria (South Africa), Galen University (Belize) and Saratov State Agrarian University (Saratov, Russia).

During AY 2007-08, there were 46 international students in the College representing 27 countries. There were a total of 39 students from the College who studied abroad. The top destinations were Europe, New Zealand and Australia.

Internationalization goals of the College include having 25 percent of graduates with a study abroad experience and 50 percent of faculty with professional experience abroad by 2014. Additionally, the College hopes to initiate a Faculty International Committee to guide actions to achieve international goals, a Student International Club to serve the international interests of students, and a Global Hunger Initiative to provide opportunities for awareness and service to contribute to the worldwide goal of ending world hunger by 2030.

IX. Outreach: For calendar year 2007, faculty and staff associated with the College participated in approximately 1,374 workshops/presentations reaching more than 47,710 total participants.

X. Student opportunities and achievements: Students in the College have many opportunities to engage in experiential learning through activities such as clubs, judging teams and internships.

The College offers the opportunity to participate in the following clubs:

- | | |
|--|---|
| 1. Ag Ambassadors | 16. CSU Versatility Ranch Horse Club |
| 2. Agribusiness Association | 17. Farm House Fraternity |
| 3. Ag Council | 18. Gillette Entomology Club |
| 4. Agronomy Club | 19. Horticulture Club |
| 5. Alpha Gamma Rho | 20. Mountain Riders Horse Club |
| 6. Alpha Tau Alpha | 21. Phi Alpha XI |
| 7. Student Chapter of the American Society
Landscape Architects | |
| 8. Block & Bridle | 22. Polo Club |
| 9. Collegiate 4-H Club | 23. Rodeo Club |
| 10. Collegiate Chapter of FFA | 24. Shotgun Sports |
| 11. Collegiate Cattlewomen's Association | 25. Sigma Alpha |
| 12. Collegiate Horseman's Association | 26. SOLDAC (Student Organization of
Landscape Designers and Contractors) |
| 13. CSU Farm Bureau | 27. SusDev (Sustainable Development) |
| 14. CSU Farmer's Union | 28. Turf Club |
| 15. CSU Pre-Vet Club | |

The College offers students the opportunity to participate on the following judging teams:

- Dairy Judging
- Horse Judging
- Livestock Judging
- Meats Judging
- Wool Judging

Students participating in various competitive activities achieved exceptional success in 2007-2008:

- CSU Meats Judging Team: Colorado State Champion 4-H Meat Judging team won the National 4-H Meat Judging Contest, Kansas City, MO; Colorado State Intercollegiate team won the International Intercollegiate Meat Judging Contest, Dakota City, NE; Reserve State Champion 4-H team won the National Western Stock Show Contest, Denver, CO
- CSU Livestock Judging Team: Won High Team Overall at the Pannell Ranch competition

- CSU Horse Judging Team: Won APHA Spring Sweepstakes, Fort Worth, TX, including High Team in Performance, 4th High Team in Reasons and High Team Overall
- Other highlights: Colorado State claimed Champion honors at the National Collegiate Beef Quiz Bowl, Reno, NV
- CSU Food Marketing Team: The Food Marketing Team won second place at the Western Collegiate Food Marketing Competition in March, and competed at the National Agribusiness Marketing Association Competition for the first time in several years. At the Westerns, the team won first place in each of 3 peer judged categories. The team also attended the Food Distribution Research Society Marketing Case Study Competition.

Internship Opportunities: Each department in the College provides internship opportunities through their respective courses of study. For Academic Year 2007-08, a total of 152 students participated in various internships (12.4% of total undergraduate enrollment).

Other Experiential Learning Opportunities:

- Ag Adventure: Ag Adventure is a program developed to educate elementary school students about the importance of agriculture in their daily lives, such as common products that agriculture provide including milk, cheese, corn, wheat, and wool for clothing, before those products are available in stores. The program provides students with focused, hands-on activities to teach them about a wide range of agricultural enterprises and products. In September, 2008, more than 2,000 local third-graders participated in the program.
- Seedstock Team: The Colorado State University Seedstock Merchandising Team showed six registered bulls at the 2008 National Western Stock Show as part of a student project emphasizing learning from, networking with and competing against experts. The students fed, led, washed and blew dry their bulls in preparation for the competition and sale. The process teaches students about the cattle industry and what it takes to manage a professional operation.

XI. Faculty Honors and Achievements: The following faculty and staff received national awards in their respective disciplines:

Department of Agricultural and Resource Economics: Dr. Dawn Thilmany: The Food Distribution Research Society Journal Award; Farm Foundation Fellow; Dr. Andrew Seidl: Erasmus Mundus Visiting Scholar, MESPOM Programme, European Union; Western U.S. Cooperative Extension Regional Early Career Award, Epsilon Sigma Phi; Dr. Nigel Griswold: National Center for Smart Growth Best Thesis Award; Dr. Marshall Frasier: Gamma Sigma Delta 2007 Faculty Award of Merit

Department of Animal Sciences: Dr. John Sofos: University Distinguished Professor, CSU: GMA/FPA Food Safety Award, International Association of Food Protection; Temple Grandin: Secretary's Highest Recognition Award, Department of Health and Human Services, Washington, D.C.; Dr. Terry Engle: 2007 NACTA Charles N. Shepardson Meritorious Teaching Award; Dr. Jim Heird: Honorary Vice President of the Uruguayan Quarter Horse Association; Dr. Bernie Rollins: Humane Award, The American Veterinary Medical Association

Department of Bioagricultural Sciences and Pest Management: Dr. Jan Leach: University Distinguished Professor, CSU; Dr. Whitney Cranshaw: Distinguished Alumni Award, Department of Entomology, University of Minnesota; Dr. George Beck: Special Achievement Award, Invasive Weed Awareness Coalition; Special Service Award, American Seed Trade Association

Department of Horticulture and Landscape Architecture: Dr. Jorge Vivanco: named Fellow, John Simon Guggenheim Memorial Foundation and selected as a Fulbright Scholar.

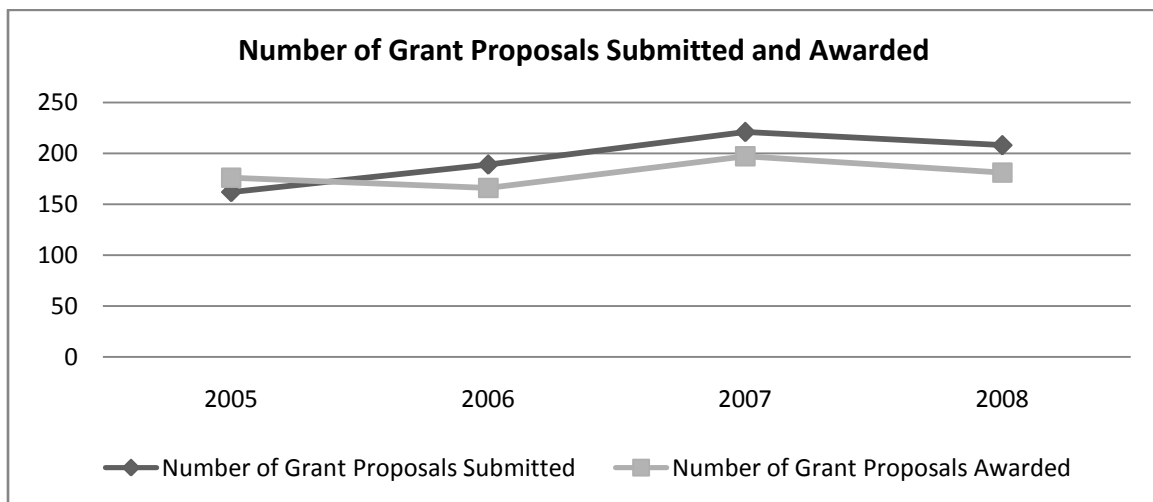
Department of Soil and Crop Sciences: Dr. Raj Khosla: Lloyd R. Frederick Soil Science Award, Soil Science Society of America; Dr. Keith Paustian: Shared in a Nobel Prize. He was a lead author on greenhouse gas inventory methods for agriculture, forestry and other land use; Dr. Jorge Delgado: affiliate faculty member, [ARS-USDA scientist], Conservation Research Award, Soil and Water Conservation Society; Dr. Gary A. Peterson: President, Soil Science Society of America

XII. Facilities: The College has made significant progress toward the renovation of two buildings on campus related to agricultural sciences, Shepardson Hall and Animal Sciences. Designs and program reviews were completed in 2006. The President of the CSU System, the Board of Governors and the Colorado Commission of Higher Education have all approved the plans and state funds (\$12.2 million) have been committed to aid in the renovations. Significant efforts are underway to raise private funds so that construction may begin. Plans for the renovations may be found at the following website: <http://www.agsci.colostate.edu>.

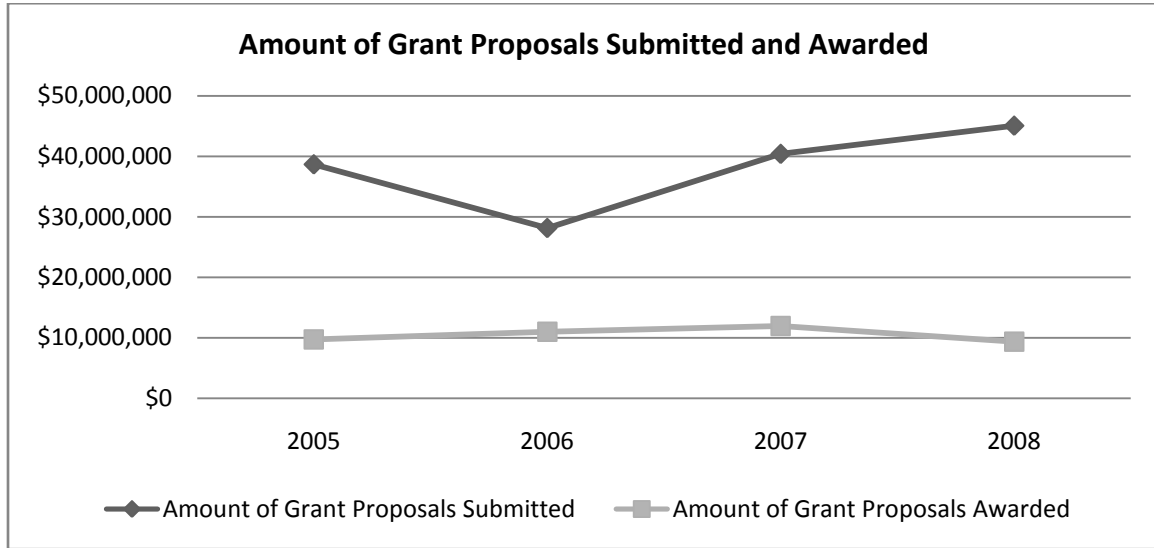
Plant Environmental Research Center (PERC) and campus greenhouses: A total of \$1.55 million from bond revenues was committed to the upgrade and renovation of the campus greenhouses and head houses as well as the facilities at PERC.

XIII. Research: Faculty, staff, and students in the College are committed to conducting fundamental and applied research supporting the initiatives outlined in the strategic plan.

The following chart shows the history of the number of grant proposals submitted and awarded by faculty and staff in the College:



The following chart shows the history of the amount of awards submitted and awarded by faculty and staff in the College:



For fiscal year 2007-08, personnel in the College expended in excess of \$24 million dollars on research related activities. The goal of the College is to achieve \$30 million in expenditures related to research by 2012.

XIV. Undergraduate Education: As stated earlier in this report, the goals of undergraduate education include raising enrollment in the College to 1,600 undergraduate majors, improving the student/faculty ratio, and enhancing international and experiential learning experiences to supplement excellent classroom experiences. The strategy for enrollment growth is to improve recruiting activity, provide more scholarships, offer new degree programs attractive to a broader range of student interest, improve physical facilities for learning, and provide CSU trained teachers for agricultural teaching positions throughout the State of Colorado.

Recruiting efforts have increased substantially under the leadership of Associate Dean Nancy Irlbeck. Working with the Office of Admissions and our College of Agricultural Sciences Student Ambassadors, College representatives are in a growing number of high schools annually telling the story of career opportunities with an agriculture degree. As reported earlier, total scholarship distribution has risen nearly 30% in the last four years growing from \$420,000 in 2004-05 to over \$550,000 in 2007-08. Scholarships and experiential learning opportunities are a major element of our capital campaign plan. Several new degrees were offered to students in the College. Last year the Interdisciplinary Degree in Organic Agriculture was started. This year we have a new degree concentration in viticulture and enology. The College is planning a new degree in golf course management to begin next year. Improvement in physical facilities will take time. Elsewhere in this report is a description of plans to renovate and expand the Animal Sciences Building and Shepardson Hall. Every student in the College is affected by classrooms in these two buildings; attractive, effective spaces are important for learning success and for successful recruiting. Building renovations and expansions are another important element of our capital campaign.

The College has taken a particularly active position on improving the degree offering in Agricultural Education. This program suffered a lack of attention in past years and low student enrollment and graduation of a small number of agriculture teachers resulting. In the past two years, the College has

worked with the School of Education at CSU to hire a faculty position devoted to Agricultural Education. Our objectives are to double enrollment to 60 students, create double majors with Agriculture Education, provide a departmental home for Ag Ed majors, as well as, provide depth of knowledge in one subject field, and create a much stronger relationship with existing agriculture teachers throughout Colorado's high schools. The Agricultural Education Foundation has been helpful in strengthening the program.

- XV. Graduate Education:** Departments in the College are attractive to students seeking MS and PhD degrees. However, Colorado is nearly unique in the way it finances graduate education. In most states, a student on a graduate teaching or research assistantship is immediately identified as an employee of the university and offered in-state tuition. In Colorado, only citizens are offered in-state tuition. So, graduate students from other states must pay out-of-state tuition for the first year and do what is necessary to become a citizen during their first year in Colorado to qualify for in-state tuition in their second year. International students can never become Colorado residents and never qualify for in-state tuition. This policy makes graduate education in Colorado much more expensive than other states. The strategy adopted in the College is to allocate more research funds to research projects such that the funds must be spent on graduate students. In fall, 2008, the College continued to increase the total number of graduate students to 226. The College desires to raise the number of graduate students from the 226 present in fall, 2008 to 400 in fall 2014. It will take continuous attention to financial strategies to draw that number of graduate students to the College. The importance of building a graduate program is that the reputation of the institution in the State of Colorado is tied strongly to the quality of the undergraduate and applied research programs. The reputation of a university in the nation and world is tied to the quality of graduate and fundamental research programs. Both are important in building reputation of the institution and maintaining value of Colorado State University degrees.
- XVI. K-12 Initiatives:** The College is significantly involved with youth from kindergarten to high school ages. In spring each year, the College hosts and creates the annual Future Farmers of America (FFA) state competitions bringing over 1,000 high school youth and 300 parents and advisors to campus. The College provides specialist support for 4-H projects, especially in livestock learning and competition projects in counties and at the State Fair. The College hosts Agriculture Adventure, an agricultural awareness program for third graders in the Poudre Valley School District; more than 2,000 third graders visited ARDEC for the program in fall, 2008. The Agriculture Adventure program was invited to present experiential learning modules for youth at the National Western Stock Show and the Colorado State Fair. Agricultural scientists serve as advisors to high school students participating in Science Fairs on the Western Slope, the San Luis Valley, the Arkansas River Valley and in Fort Collins. The College is greatly expanding the Agricultural Education degree program with the strategic intent to raise the number of majors in the program to no less than 60 and make it possible to provide a sufficient number of agriculture teachers to fill annual vacancies in Colorado high schools. The University has allocated a new faculty position to the College to enhance the degree program. Additionally, the College is a regular participant in the statewide coordinated effort to organize agricultural education in high schools, community and junior colleges and four-year colleges; this effort is led by the Community College System Office.
- XVII. Development:** The College of Agricultural Sciences achieved a record setting year for private support. Net private support accumulated to slightly over \$9.41 million, a testament of the high quality of students, faculty, staff and research, as well as a strong support of alumni and friends.

Private Support Objectives	Private Support (millions)
Academic Excellence	\$4.48
Research, Outreach and Programs	\$4.68
Facilities	\$.25
Total	\$9.41

Over the past year, the College maintained a focus on three primary objectives: Academic Excellence; Research, Outreach and Programs; and Facilities.

A keen focus on Academic Excellence continues to provide support to both students and faculty through scholarships and endowed faculty positions. Great teachers, researchers, and students are the backbone of any higher education institution. Efforts such as undergraduate and graduate level scholarships, endowed chairs, professorships and other efforts to provide recognition and support for faculty and students are vital to the success and growth of the College. Success in these areas also assists in the recruitment and retention of leading scientists and top-notch students. In 2007-2008, Academic Excellence accounted for approximately \$4.48 million of our net private support. Our highlight private gift in this area is the Tom and Alice Kiplinger Scholarship, benefitting Animal Science students.

Emphasis on Research, Outreach and Programs helps to sustain and grow the cutting-edge research conducted by our outstanding faculty, the experiential hands-on learning our students participate in to enhance their education beyond the classroom, and enables administrators to address the most pressing, often unplanned for, demands of sustaining and enhancing the College. Private support for programs and activities within the College creates a connection and dialogue with interested and involved stakeholders. There are numerous opportunities for public/private partnerships through shared direction, common goals and leveraged support that enable faculty, students, and stakeholders to address relevant needs in the industry both in Colorado and nationally. In 2007-2008, Research, Outreach and Programs accounted for approximately \$4.68 million of our net private support. A few gift highlights in this area came from the Colorado Certified Potato Growers Association, Aurora Organic Dairy, and National Cattlemen’s Beef Association.

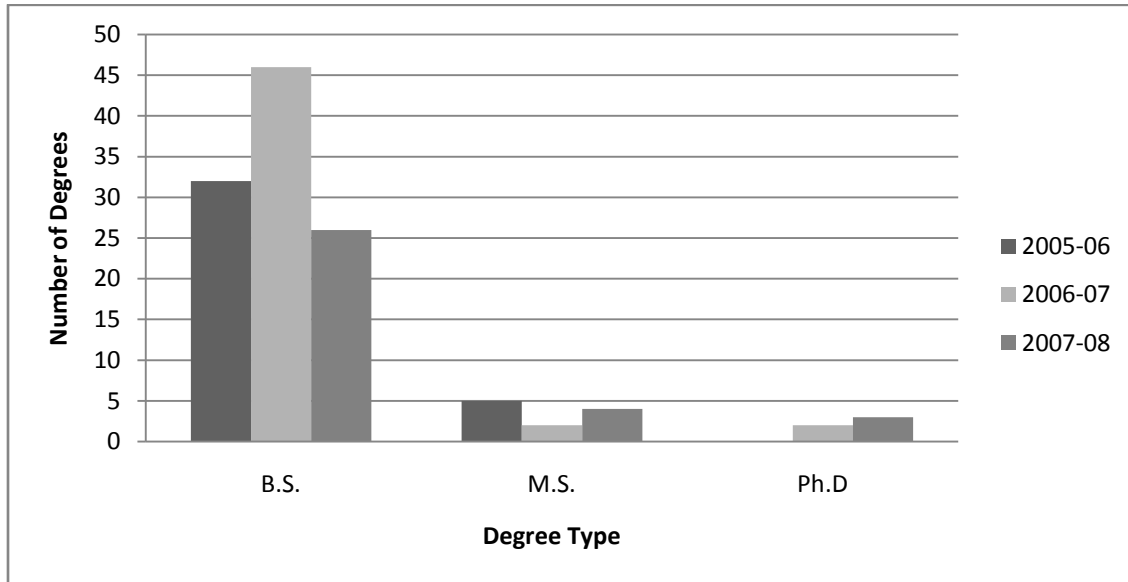
Facilities are a critical resource in the College. They provide the setting for learning, research and are the campus–base for outreach activities. Facilities are a means for recruiting and retaining the best and the brightest students and faculty. Our commitment to improvements to both the Animal Science and Shepardson buildings has built momentum over the past year, with significant movement planned for the coming year. In 2007-2008, Facilities accounted for approximately \$.25 million of our net private support, with multiple large potential gifts in progress for the coming year. Our highlight private gift in this area is the Schalk Family, in support of the Animal Science Building renovation.

XVIII. Diversity: The College has devoted numerous resources towards progress of our Diversity Plan. Freshmen seminar classes include dedicated time for emphasis on diversity. Diversity training is provided to freshmen and transfer students. Surveys from senior capstone classes include questions related to diverse experiences at CSU. Approximately 49% of faculty have international experience. The Associate Dean for Academic Affairs has organized an advisory committee to activate a local chapter of Minorities in Agriculture, Natural Resources and Related Sciences (MANNRS), a national society that welcomes membership of people of all racial and ethnic groups. Outreach and recruiting activities directed toward underrepresented student populations have increased and our Ag Ambassadors received training in effective recruitment of diverse populations.

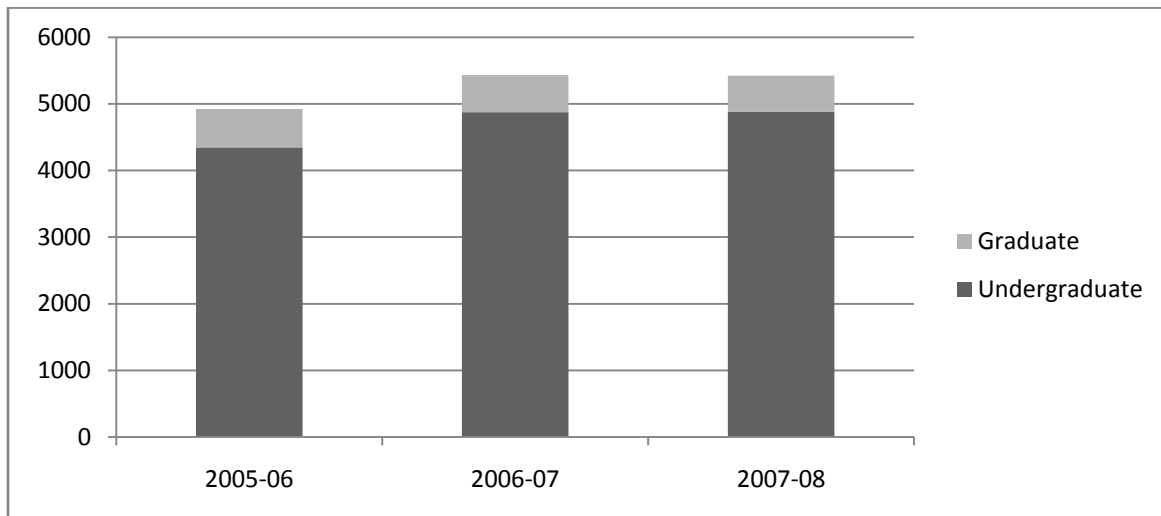
XIX. Departmental Analysis: Selected data associated with each department in the College are presented below.

A. Agricultural and Resource Economics:

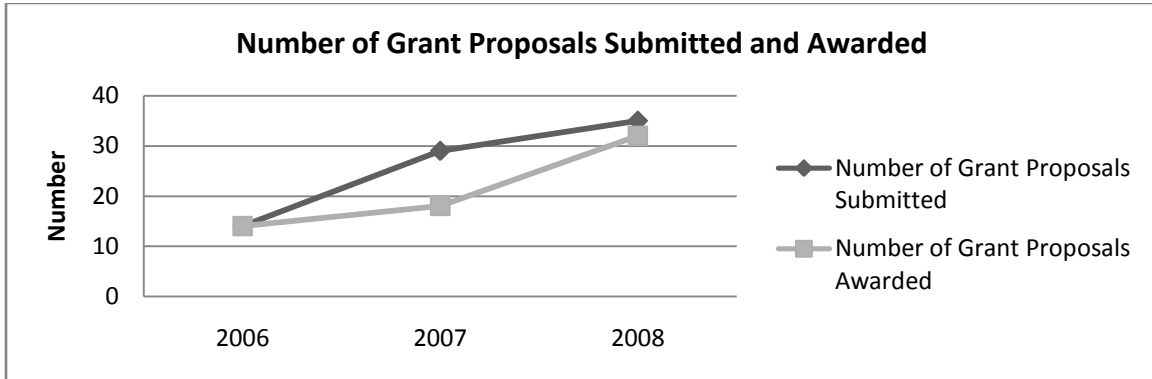
Degrees: The following chart shows the history of the number and type of degrees conferred by the department:



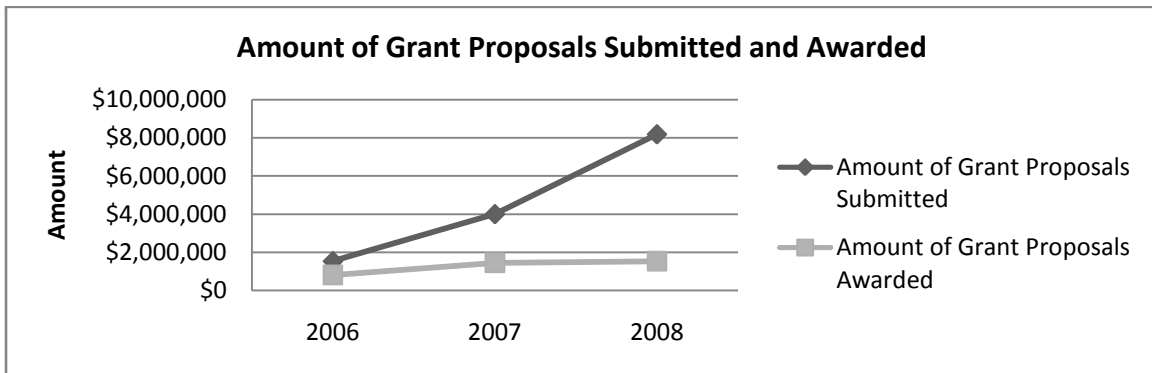
Student Credit Hours: The following chart shows the history of undergraduate and graduate student credit hours attributed to the department:



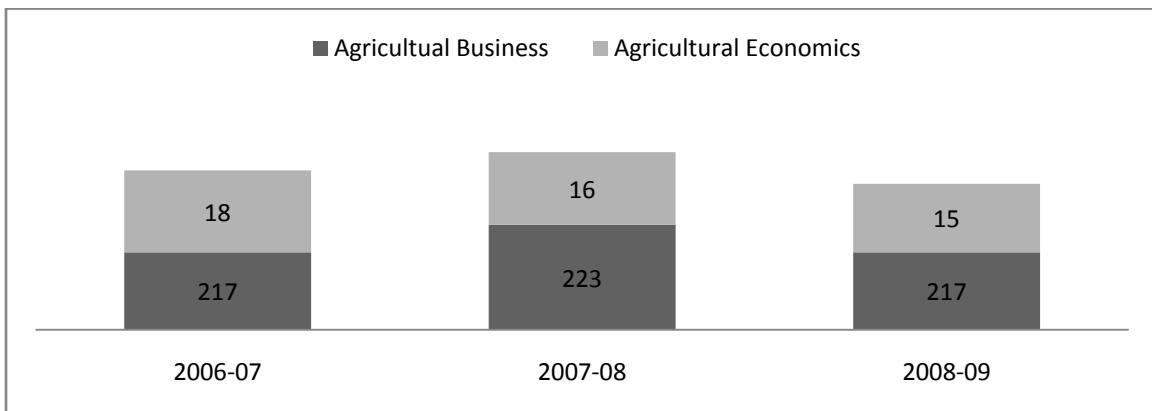
Grant Proposals Submitted and Awarded: The following chart shows the history of the number of grant proposals submitted and awarded by faculty and staff in the department:



The following chart shows the history of the amount of grant proposals submitted and awarded by faculty and staff in the department:

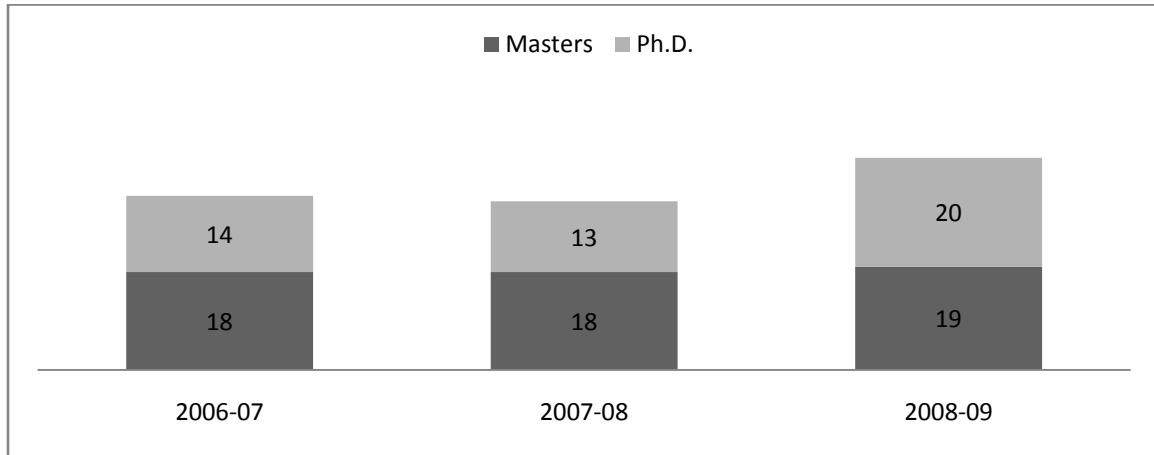


Majors: The following chart shows the history of the number of undergraduate majors in the department:



*Includes secondary majors

The following chart shows the history of the number of graduate majors in the department:



*Includes secondary majors

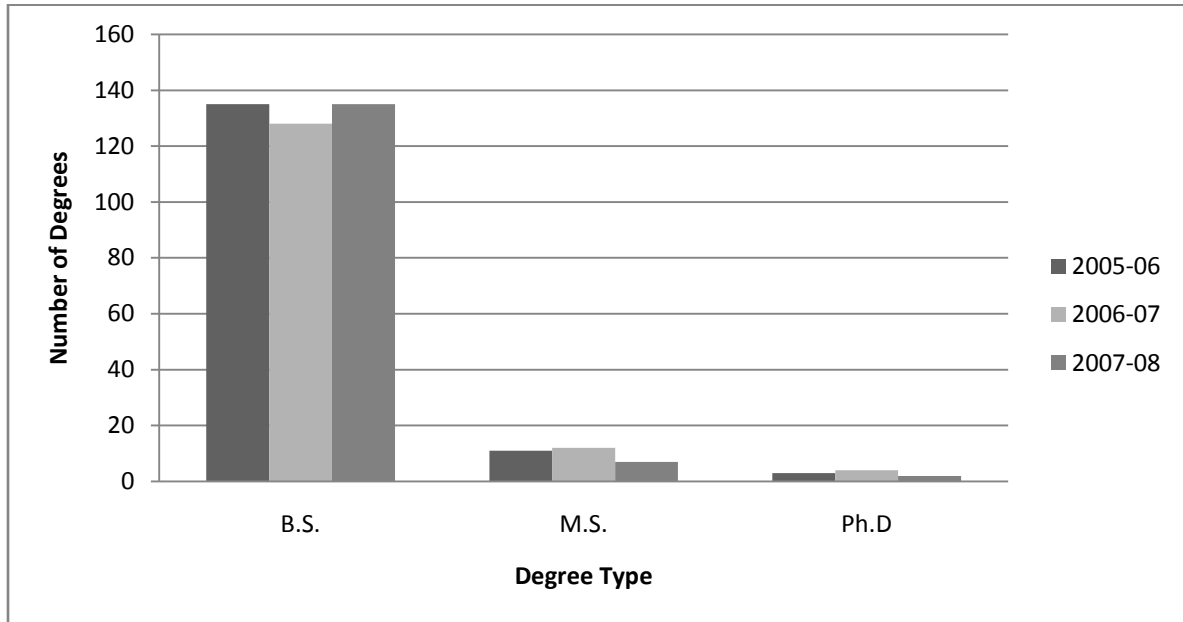
Publications: For calendar year 2006, faculty and staff in the department published 34 refereed journal articles. For calendar year 2007, faculty and staff in the department published 28 refereed journal articles, a decrease of 6 (-17.6%) from the previous year. In addition, for calendar year 2007, faculty, staff and students in the department produced 143 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

Student/Faculty Ratios: For Academic Year 2007-08, the student to faculty ratio for the department was 28.8 students per every 1 resident instruction faculty member. The faculty to student credit hour ratio was 1 resident instruction faculty member for 654.2 student credit hours (includes both undergraduate and graduate).

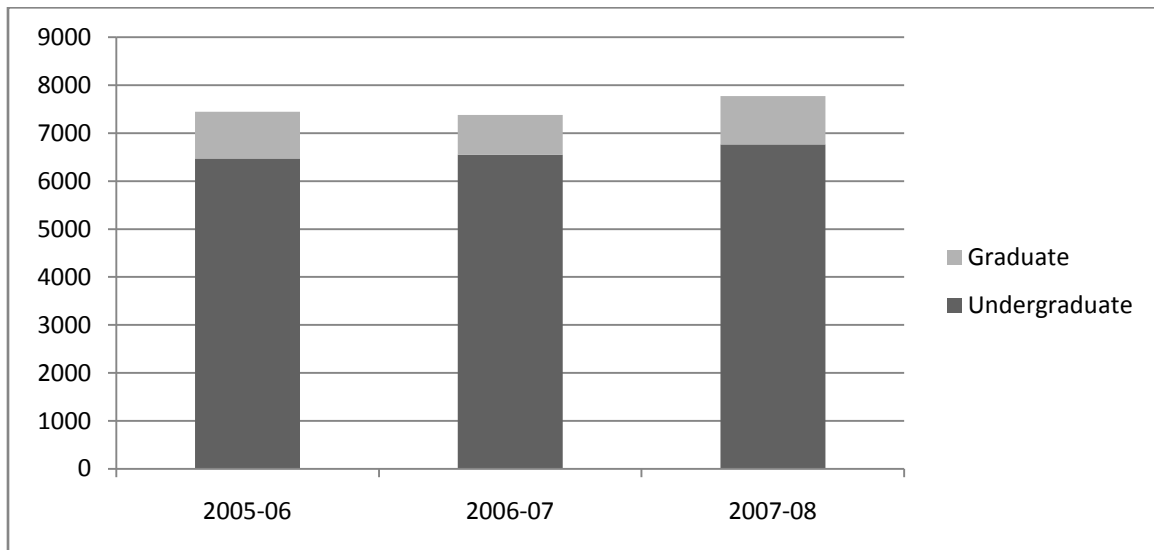
Outreach: For calendar year 2007, faculty and staff associated with the department participated in approximately 231 workshops/presentations reaching more than 5,774 total participants.

B. Animal Sciences:

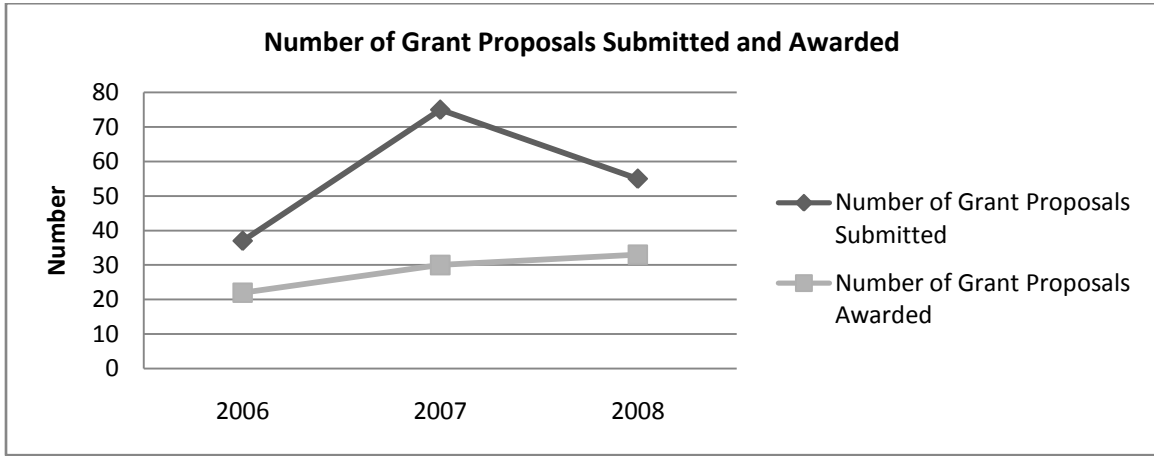
Degrees: The following chart shows the history of the number and type of degrees conferred by the department:



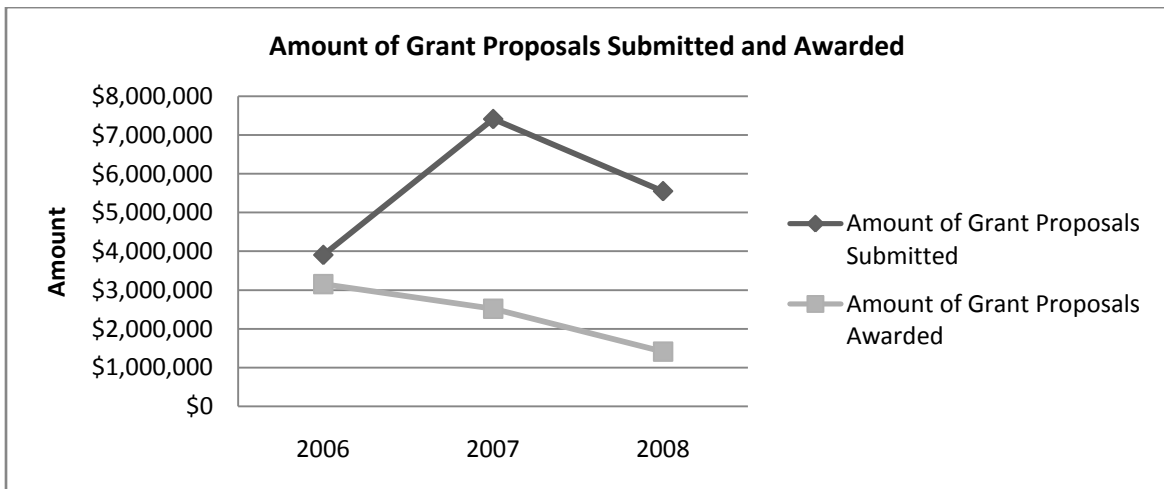
Student Credit Hours: The following chart shows the history of undergraduate and graduate student credit hours attributed to the department:



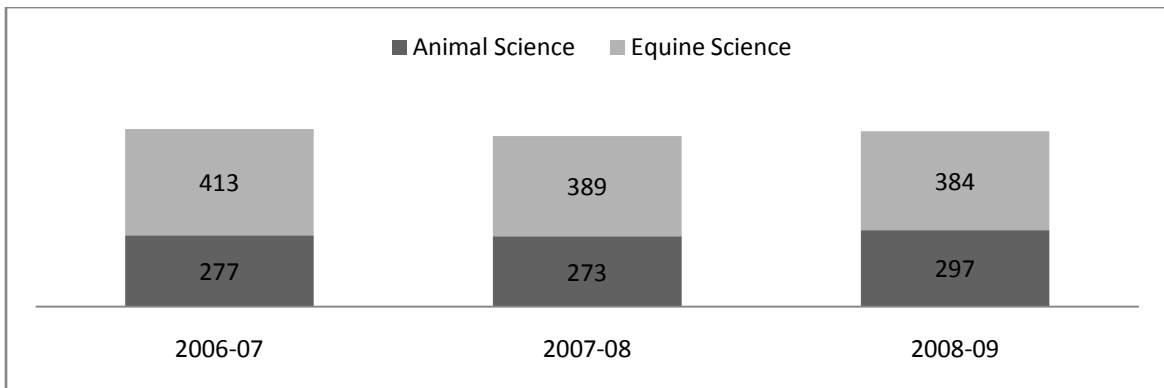
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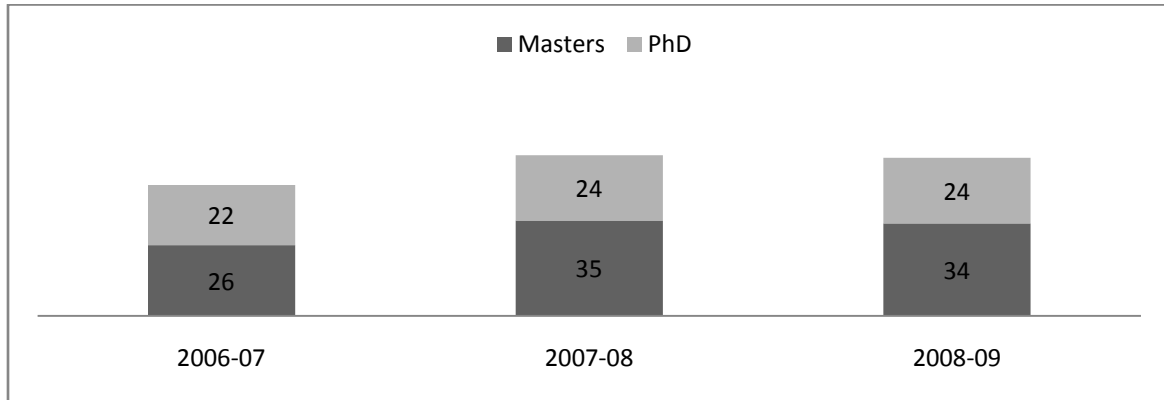


Majors: The following chart shows the history of the number of undergraduate majors in the department.



*Includes secondary majors

The following chart shows the number of graduate majors in the department.



*Includes secondary majors

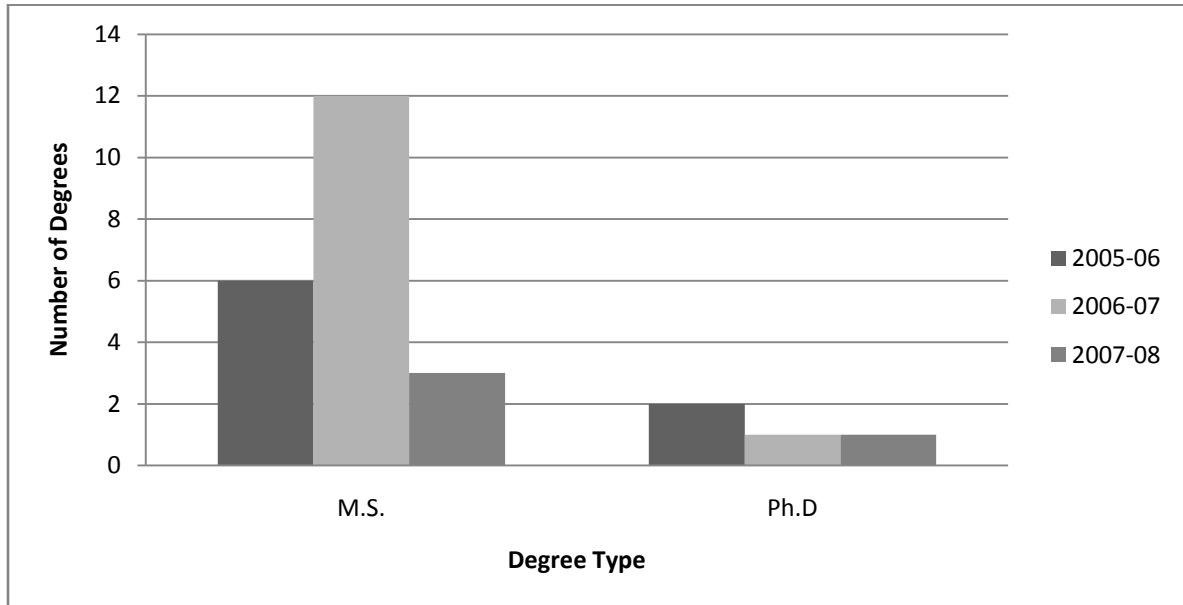
Publications: For calendar year 2006, faculty and staff in the department published 56 refereed journal articles. For calendar year 2007, faculty and staff in the department published 41 refereed journal articles, a decrease of 15 (-26.8%) from the previous year. In addition, for calendar year 2007, faculty, staff and students in the department produced 260 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

Student/Faculty Ratios: For Academic Year 2007-08, the student to faculty ratio for the department was 53.9 students per every 1 resident instruction faculty member. The faculty to student credit hour ratio was 1 resident instruction faculty member for 633.05 student credit hours (includes both undergraduate and graduate).

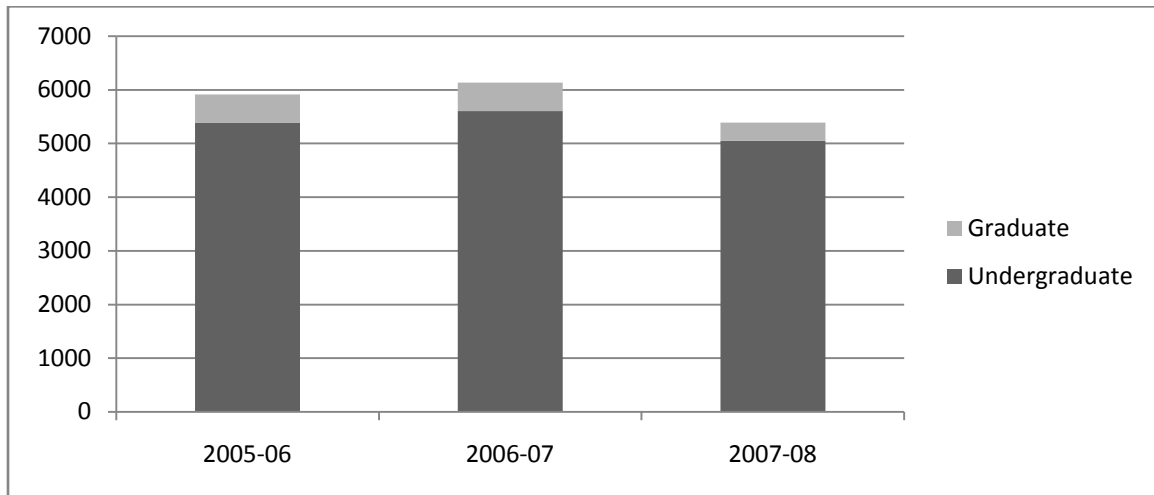
Outreach: For calendar year 2007, faculty and staff associated with the department participated in approximately 306 workshops/presentations.

C. Bioagricultural Sciences and Pest Management:

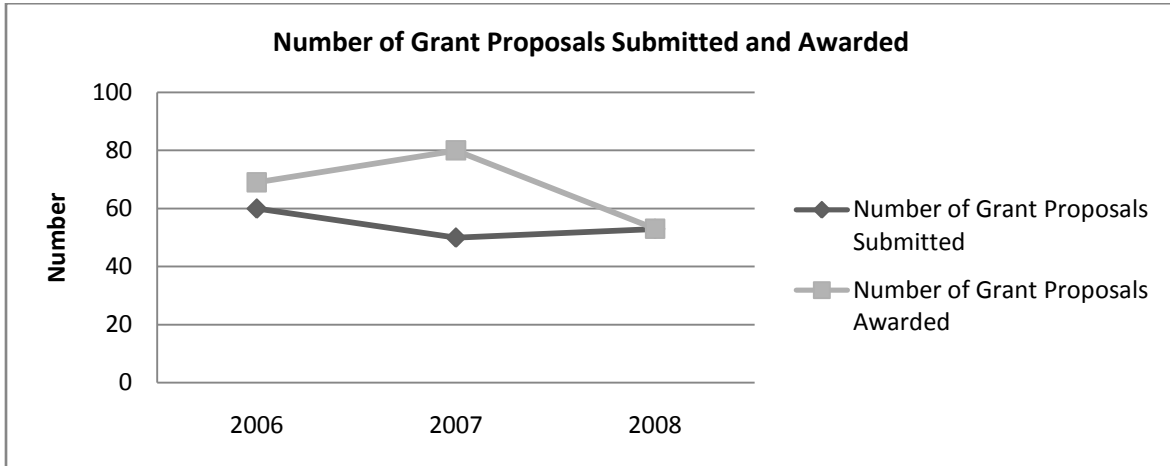
Degrees: The following chart shows the history of the number and type of degrees conferred by the department:



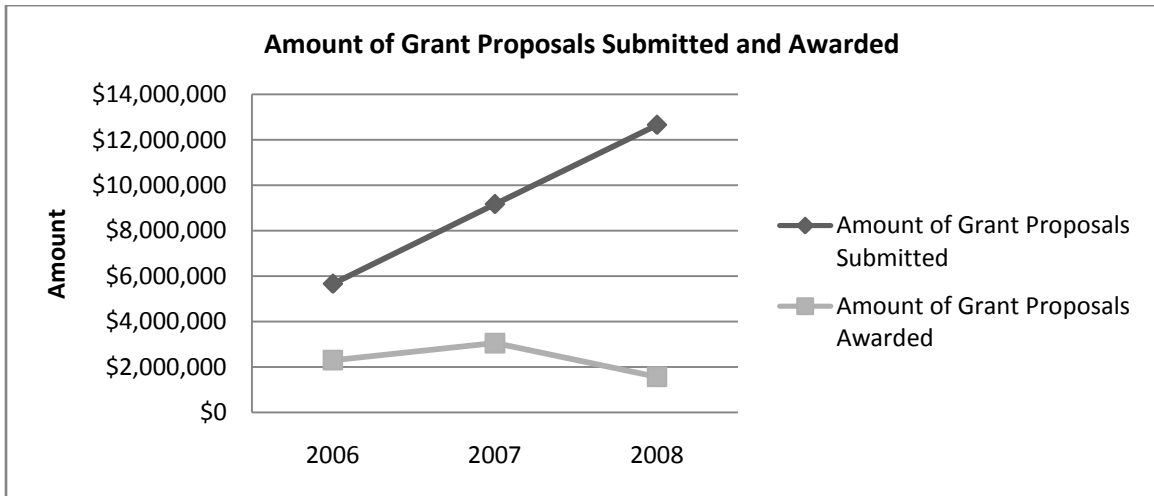
Student Credit Hours: The following chart shows the history of undergraduate and graduate student credit hours attributed to the department:



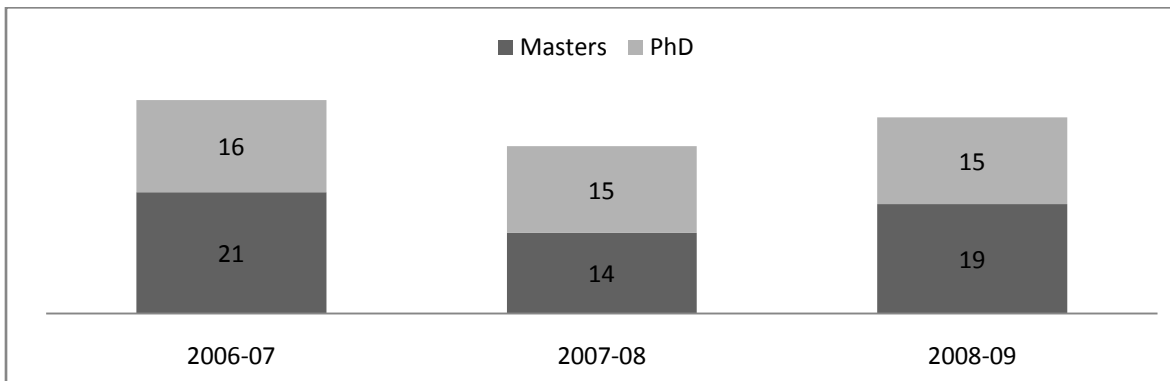
Grant Proposals Submitted and Awarded: The following chart shows the history of the number of grant proposals submitted and awarded by faculty and staff in the department:



The following chart shows the history of the amount of grant proposals submitted and awarded by faculty and staff in the department:



Majors: The following chart shows the number of graduate majors in the department.



*Includes secondary majors

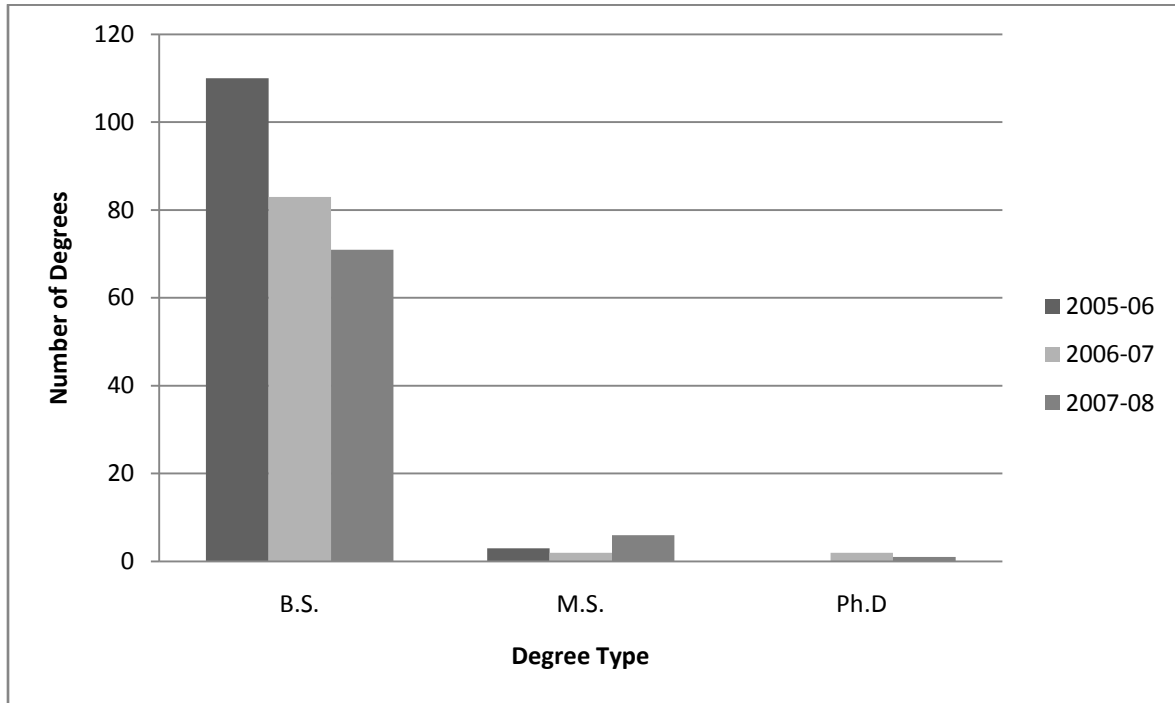
Publications: For calendar year 2006, faculty and staff in the department published 50 refereed journal articles. For calendar year 2007, faculty and staff in the department published 44 refereed journal articles, a decrease of 6 (-12%) from the previous year. In addition, for calendar year 2007, faculty, staff and students in the department produced 63 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

Student/Faculty Ratios: For Academic Year 2007-08, the student to faculty ratio for the department was 4.27 students per every 1 resident instruction faculty member. The faculty to student credit hour ratio was 1 resident instruction faculty member for 793.68 student credit hours (includes both undergraduate and graduate).

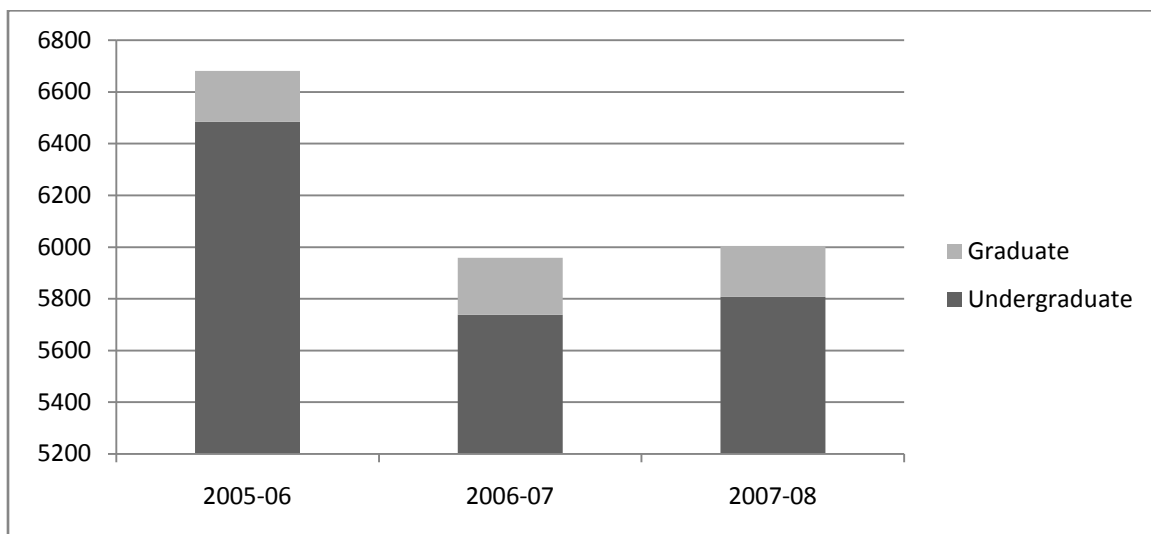
Outreach: For calendar year 2007, faculty and staff associated with the department participated in approximately 343 workshops/presentations reaching more than 19,899 total participants.

D. Horticulture and Landscape Architecture:

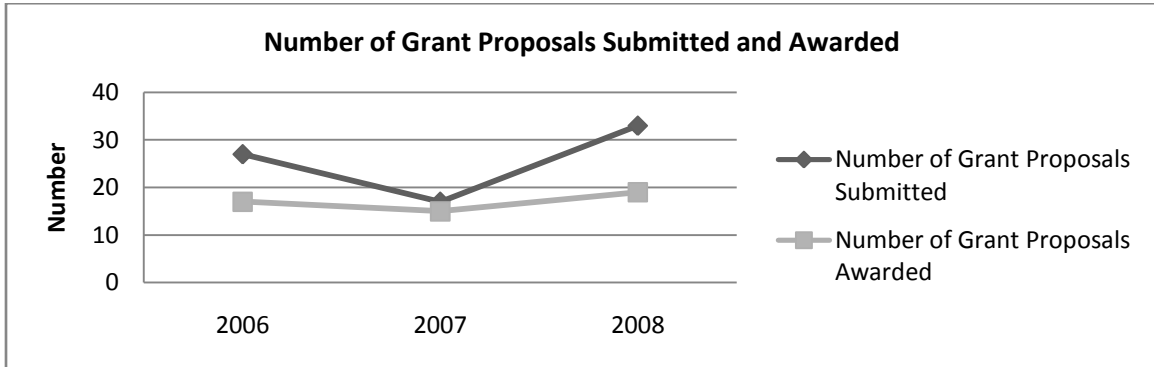
Degrees: The following chart shows the history of the number and type of degrees conferred by the department:



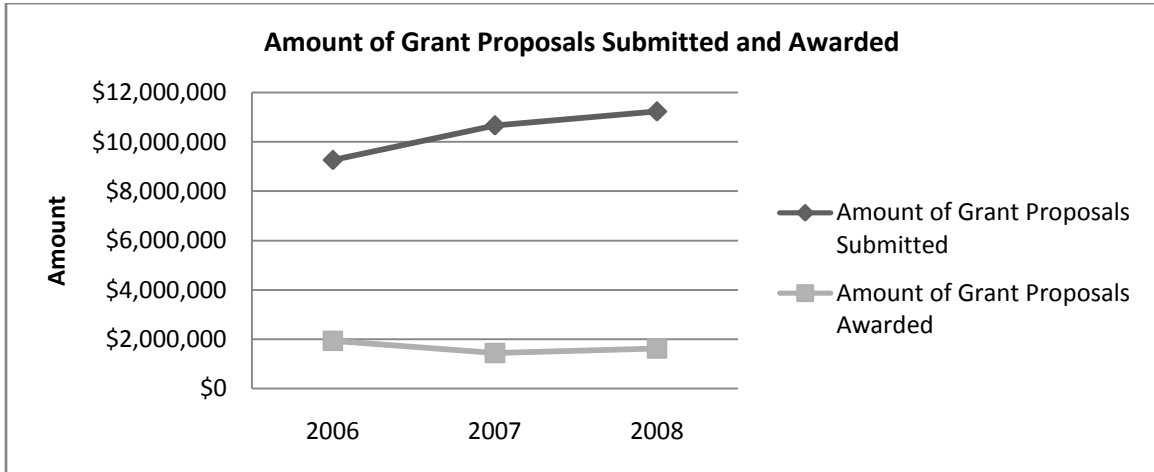
Student Credit Hours: The following chart shows the history of undergraduate and graduate student credit hours attributed to the department:



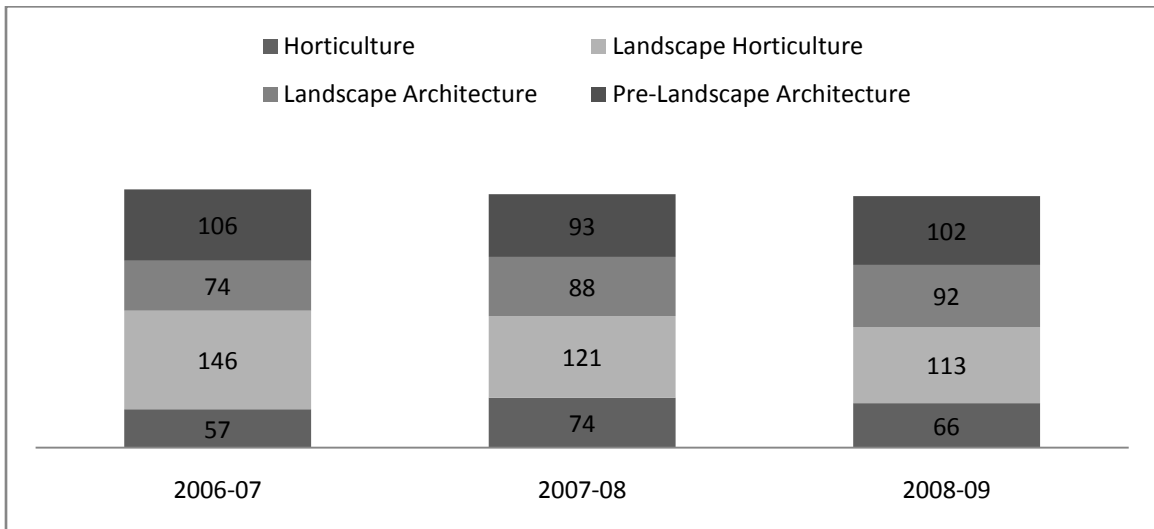
Grant Proposals Submitted and Awarded: The following chart shows the history of the number of grant proposals submitted and awarded by faculty and staff in the department:



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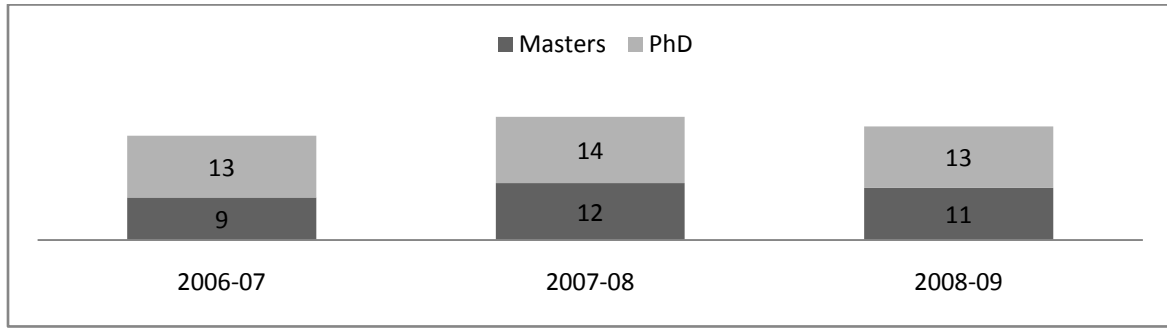


Majors: The following chart shows the number of undergraduate majors in the department.



*Includes secondary majors

The following chart shows the number of graduate majors in the department.



*Includes secondary majors

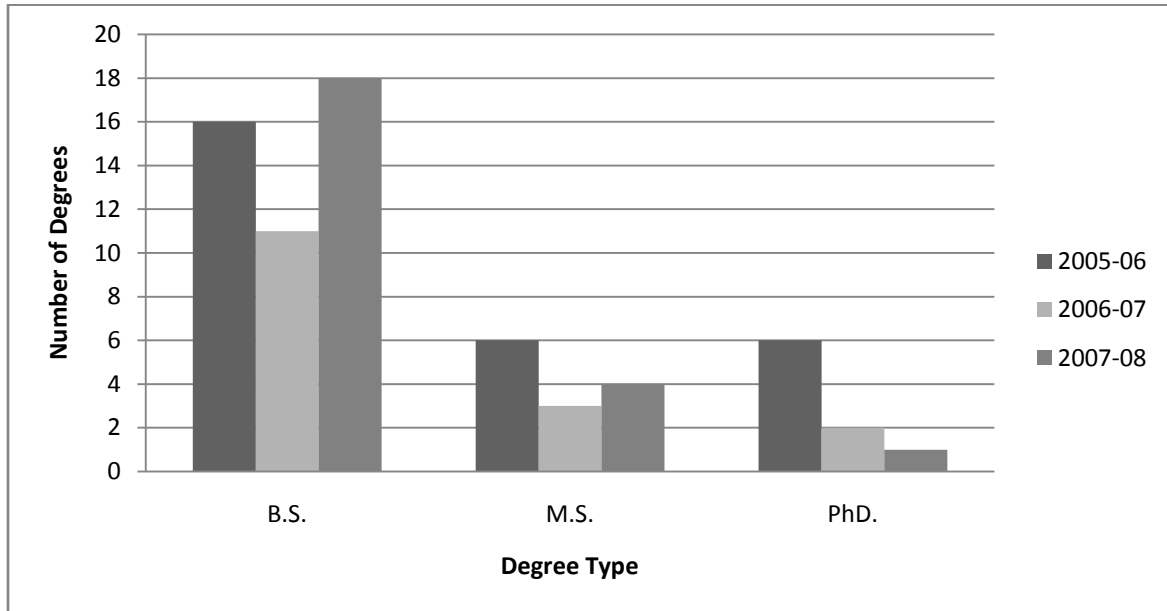
Publications: For calendar year 2006, faculty and staff in the department published 22 refereed journal articles. For calendar year 2007, faculty and staff in the department published 29 refereed journal articles, an increase of 7 (31.8%) from the previous year. In addition, for calendar year 2007, faculty, staff and students in the department produced 118 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

Student/Faculty Ratios: For Academic Year 2007-08, the student to faculty ratio for the department was 39.6 students per every 1 resident instruction faculty member. The faculty to student credit hour ratio was 1 resident instruction faculty member for 632.76 student credit hours (includes both undergraduate and graduate).

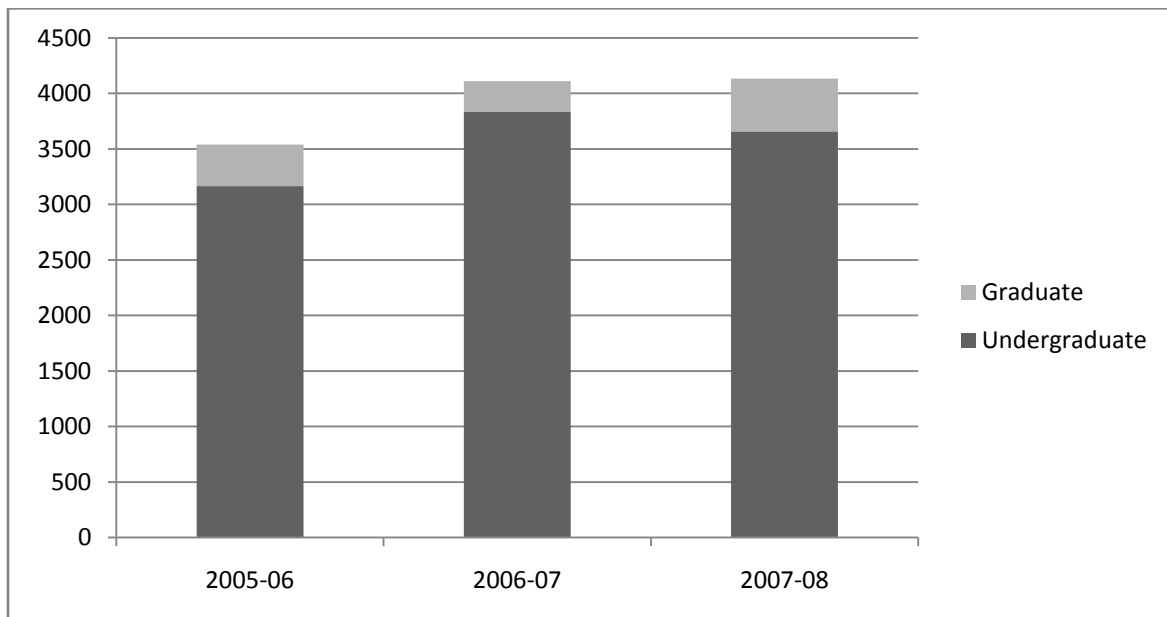
Outreach: For calendar year 2007, faculty and staff associated with the department participated in approximately 317 workshops/presentations reaching more than 14,303 total participants.

E. Soil and Crop Sciences:

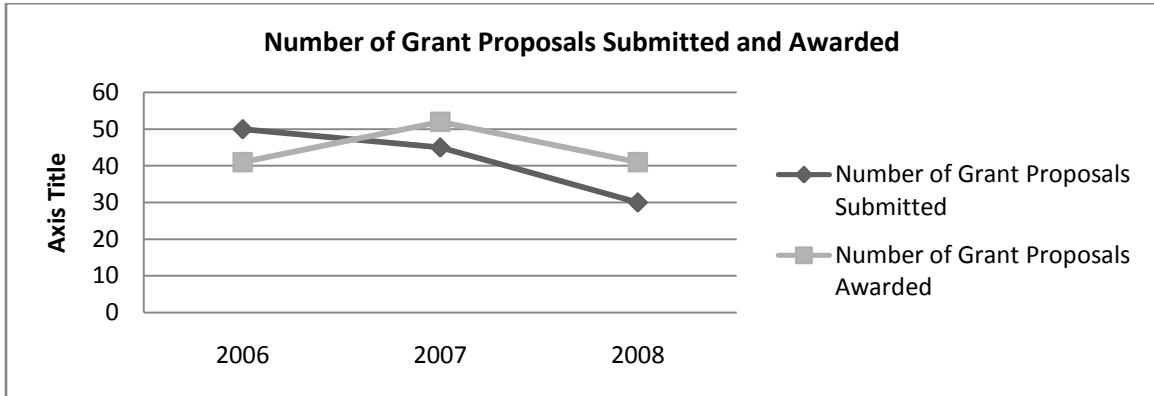
Degrees: The following chart shows the history of the number and type of degrees conferred by the department:



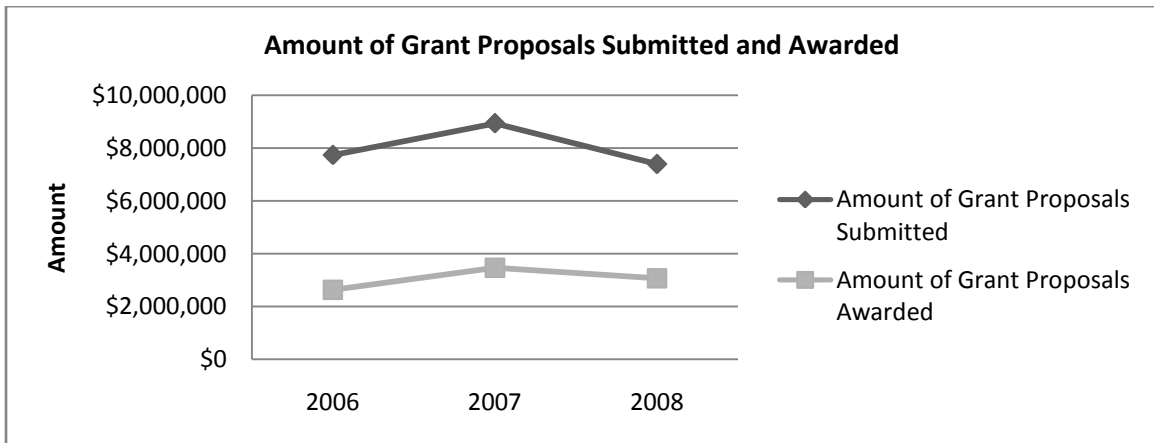
Student Credit Hours: The following chart shows the history of undergraduate and graduate student credit hours attributed to the department:



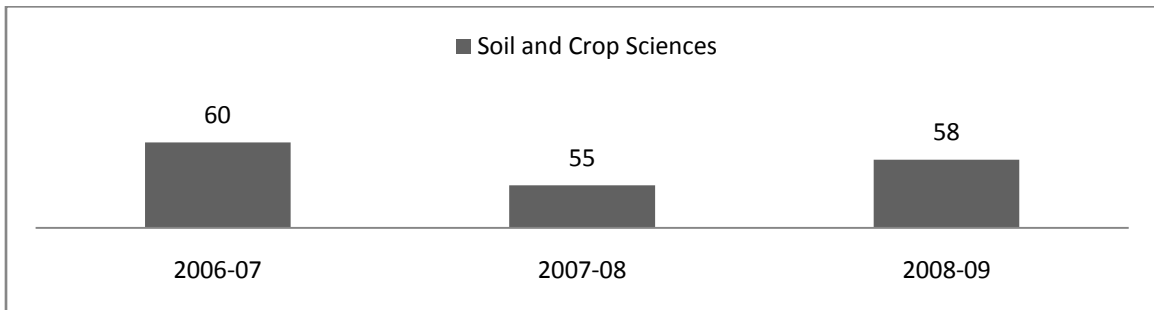
Grant Proposals Submitted and Awarded: The following chart shows the history of the number of grant proposals submitted and awarded by faculty and staff in the department:



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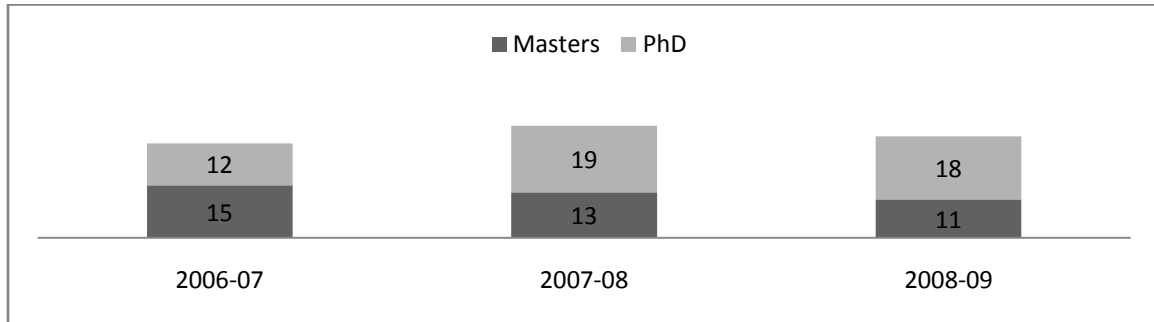


Majors: The following chart shows the number of undergraduate majors in the department.



* Includes secondary majors

The following chart shows the number of graduate majors in the department.



* includes secondary majors

Publications: For calendar year 2006, faculty and staff in the department published 40 refereed journal articles. For calendar year 2007, faculty and staff in the department published 54 refereed journal articles, an increase of 14 (35%) from the previous year. In addition, for calendar year 2007, faculty, staff and students in the department produced 251 other publications, including but not limited to, proceedings, transactions, abstracts, reports, software, websites, textbooks, etc.

Student/Faculty Ratios: For Academic Year 2007-08, the student to faculty ratio for the department was 5.87 students per every 1 resident instruction faculty member. The faculty to student credit hour ratio was 1 resident instruction faculty member for 441.78 student credit hours (includes both undergraduate and graduate).

Outreach: For calendar year 2007, faculty and staff associated with the department participated in approximately 177 workshops/presentations reaching more than 7,734 total participants.

Annual Report
2007-08

Ruminant Production Systems

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research, and outreach in cattle/beef production systems and be recognized as the leading university program in cattle/beef production systems in the West. This will include experiential learning in the animal sciences BS degree designed to add practical experience in the science, production, and business aspects of the industry to prepare students for leadership positions in ranch, farm, and agribusiness management. Graduate education and research will focus on fundamental and applied research in breeding, nutrition, physiology, behavior, integrated resource management systems, economics, health, and range/forage management. Outreach will span the breadth of the topics of research to assure that industry participants have the latest practical knowledge in modern beef, dairy, and sheep production systems; biosecurity; economic and risk management; and response to policy and consumer changes. Outreach to youth involved in livestock production and judging events will continue as part of experiential learning in 4-H, FFA, and college judging teams.

Purpose: Animal agriculture is a major component of the United States' economy and the leading agricultural activity in Colorado. In 2007, live meat animal sales in Colorado were valued at \$3.48 billion and the value of dairy production was \$516 million. Livestock and livestock products accounted for 67.8% of crop and livestock sales in Colorado. Remaining competitive requires that the industry produce the most technically sophisticated systems available while considering environmental and animal welfare dimensions to maintain the confidence of the consuming public. Ruminant production agriculture is the one significant agricultural enterprise ubiquitous in Colorado. In addition to novel and economic production practices, today's livestock producers must be knowledgeable of alternative supply chains to select a lucrative market, be aware of animal identification and trace-back requirements, understand the effects of emerging animal public health conditions, and understand the international and domestic trade environment, trends and how to respond with risk management strategies. Colorado State University has many resources devoted to this broad subject, and it is a fertile field to foster multi-department, multi-college, and multi-county interactions. Young people on or near farms and ranches have opportunities to build maturity by taking responsibility for raising and showing ruminant species; Colorado State University supports experiential learning opportunities for youth through 4-H, FFA, and college judging team contests. Colorado State University is in a strong position to provide undergraduate and graduate education to prepare people for ruminant industry positions, research in the basic animal sciences, production management systems, methods to respond to national and international markets and policy, and outreach tools to assure dissemination of research knowledge to livestock industry practitioners.

Strategic Actions:

- Renovate the Animal Sciences Building.
- Reposition the Integrated Resource Management teaching and research program.
- Replace critical faculty positions: Livestock Environmental Systems and 4-H.
- Elevate the Southeastern Colorado Research Center regarding research/outreach mission.

Critical Resource Growth Needs:

- Secure funds to renovate the Animal Sciences Building (\$13 million). Align land and field laboratory facilities with future research and teaching directions.
- Significantly increase grant and contract revenue sources to support all programs.

Accomplishments: Successful programs are built with strong teams comprised of faculty members with complementary skills. A dedicated team will champion the land grant mission for a ubiquitous cattle/beef industry in Colorado. With a coordinated effort, this team understands what the process requires, and has a

passion to get things done. Innovation and discovery are ongoing processes, which reenergizes the members and stakeholders.

1. CSU Animal Sciences/ Ruminant Production Capstone Courses:

The beef capstone courses create an environment for integrative learning, multidisciplinary thinking, and problem solving. During the past several years, we have increased enrollment in the 476-478 series as students look for opportunities to understand the industry on a broader scale.

2. CSU Seedstock Team:

The seedstock merchandising team is a case-based, industry focused yearlong experience that allows students to make decisions that are measured with customers and market response. The course provides highly motivated students the opportunity to build a professional network based on functional interactions with customers, suppliers, and other participants in the beef industry.

3. CSU Beef Extension/outreach:

The CSU Beef Team functions regularly to address topics, events and issues that are pertinent to the Colorado Beef Industry. Examples include: 1) Coordination of an annual field day at a beef producer's ranch designed to allow fellow producers the opportunity to view and discuss production and marketing practices; 2) Planning and conduct of a Beef Day at the Colorado Farm Show each January; and 3) Training and update meetings held twice annually specifically designed for the Beef Team to assure currentness and competency among the members of the team. Frequent conference calls are held to facilitate communication and coordination and the Beef Team List Serve is used regularly to disseminate information to the team. Marked enhancement of a focused website (CSUBeef.Com) has occurred and is now the location for electronic access to the Cow-Calf Management Guide and Cattle Producers Library.

4. South Eastern Colorado Research Center (SECRC):

SECRC Research –Research activities have included experiments investigating the impacts of: 1) trace minerals, 2) growth promotants and feed additives, 3) feed processing, and 4) feed management strategies on immunity, performance, environmental management, and carcass characteristics of feedlot steers and heifers. South Eastern Colorado Research Center hosted an open house consisting of several scientific presentations as well as a dinner for the attendees. The research center continues to host short courses on feedlot processing and management techniques. In 2007, the Breeding and Genetics program initiated a large study to evaluate genetic differences amongst animals for resistance/tolerance to bovine respiratory disease. The first year of this multi-year study, involved over 1500 steers upon which detailed health and recovery data were collected.

5. Agriculture, Research, Development, and Education Center (ARDEC):

ARDEC Research –Several metabolism experiments have been conducted investigating techniques to potentially alleviate the long-term impacts of certain nutritionally related metabolic disorders in cattle and swine. Other research has included immunological and nutritional investigations in horses and sheep. This past summer a Ph.D. student from Spain completed an internship in the Department of Animal Sciences and conducted several experiments in the metabolism building at ARDEC. She presented a portion of her Ph.D. research at the Colorado Nutrition Roundtable held at ARDEC. Several laboratories for the Front Range Community College Veterinary Technician Program were also held at ARDEC. Additionally, during the summer of 2007, a study was conducted which evaluated methods to reduce nitrogen inputs into feedlot systems without reducing productivity. This is of particular interest as there is growing pressure for livestock producers in the state of Colorado to reduce nitrogen emissions from their operations. Additionally, three fistulated steers were provided by Five Rivers Cattle Feeding LLC for the use in teaching and research projects. In the summer of 2008, these steers allowed the procurement of a grant to study the effects of water treatment systems on the digestibility of feeds and survivability of food borne pathogens.

6. Eastern Colorado Research Center (ECRC):

ECRC Research - A study was conducted to determine the nutritive value, characterize the protein degradability, and determine the effects of seasonal changes on diets selected by cows grazing on northeastern Colorado rangelands. Nutrient content of diets was determined from grab-samples, collected from three ruminally fistulated cows, using the rumen evacuation technique. Samples were collected twice a month during the spring and summer, and once a month during the fall and winter, over a three year period. Forage availability was determined as adequate by ocular assessment. Ingested forage was analyzed for CP, NDF, ADF, NDIP, ADIP, EE and Ash. *In situ* neutral detergent fiber nitrogen kinetics of disappearance was determined. Regression equations to predict nutrients levels (NDF, ADF, CP and undegradable intake protein; **UIP**) were developed from these data. Range samples were highest in quality during the spring and early summer months, especially when precipitation levels were adequate. Crude Protein and UIP levels followed the same trends throughout the year. Fiber content increased with the advance of the growing season, after mid July, for years with average weather conditions. Nutrient levels were highly dependent on weather conditions, especially during the growing season. Understanding seasonal effects, on native range nutritive values, is important for developing cost effective nutrition programs for the cowherd.

7. Beef Improvement Center, Saratoga, WY (Rouse Ranch):

The Center began 2008 by setting a record high average price at the annual bull sale in April—the second high average in the last 3 years. Research continued into the genetics of adaptability to high altitude disease in beef cattle with matings designed to establish genetic ties between the Center’s cowherd and popular Angus sires where genetic ties are an essential element of advancing research plans and external funding requests to establish a regional center for genetic evaluation of High Altitude (Brisket) Disease. Student involvement continued as over 90 undergraduate and veterinary students were involved with internships, classroom, and graduate/capstone project activities involving the ranch animals and production system. To better evaluate the unique beef genetics at the Center and to genetically tie CSU beef cattle research herds, the Center continued to produce replacement females for the ECRC (see above). The resulting offspring will enhance research opportunities and leverage animal resources for more robust data. The Center also provides data for use in development and testing of new genetic evaluation techniques by the CSU Center for Genetic Evaluation of Livestock. The Center completed a 10 year review with considerable positive feedback from the external review committee (committee consisted of scientists from Cornell University, Iowa State University, and the USDA). Cattle from the Center continue to outperform industry standards with the latest harvest group averaging 30 percentage points’ greater choice carcasses than current industry levels.

8. Center for Genetic Evaluation of Livestock:

The Center continued to provide genetic evaluation services for 14 beef breed associations with a total membership in excess of 50,000 breeders. Funds from these services supported a research associate and two graduate students. As one of the two primary institutions involved in beef cattle genetic evaluation research and production, the Center continued its pivotal role in the National Beef Cattle Evaluation Consortium receiving over \$250,000 in research support for the last 2 years. These monies support travel, a research associate, graduate students, and summer faculty appointments. Evaluation and research results were used for education purposes in four courses with over 60 undergraduate and graduate students. The Center also provided free genetic evaluation services for the Beef Improvement Center.

Internal Linkages: Several internal linkages have been made over the past year. Members in the Department of Animal Sciences along with the members from Microbiology, Immunology and Pathology (MIP), Clinical Sciences, Philosophy, and Engineering are working together to evaluate alternative methods for animal euthanasia. Furthermore, the Department of Animal Sciences and Clinical Sciences are investigating alternative field diagnostic tools to monitor animal health. The departments of Soil and Crop Sciences and Animals Sciences are working together investigating endocrine disruptor residues in waste streams.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Majors:

The following table shows the trend in the number of undergraduate majors associated with this strategic initiative:

Major (Fall Semester)	2005-06	2006-07	2007-08	2008-09
Animal Science	265	277	273	267

*Includes secondary majors

The following table shows the trend in the number of graduate majors associated with this strategic initiative:

Major	2005-06	2006-07	2007-08	2008-09
Animal Sciences	48	48	59	58

II. Financial Resources:

Faculty and staff representing the departments of Animal Sciences, Agricultural and Resource Economics, Soil and Crop Sciences and the Agricultural Experiment Station dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$720,290	\$681,327	-\$38,963 (-5.4%)	\$771,240	\$89,913 (13%)
AES					
State	\$545,443	\$472,945	-\$72,498 (13.3%)	\$332,678	-\$140,267 (-29.6%)
Federal	\$179,807	\$155,987	-\$23,820 (-13.2%)	\$201,953	\$45,966 (29.5%)
Extension					
State	\$174,245	\$160,718	-\$13,527 (-7.8%)	\$166,474	\$5,756 (3.6%)
Federal	\$610	\$321	-\$289 (-47.3%)	\$0	-\$321 (-100%)
Grant/Contract	\$399,615	\$569,867	\$170,252 (42.6%)	\$705,913	\$136,046 (23.9%)
Cash	\$1,107,081	\$2,491,773	\$1,384,692 (125.1%)	\$3,155,282	\$663,509 (26.6%)
Gift	\$40,290	\$74,932	\$34,642 (86.0%)	\$57,870	-\$17,062 (-22.7%)
Totals	\$3,167,381	\$4,607,870	\$1,440,489 (45.5%)	\$5,391,410	\$783,540 (17%)

III. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 23 total refereed journal articles were published. For 2007, 23 total refereed journal articles were published.

Analysis: Refereed journal articles published for this initiative stayed the same from calendar year 2006 to calendar year 2007.

IV. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with this strategic initiative participated in approximately 113 workshops/presentations reaching more than 548 total number of attendees.

V. Research Activities: The following AES research projects are associated with this strategic initiative:

- Germ Cell and Embryo Development and Manipulation for the Improvement of Livestock
- Stress Factors of Farm Animals and Their Effects on Performance
- Integrated Resource Management - Beef Cattle and Sheep
- National Beef Cattle Genetic Evaluation
- Regulation of Animal Growth by Hormones and Growth Factors
- Sustainability of Matching Cow Nutrient Requirements With Nutrient Content of Grazed Forages
- Enhancing Efficiency in Cow-Calf Production
- Reproductive Performance in Domestic Ruminants
- Economic, Environmental, Genetic, and Nutritional Aspects of Grass-Fed Beef
- Nutrition and Management of Feedyard Cattle to Enhance Performance, Carcass Value and Environmental Sustainability
- Livestock Management Systems

External Linkages:

Faculty have excellent working relationships with key personnel in federal agencies, e.g., USDA-APHIS, USDA-FAS, and associations such as NCBA, CLA, CCA, WDPA, CPPC, CFB, CBC, CWG and CHC as well as an excellent interaction with meat processors such as Swift & Co. and Cargill Meat Solutions. Since the establishment of the South Eastern Colorado Research Center in 2005, the Department of Animal Sciences continues to work closely with Five Rivers Ranch Cattle Feeding conducting research and education programs in the production of fed beef. Additionally, the faculty have conducted numerous research and educational activities for the National Cattlemen's Beef Association, the American Sheep Industry Association, and numerous beef breed associations. Research is underway, funded by APHIS-USDA, to help select appropriate means for identifying cattle, sheep and swine for animal-health protection traceability. Numerous other nutrition research trials are underway funded by the private sector at our ruminant research facilities.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: William Wailes

Steering Committee Chair(s): Jack Whittier, Terry Engle, Shawn Archibeque

Steering Committee Members: Kraig Peel (IRM & AS), Frank Garry (CVMBS), Joe Brummer (SCS), Stephen Koontz (DARE), Robbie LeValley (CE), Bruce Bosley (CE), George Beck (BSPM), Roger Ellis (VMBS), Mark Enns (AS), Hyungchul Han (AS), Steve LeValley (AS)

A. Agricultural and Resource Economics:

Faculty: Norm Dalsted, Jay Parson, Dustin Pendell

- B. Animal Sciences:
Faculty: Temple Grandin, Brett Kaysen, John Wagner, David Ames, Larry Goodridge, Keith Belk, Gary Smith, John Sofos, Daryl Tatum
Post Docs: Nichole Marcillac
Admin. Pro.: Michael Boyce, Brian Brigham, Doug Couch, Travis Hoffman, Mike Moon, Chad Murnin, Misti Roberts, Scott Speidel, Casey Thompson, James Wood, Randy Blundell, Dusty Wallace
Fac. Affil.: Patrick Burns
- C. Soil and Crop Sciences
Faculty: Joe Brummer
- D. Agricultural Experiment Station
Admin. Pro.: Beth Lashell, Doug Zalesky
- E. Colorado State University Extension
County agents: Adrian Card, David Colburn, John Deering, Marlin Eisenach, Bill Ekstrom, Bruce Fickenscher, Eldon Fisher, Larry Hooker, Michael Jarosz, Michael Livingston, Keith Maxey, Tom McBride, CJ Mucklow, Bill Nobles, Dean Oatman, Rod Sharp
- F. Other Non-College Faculty and Staff: NREL – Niall Hanan

Annual Report
2007-08

Meat Science and Animal Product Food Safety

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research and outreach in meat science and animal product food safety and be recognized nationally as one of the top three university programs. This will include experiential learning in the animal science BS degree designed to add practical experience in meat science and microbiology and to prepare students for leadership positions in the meat production and food manufacturing industries and regulatory agencies. Graduate education, research, and outreach will focus on pre-harvest management of livestock to prevent acquisition of human pathogens in livestock production and handling, post-harvest detection and management systems to prevent and control contamination of meat products with human pathogens, assessment of production systems and regulatory protocols for effective food safety results and domestic and international credibility of the meat products, and producer, consumer, and food handler education in food safety to prevent or control contamination and food safety risks.

Purpose: Animal agriculture is a major economic sector in the United States. The red meat industry contributes substantially to the U. S. economy. Each year 30 to 35 million cattle (26.5 million fed steers and heifers), 80 to 92 million hogs, and 5 to 7 million lambs are marketed in the U. S. Remaining competitive requires that the industry provide consumers with products that meet their demands for safety, wholesomeness, quality, convenience, and price. Efforts in meat science focus upon the manner in which food animals are produced, harvested, processed and presented to consumers in order to be safe and desirable for consumption, and on appearance and palatability of fresh beef, pork and lamb. A specific need is to assure that US fresh meat is acceptable to both domestic and international markets and performs beyond expectation when consumed. Extensive efforts have generated research results and pertinent documents intended to assist the industry to solve problems related to *Escherichia coli* O157:H7, *Salmonella* and other pathogenic bacteria in fresh beef or pork, *Listeria monocytogenes* in processed ready-to-eat meat products, and bovine spongiform encephalopathy in beef. As new food safety issues develop (e.g., the advent of antimicrobial resistance of food-borne pathogens, etc.), it will be increasingly important that proactive scientific investigations occur for policy-makers and regulators to have access to the necessary factual information from which sound regulatory decisions may be made. Additional efforts are aimed to enhance consumer confidence that livestock producers, packers, and processors generate products from animals that are reared in a compassionate manner, handled appropriately, and produced with environmentally responsible methods. Colorado State is in a strong position to assist with the economic development of Colorado's livestock and meat industry and to enhance the public health of citizens by educating meat industry scientists and professionals, by researching technical and economic issues related to improved product quality, safety and international competitiveness, and by being actively involved with the livestock and meat industry and governmental agencies to assure that the latest knowledge is incorporated in management, education and regulatory decisions.

Strategic Actions:

- Continue developing approaches for meat science and safety research management to be more responsive to industry, regulatory, consumer and export issues.
- Develop new approaches with which to transfer technology from research to industry and governmental partners. Example includes Micro Rx relationship.
- Increase support staff including graduate students and Research Associates.
- Develop a five-year BS/MS degree program in Meat Science, following consultation with industry to determine needs and commitment.
- Secure funding for renovation of Animal Sciences building

Critical Resource Growth Needs:

- Renovate and expand the Animal Sciences Building to improve laboratory, classroom, and office space (estimated at \$13 million).
- Add a faculty position in the area of meat processing.
- Secure one endowed faculty chair to raise the level of one faculty position.
- Secure bridge funding to maintain current status if grant funding decreases or changes.
- Add two Post-Doctoral Fellows, two Research Associates, two meat science/food safety outreach professionals, and 18 graduate student first-year stipends.
- Secure an additional \$50,000 annually for faculty, student, and outreach professional travel and project development.

Accomplishments:

The increasing complexity of our food production, processing and distribution systems, as well as the continuous development of new products by the food industry to answer consumer demands for convenience, changing lifestyles and dietary preferences, challenges producers, processors, distributors, retailers, researchers, regulators and public health authorities to work on ensuring exemplary product safety and quality at a reasonable cost. Assuring that consumers have access to a dependable supply of high quality and safe meat products is the main mission of the Meat Science and Animal Product Food Safety program, as applied by the Center for Meat Safety & Quality (CMSQ) at Colorado State University. The expertise available at the CMSQ of Colorado State University has the capability to/and contributes to the solution of all of the above issues.

Colorado State University scientists conducted research addressing current red meat (a) safety, (b) quality, and (c) marketing issues in 2008. Efforts to restore beef export trade continued following the 2003 detection of BSE in the U.S. Although several key export markets were re-opened to shipments of U.S. beef (e.g., Japan, Korea, etc.) in 2006, export volume remained low due to overly-restrictive trade terms concerning definitions for prohibited tissues; research was initiated to assist U.S. negotiators and domestic policy-makers in clarifying such definitions. Prevalence of BSE in U.S. cattle has remained at two positive cows since initiation of enhanced surveillance in June of 2004. Research conducted to modify Egyptian storage life requirements for imported U.S. beef variety meats was presented to the Egyptian government, resulting in modification of import restrictions and significant increases in U.S. beef exports during 2006 and the first quarter of 2007. Additionally, the group conducted a study to better characterize cattle that do, versus cattle that do not, persistently shed *E. coli* O157:H7 using molecular techniques; this research resulted in isolation of *E. coli* O157:H7 molecular subtypes from a larger population that displayed relatively greater attachment efficacy than less prevalent subtypes, even in light of equal presence of virulence factors. Over time, food safety efforts continue to generate reduced prevalence of food-borne pathogens on meat as documented by USDA-FSIS and CDC.

Red meat quality issues were addressed by completing efforts to characterize postmortem aging patterns and tenderness improvement of 18 beef muscles, resulting in NCBA Guidelines for Beef Aging. In addition, research addressing reduced value of “out” non-conforming beef carcasses marketed in formula, grid, or branded beef programs was conducted leading to better understanding of how fed cattle should be priced in such markets; an effort that will improve value of fed cattle substantially. Efforts to research beef carcass instrument grading technology resulted in significant advancements during 2006; USDA-AMS now has approved video image analysis (VIA) instruments for official measurement of ribeye area (REA) and marbling scores, as well as for official application of Yield Grades. Commercial adoption of instrument augmentation for purposes of beef carcass grade application is anticipated to be widespread in 2007, and a similar project has been initiated by the American Sheep Industry Association, USDA, and our scientists to accomplish similar advancements in lamb carcass grading.

Summarizing, in the past 24 months, accomplishments of scientists at the CMSQ include:

- Red meat quality issues were addressed by completing efforts to characterize postmortem aging patterns and tenderness improvement of 18 beef muscles, resulting in NCBA Guidelines for Beef Aging.
- Efforts to research beef carcass instrument grading technology resulted in significant advancements during 2006; USDA-AMS approved video image analysis (VIA) instruments for official measurement of marbling scores.
- Grading instrumentation now is approved for use in official USDA assessment of (a) ribeye area (REA), (b) Yield Grades, and (c) marbling scores for application of Quality Grades. Commercial adoption of instrument augmentation for purposes of beef carcass grade application is anticipated to be widespread in 2007.
- Faculty members of CMSQ interacted with management personnel of National Pork Board, National Meat Association, National Cattlemen's Beef Association, AMS-USDA, Southwest Meat Association, American Meat Science Association, National Institute for Animal Agriculture, American Association of Meat Processors, National Renderers Association, APHIS-USDA, FSIS-USDA, U.S. Meat Export Federation, FDA-USDHHS and American Meat Institute as well as with cattlemen, cattle feeders, beef packers and beef retailers on issues related to foreign animal disease, meatborne pathogens, quality/palatability/shelf-life, value-determining characteristics, export-market access, animal identification and traceability, animal care and handling and meat-waste disposal.
- The CMSQ scientists were interviewed by persons from the local, state, national and international media, appeared on television and on expert panels, have participated in teleconferences and have worked diligently—behind the scenes—to help shareholders in the meat industry mitigate risk and maximize profitability.
- Faculty members of the CMSQ delivered lectures on meatborne pathogens in 21 countries and traveled to Egypt, Vietnam, Japan, South Korea, Mexico, Taiwan and China as members of U.S. trade teams.
- A test developed by CSU scientists for demonstrating safety (freedom from central nervous system tissue) of U.S. beef relative to BSE Specified Risk Material removal in U.S. beef packing plants is used throughout the world.
- Faculty members served on the US/Japan BSE Working Group, US Beef Export Verification Program Planning Committee, USDA Age-Month (Beef Carcass Maturity) Expert Committee, and International BSE Expert Forum.
- A faculty member presently serves as Editor of the Journal of Food Protection, is a member of the National Advisory Committee on Microbiological Criteria for Foods, and serves as international advisor on European Union funded food safety projects of multi-institution consortia.
- A substantial amount of research geared towards addressing prevalence and control of *E. coli* O157:H7 and *Salmonella* in live animals pre-harvest, and on carcasses and fresh meat post-harvest and during processing, and on *Listeria monocytogenes* in ready-to-eat meat and poultry products was conducted, presented at national and international meetings, and published in scientific journals and trade magazines. Over time, these food safety research efforts continue to contribute to the reduction of food-borne pathogens on fresh meat and processed products as documented by USDA-FSIS and CDC.
- Four major research grants were obtained in 2005-2006 to support research related to *Listeria monocytogenes* as it applies to control in food and to human health. Results obtained from this research will be used to determine the ecology of bacterial pathogens in settings related to human health, and will develop ways to mitigate risks associated with the pathogen.
- Three research grants were obtained in 2006 to support development of rapid methods for toxic microorganisms including rapid assays for detection of *Salmonella* and *Listeria monocytogenes*, and work is ongoing to develop a rapid test for *E. coli* O157:H7.
- Training was provided for graduate students in food safety at the pre-harvest, post-harvest, processing and retail level, in molecular approaches to track and control foodborne pathogens in the human food chain, and in pathogen detection and identification. These students are highly sought-after for

employment at the national and international level to fill positions that will contribute to the enhancement of the safety of our food supply.

- Independent research opportunities were provided for undergraduate students in order to facilitate interest in pursuing graduate training in food safety.
- Educational and research opportunities were provided for women and minorities in food safety.
- Results of studies are being used by industry as it applies antimicrobial interventions to animals pre-harvest, carcasses during slaughter, and to processed meat products for reduction, inactivation or control of pathogens. This allows meat plants to comply with regulatory criteria, meet commercial product specifications, and provide safer products to consumers.

Internal Linkages:

In completing several live-cattle pre-harvest food safety efforts, the group has worked closely with the Animal Population Health Institute (APHI) in the College of Veterinary Medicine and Biomedical Sciences—both on projects in which APHI faculty were PIs and on projects in which Animal Science faculty were PIs—and with USDA/APHIS Center Epidemiology and Animal Health. Additionally, the group currently is conducting collaborative research with the Veterinary Diagnostic Laboratory and the USDA/APHIS National Wildlife Laboratory (Foothills Campus) related to biowaste disposition and dissemination of Transmissible Spongiform Encephalopathies. The group has an on-going relationship with Clinical Sciences personnel in the College of Veterinary Medicine and Biomedical Sciences, and has submitted several research proposals in conjunction with that group. Relative to diagnostics development efforts associated with BSE and trade issues, along with Beef Quality Assurance programs, the group has worked closely with Microbiology, Immunology, and Pathology Department and Biomedical Sciences Anatomy Section scientists in the College of Veterinary Medicine and Biomedical Sciences. They have conducted collaborative projects related to animal traceability and biosecurity with the Department of Computer Sciences and the USDA/APHIS/VS/NCAHP/SIP National Animal Identification System. Scientists in the Departments of Animal Sciences and Agricultural and Resource Economics are presently working together on a project related to the National Animal Identification System, to assist APHIS-USDA in improving “Animal Termination Reports” filed by cattle, sheep and swine harvesters and renderers. Scientists of the CMSQ are involved in conducting research related to farm animal and human health aspects of BSE. They had a very close working relationship for a number of years and are working collaboratively on several projects with Pat Kendall of the Department of Food Science and Human Nutrition of the College of Applied Human Sciences. Animal sciences faculty provide the food microbiology expertise and Dr. Kendall the consumer and health care provider extension/outreach component in a really integrated effort. They are participating in the Food Safety cluster in the Colorado State University Infectious Diseases Supercluster; John Sofos will be directing that effort. Lastly, the group works very closely on most research activities with Drs. Chapman and ZumBrunnen of the Department of Statistics, and have co-authored many peer-reviewed publications with our group.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Financial Resources:

Faculty and staff representing the departments of Animal Sciences and Agricultural and Resource Economics in the College of Agricultural Sciences dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident tuition, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant expenditure activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$482,626	\$503,261	\$20,635 (4.3%)	\$575,680	\$72,419 (14.4%)
AES					
State	\$280,981	\$252,706	-\$28,275 (-10.1%)	\$227,321	-\$25,385 (-10%)
Federal	\$112,828	\$106,343	-\$6,485 (-5.7%)	\$138,819	\$32,476 (30.5%)
Extension					
State	\$110,795	\$110,866	\$71 (0.1%)	\$112,117	\$1,251 (11.3%)
Federal	\$451	\$264	-\$187 (-41.5%)	\$0	-\$264 (-100%)
Grant/Contract	\$1,224,887	\$1,598,521	\$373,634 (30.5%)	\$1,290,347	-\$308,174 (19.3%)
Cash	\$695,278	\$491,894	-\$203,384 (-29.3%)	\$1,015,114	\$523,220 (106.4%)
Gift	\$118,238	\$118,476	\$238 (0.2%)	\$13,336	-\$105,140 (-88.7%)
Totals					
	\$3,026,084	\$3,182,331	\$156,247 (5.2%)	\$3,372,734	\$190,403 (6%)

II. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 34 total refereed journal articles were published. For 2007, 34 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative stayed the same from calendar year 2006 to calendar year 2007.

III. Outreach activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in 194 total workshop/presentations. The number of participants at these workshop/presentations was not reported in the Annual Faculty Evaluations and therefore, cannot be reported here.

IV. Research Activities: The following AES research projects are associated with this strategic initiative:

- Control of Food-Borne Pathogens in Pre- and Post-Harvest Environments
- Enhancing the Safety of Meat Products and Other Foods
- Enhancing the Competitiveness and Value of U.S. Beef

External Linkages:

Faculty have excellent working relationships with key personnel in several federal agencies, e.g., USDHHS-FDA, USDA-AMS, USDA-FSIS, USDA-APHIS, USDA-FAS, and associations such as AMI, FMI, NMA, and NAMP, and excellent interaction with meat processors such as Swift & Co., Cargill Meat Solutions, Tyson Fresh Meats, National Beef Processors, the Smithfield Beef Group, Harris Ranch Beef, Sam Kane Beef Processors, Hormel, etc. Additionally, the Group has conducted numerous research and educational activities for the National Cattlemen's Beef Association, the National Meat Association, the American Meat Institute Foundation, the American Meat Science Association, the National Pork Board, the National Pork Producer's Council, the American Sheep Industry Association, several beef breed associations, and a wide array of private companies (e.g., Booth Creek, Purac, Novozymes, RMS Research Management Systems, Inc., Nolan Ryan Tender Aged Beef, Food Safety Net Services, LLC, Chipotle, etc.). Research is presently underway, funded by CSREES-USDA under the National Integrated Food Safety Initiative, involving collaboration with scientists from Cornell University, Ohio State University, University of Nebraska, and Kansas State University.

Additional research is underway, funded by APHIS-USDA, to help select appropriate means for identifying cattle, sheep and swine for animal-health protection traceability.

Faculty and staff associated with Strategic Initiative

Administrative Advisor: Bill Wailes

Steering Committee Chair: John Sofos

Steering Committee Members: Daryl Tatum (AS), Gary Smith (AS), Keith Belk (AS), Pat Kendall (FSHN), Larry Goodridge (AS), Kendra Nigthingale (AS), Marisa Bunning (FSHN), Dustin Pendell (DARE)

A. Animal Sciences

Faculty:	Temple Grandin, Hyungchul Han, John Wagner, Steve LeValley, Mark Enns, Jack Whittier
Admin. Pro.:	Ifigenia Geornaras, Tanner Carpenter, Travis Hoffman
Post Doc.:	Avik Mukherjee, Yohan Yoon, Hua Yang

Annual Report
2007-08

Equine Science and Business

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, and outreach in equine sciences, and be recognized as the leading university program in equine science in the nation. Undergraduate education will include experiential learning designed to add practical experience in the science, production, sales, and show management aspects of the equine industry and prepare students for leadership positions in the equine industry. Graduate education will consist of a master's degree program in Equine Industry Leadership to further scientific and business knowledge in the field. This will complement existing graduate programs in Reproductive Physiology and Equine Nutrition. Outreach will focus on youth and adult horse competition organization and teaching, nutrition and waste management for horse owners, and equine management on small acreage holdings. NOTE: This goal refers only to the planned activity of the College of Agricultural Sciences and the Agricultural Experiment Station. It does not include strategic goals of the College of Veterinary Medicine and Biomedical Sciences.

Purpose: Estimates place the U. S. population of horses at 9.2 million with an industry economic impact of \$102 billion. In Colorado, the horse population is 194,000 and the economic value of the equine industry in Colorado is \$754 million. At Colorado State, the undergraduate program is a major within the Department of Animal Sciences in the College of Agricultural Sciences. In fall 2008, the program had 384 undergraduate majors. The program is the largest undergraduate major in the College of Agricultural Sciences and enjoys a national reputation; approximately 50% of the students are non-residents. The largest service and outreach audience are participants in the 4-H equine project, one of the largest 4-H projects with activities ranging from competitions to educational activities. Adult outreach is offered with an adult horsemanship program, farrier science and management short courses, and extension programs in nutrition, small acreage management, and waste management. Colorado State University is in a strong position to assist with the economic development of Colorado's equine industry and enhance the well-being of citizens with interests in horses by educating equine industry professionals and hobbyists, researching technical and economic issues related to equine production, training, and utilization, and being involved with the equine industry, governmental agencies, youth and other consumers to assure that the latest knowledge is incorporated in management and regulatory decisions.

Strategic Actions:

- Continue enhancement of faculty size to meet critical needs and align student/faculty ratios.
- Develop \$500,000 annually in scholarship support.
- Pursue additional support for the CSU Polo Program.
- Classroom addition to the existing facilities that would become an outreach center for the entire equine program.
- Renovation of existing office complex.
- Research endowment for faculty located within the Equine Teaching and Outreach program.
- Addition of a cover for the outdoor arena to increase the potential space for classes.
- Continue to grow International involvement and impact.

Critical Resource Growth Needs:

- Acquire one additional tenure track faculty position.
- Continue to develop a significant fund-raising program to support the Equine Sciences undergraduate program, especially for scholarships and facility and animal maintenance.

Accomplishments:

- The non-thesis master has been developed under the direction of Dr. David Denniston and the first students were enrolled in the fall of 2005. The first student completed her program of study in the Spring 2007. She has assumed a leadership position with the American Quarter Horse Association. Expectations are that future graduates assume similar positions. The program limits its enrollment to three students at one time.
- A show team was in place for the fall of 2005. Students participated in several shows within the local area. This provided an opportunity for a major gift of equipment from TransWest trucks. There is a plan now to drop this and add more hands-on classes.
- A therapeutic riding class was added to the curriculum starting in the fall of 2005. Since then the course has been taught 2 times per year. Approximately 60 students take the course each year. The equine program maintains 3-5 horses for this program and has developed a partnership with the Front Range Exceptional Equestrians program. This program was reaccredited in the summer of 2008.
- The first Legends of Ranching Sale was held on March 11, 2006 and each year thereafter. Horses from leading ranches across the US are consigned and the two year olds are fitted and prepared by CSU students. Students from the program, with Dr. Karen Hansen’s and Anna Morrison’s direction, develop the advertising program, the sale catalog and run the sale. The sale averages \$5800.00 with the top horses bringing in the range of \$25,000. Approximately 450 spectators attend the event. In addition, the event is publicized in several national magazines. The national exposure due to the sale has greatly increased the programs visibility. The sale was moved to the Equine Teaching and Research Center in 2008.
- A detailed individual advising plan is in place. Students receive group advising for curricular issues and individual advising by faculty members for career counseling. In addition, with the help of additional support from the department, a half-time advisor has been hired. The program is receiving recognition for its individual attention to students. In addition, the program has initiated a 1st year experience program for all of its entering students.
- An internship coordinator has been hired and there seems to be additional activity and participation by students. Twelve students traveled to Europe to conduct clinics for AQHA during 2006. This has allowed greater exposure of our students to the industry and fostered greater support from Industry. Eight students went to South America in 2007 and 10 students will go to Uruguay and Brazil in 2008.
- The judging team continues to be successful. This spring they won the 2008 APHA contest. The judging team’s success is a prime recruiting tool for outstanding students and provides national publicity.

Internal Linkages: Within Colorado State University, the Equine Teaching and Outreach program has worked with the College of Business, CSU Extension, Department of Agriculture and Resource Economics, College of Veterinary Medicine and Biomedical Sciences, Facilities, and the Veterinary Teaching Hospital.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Majors:

The following table shows the trend in the number of undergraduate majors associated with this strategic initiative:

Major (Fall Semester)	2005-06	2006-07	2007-08	2008-09
Equine Science*	413	397	389	384

*Includes secondary majors

II. Financial Resources:

Faculty and staff representing the Animal Sciences department in the College of Agricultural Sciences dedicated time to this strategic initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$275,237	\$425,112	\$149,875 (54.5%)	\$487,027	\$61,915 (14.6%)
AES					
State	\$160,797	\$213,727	\$52,930 (32.9%)	\$191,162	-\$22,565 (-10.6%)
Federal	\$64,463	\$89,871	\$25,408 (39.4%)	\$117,958	\$28,087 (31.2%)
Extension					
State	\$61,779	\$91,625	\$29,846 (48.3%)	\$91,713	\$88 (0.09%)
Federal	\$265	\$228	-\$37 (-14.0%)	\$0	-\$228 (-100%)
Grant/Contract	\$34,646	\$14,236	-\$20,410 (-58.9%)	\$11,099	-\$3,137 (-22%)
Cash	\$0	\$0	\$0 (0%)	\$0	\$0 (0%)
Gift	\$0	\$27,175	\$27,175	\$149,939	\$122,764 (451%)
Totals	\$597,187	\$861,974	\$264,787 (44.3%)	\$1,048,898	\$186,924 (21.7%)

III. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 5 total refereed journal articles were published. For 2007, 2 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative decreased by 3 from calendar year 2006 to calendar year 2007.

IV. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with this strategic initiative participated in approximately 64 workshops/presentations. The number of participants at these workshop/presentations was not reported in the Annual Faculty Evaluations and therefore, cannot be reported here.

V. Research Activities: The following AES research projects are associated with this strategic initiative:

- Identification of Factors and Development of Technologies to Improve Efficiency of Assisted Reproductive Technologies in the Horse

External Linkages: The Colorado State Equine Teaching and Outreach program maintains relationships with the Quarter Horse Association, American Quarter Horse Association, National Western Stock Show, various ranches and farms, feed companies, realtors, banks, truck and trailer dealers and equipment dealers.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: Bill Wailes

Steering Committee Chair: Jim Heird

Steering Committee Members: Jason Bruemmer (AS), Karen Hansen (AS), Jeff Goodwin (CE), Pat McCue (CVMBS), Dave Denniston (AS), Robbie Skelton (AS), Tiare Wells (AS), Equine Advisory Committee

- A. Extension Agents: Members of the 4-H Equine Advisory Committee.
- A. Non-College of Agricultural Sciences faculty and staff:
 - College of Business: Ajay Menon, John Olienyk, John Hoxmeier, Sue Hine

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Animal Environmental Systems

Goal: Colorado State University will enhance its focus, depth, and integration in undergraduate education, graduate education, research, and outreach in environmentally sound systems for animal production units and be recognized as the leading university program in the West and among the top five university programs nationally in cattle and equine environmental systems. This will include experiential learning in courses contributing to the BS in Animal Sciences, Equine Sciences, and Soil and Crop Sciences designed to add practical experience in the science and applications of environmental management systems for air and water quality protection related to animal production systems. Graduate education, research, and outreach will consist of masters and doctoral degree programs related to livestock nutrition and management, soil science, engineering, and economics of waste management systems and the evaluation of production systems and regulatory protocols for effective environmental protection.

Purpose: In 2007, live meat animal sales in Colorado were valued at \$3.48 billion and the value of dairy production was \$516 million. Livestock and livestock products accounted for 76.8% of crop and livestock sales in Colorado. The Colorado horse population is 194,000 with an economic value of \$754 million. Cost effective technologies to protect soil, water, and air quality near livestock production sites is one of the most limiting factors to growth in the livestock industries. Livestock production in the South Platte Basin is known to have resulted in nitrate contamination of groundwater and elevated phosphorus levels in reservoirs. Water quality issues are not limited to nutrients, but could include pathogens and pharmaceuticals. The Arkansas Basin, Great Plains, and Tri-River Area (Gunnison, Uncompagne, and Colorado Rivers) on the West Slope face similar issues. Over the last decade livestock operations have become more concentrated, thus multiplying the potential for environmental hazards. Rapid urbanization along the Front Range has led to increased competition between urban and rural water uses and increased conflict between urban and rural people. Regulatory enforcement has increased at both federal (EPA) and state (Colorado Water Quality Control Commission and Colorado Air Quality Control Commission) levels.

Colorado State University is in a strong position to assist with the economic development of Colorado's livestock and equine industry, to enhance environmental quality, and to enhance the public health of citizens with improved livestock environmental solutions by educating livestock and equine industry professionals and small acreage owners in best management practices for nutrient management, odor and dust control; researching technical and economic issues related to improved animal production practices; and being actively involved with livestock and equine industry personnel, governmental agencies, and small acreage owners, to assure that the latest knowledge is incorporated in management and regulatory decisions.

Strategic Actions:

- Development and implementation of the newly established Institute for Livestock and Environment; goals of the Institute are to develop new approaches for animal environmental system research management to be more cohesive and more responsive to industry and regulatory issues and develop new approaches with which to transfer technology from research to industry and governmental partners; the Institute will organize continuous relationships with livestock production organizations and regulatory agencies to create the position of knowledge leader in the topic area;
- Develop Colorado industry funding mechanisms, like market order systems, to provide sustainable sources of revenue for research and educational work in animal environmental systems.
- Develop an active graduate program in animal environmental systems, thereby, attracting more graduate students in this area to CSU.

Critical Resource Growth Needs:

- Seek additional funding to promote current research coordinator to full – time status.
- Add a producer-based research investment fund of \$500,000 annually to support animal environmental research and education, and increase grant funding.

Accomplishments:

In the past year, we formed the Institute for Livestock and the Environment, a multi-disciplinary effort to achieve the goals of our strategic plan. To support the institute, we hired a Research Coordinator, Katherine Sánchez Meador, and a new faculty member in Civil Engineering, Sybil Sharvelle, with a focus on animal waste treatment. We have developed a website located at www.LivestockAndEnvironment.info and a monthly newsletter entitled Livestock Links which is distributed through the Colorado Livestock Association and our website. In addition, we wrote a press release which was printed in the following locations: the Greeley Tribune, the Beef Blog at Purdue, Cattle Network, and High Plains Journal. A TV station in San Angelo, TX (NBC affiliate) and the Colorado Equipment Show on radio station 1310 KFKA in Greeley, CO (audience size is approximately 20,000) also ran stories on the institute.

Knowledge of livestock producers (feedlots, dairies, and swine) regarding management practices to reduce their environmental impact has been improved through CSU's efforts this year. We developed a series of two webcasts on the subject of livestock pharmaceuticals in the environment (delivered in March and April 2008) and another one on ammonia Best Management Practices and impacts (June 2008), delivered through eXtension (http://www.extension.org/pages/Livestock_and_Poultry_Environmental_Learning_Center_Webcast_Series). We are leading the development of an air quality assessment tool for cattlefeeders as part of a national project team. In addition, we delivered the Rocky Mountain Compost School for the second time in April 2008 and finalized a Western Region 4-H curriculum on manure management.

We are doing applied research to solve problems at the interface of livestock production and environmental management. For example, our multi-disciplinary research project on ammonia Best Management Practices is testing BMPs on feedlots and dairies in Colorado and surveying producers regarding their current BMP use and barriers to further BMP adoption in order to optimize our recommendations. Our research on site-specific manure management will help producers use manure to improve soil quality and protect water quality. We established a new project this year focused on forage production for organic dairies in conjunction with Aurora Organic Dairy and are building a relationship with Horizon Organic Dairy (White Wave), as well. This project includes the education of three graduate students.

In addition, we have aided regulators in increasing their scientific understanding of agricultural and environmental issues so that regulations can be written and enforced based on the best science available. We participated in the Colorado Department of Agriculture's Compost Regulations stakeholder team and several Colorado Department of Public Health and Environment stakeholder groups including Concentrated Animal Feeding Operations, Housed Confined Swine Feeding Operations, Composters, the Rocky Mountain National Park Ag Team, and the Agricultural Air Quality Work Group.

Internal Linkages: Development and implementation of environmental solutions for livestock production require a multi-disciplinary effort. Therefore, our steering committee is made up of faculty from three departments in the College of Agriculture, as well as, faculty from the colleges of Engineering, Liberal Arts, Natural Resources, and Veterinary Medicine. In total, 10 departments are represented in our satellite teams (air, water, pathogen, and pharmaceutical teams).

New courses are being developed in order to meet the needs of our students in the area of livestock and the environment. Composting Principles and Practices (SOCR343) was taught for the first time in Fall 2007, and Equine Manure Management (ANSC300-W) was taught for the second time in Spring 2008. In addition, aspects of sustainable livestock production were incorporated into another new class, Topics in Organic

Agriculture (SOCR424/HORT424). The students that take these classes will become leaders in their respective fields where they will be making choices based on their new knowledge.

The Institute for Livestock and the Environment is working in conjunction with the Colorado Water Institute (Reagan Waskom), the Energy Super-Cluster (Bryan Willson and Ken Reardon), the Center for Meat Safety and Quality and the Infectious Diseases Super-Cluster (John Sofos).

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Financial Resources:

Faculty and staff presenting Agricultural and Resource Economics and Soil and Crop Sciences departments in the College of Agricultural Sciences dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agricultural Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas.

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$62,939	\$55,291	-\$7,648 (-12.2%)	\$55,065	-\$266 (-0.4%)
AES					
State	\$54,396	\$53,380	-\$1,016 (-1.9%)	\$55,388	\$2,008 (3.8%)
Federal	\$30,512	\$28,062	-\$2,450 (-8.0%)	\$36,796	\$8,734 (31.1%)
Extension					
State	\$21,909	\$18,894	-\$3,015 (-13.8%)	\$20,866	\$1,972 (10.4%)
Federal	\$0	\$0	\$0 (0%)	\$0	\$0 (0%)
Grant/Contract	\$93,549	\$142,991	\$49,442 (52.9%)	\$152,430	\$9,439 (6.6%)
Cash	\$0	\$0	\$0 (0%)	\$114,704	
Gift	\$63	\$271	\$208 (330.2%)	\$12,968	\$12,697 (4685%)
Totals	\$263,368	\$298,889	\$35,521 (13.5%)	\$448,217	\$149,328 (50%)

II. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 3 total refereed journal articles were published. For 2007, 5 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative increased by 2 from calendar year 2006 to calendar year 2007.

III. Outreach activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in 24 workshop/presentations reaching more than 628 total number of participants.

IV. Research Activities: The following AES research projects are associated with this strategic initiative:

- Chemistry, Bioavailability, and Toxicity of Constituents in Residuals and Residual-Treated Soils
- Evaluating the Physical and Biological Availability of Pesticides and Pharmaceuticals in Agricultural Contexts
- Best Management Practices for Antibiotic Resistance Gene (ARG) Treatment in Livestock Lagoons
- Development and Application of Continuous Measurement Methods for Assessing Air Quality Impacts of Confined Animal Feeding Operations
- Minimizing the Release of Animal Antibiotics from Aerobic and Anaerobic Lagoons
- Improving Water and Nitrogen Use Efficiency with Manure and Compost
- Improving the Sustainability of Livestock and Poultry Production in the United States
- Improving the Sustainability of Livestock and Poultry Production in the United States

External Linkages: It is our intention to improve the scientific basis of environmental decision-making by both livestock producers and regulators. We have strong external linkages with the Colorado Livestock Association (CLA) and the Colorado Department of Public Health and Environment. In particular, we hosted a CLA Board meeting on-campus in Feb. 2008 and spoke to their annual membership meeting in June 2008. We are partners with the Western Dairy Association, the Rocky Mountain Organics Council (professional composters organization), the USDA Natural Resource Conservation Service (technical advisors to livestock producers), the Livestock and Poultry Environmental Learning Center (linking scientists to decision-makers), EPA Region 8, and the Rocky Mountain Ag Business Association; and we testify regularly before the Colorado Water Quality Control Commission and the Colorado Air Quality Control Commission.

Faculty and Staff associated with this Strategic Initiative

Administrative Advisor: Lee Sommers

Steering Committee Chair: Jessica Davis

Steering Committee Members: Catherine Keske (DARE), Shawn Archibeque (AS), Sybil Sharvelle (Civil Eng), Michael Carolan and Mike Lacy (Sociology), Maria Fernandez-Gimenez (FRWS), Frank Garry (Clinical Sciences)

- A. Agricultural and Resource Economics
Faculty: Gorm Kipperberg
- B. Animal Sciences
Faculty: Lawrence Goodridge (Leader, Pathogen Team), Kendra Nightingale, Noa Roman-Muñiz
Admin. Pro.: Nichole Marcillac
- C. Soil and Crop Sciences
Faculty: Thomas Borch, Joe Brummer, Jay Ham (Leader, Air Quality Team)
Admin. Pro.: Katherine Sanchez-Meador, Troy Bauder
- D. Extension Field Staff: Perry Cabot (Southern Region) is serving on the Water Team. An additional extension agent/regional specialist will be identified for each of the Satellite Teams in the first quarter of the upcoming fiscal year. In addition, we have begun working with the Extension Plan of Work Teams, in particular the Beef Team and the Water Team, to integrate the ILE with outreach efforts already underway.
- E. Non-College of Agricultural Sciences faculty and staff:

Civil and Environmental Engineering: Mazdak Arabi (Leader, Water Team), Amy Pruden
Atmospheric Sciences: Jeffrey Collett
Natural Resources Ecology Lab: Jill Baron
Environmental Health: Stephen Reynolds, Jennifer Peel, John Volckens
Clinical Sciences: Paul Morley, Ashley Hill, Dave Dargatz

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Fundamental Biology of Plants and Plant Pests

Goal: Colorado State University will enhance its focus and depth in graduate education and research in fundamental plant biology and be recognized nationally and internationally as a competitive institution for national and international grants that is attractive to graduate students across the United States and the world. This will include graduate education and research in molecular biology and genomics of crop plants and their pests, mechanisms of biological resistance to pests, mechanisms of invasion of weed species, plant physiology and ecology, and understand the molecular, cellular, whole plant, and ecological foundations for crop improvement and crop pest management.

Purpose: Fundamental plant biology linking basic science with applied science is important to bring the results of basic plant science toward a usable form for applied agricultural sciences. Molecular biology and genomics are opening many new pathways for crop plant improvement and pest management, which will enhance the economic development of agricultural regions, enhance human health through more nutritious and safer food products, and find fundamental solutions to societal issues through renewable and sustainable crop production and pest management. Successful applied crop science, environmental science, and pest management do not occur in the absence of scientists actively involved in fundamental plant and pest sciences. Colorado State University is in a strong position to assist with the economic development of Colorado's agricultural industry and to enhance the public health and well-being of citizens with research in fundamental genetic potentials of crop plants, management of plant pests, and preparation of industry, government, and academic scientists.

Strategic Actions:

- Build greenhouse and laboratory facilities (including growth chambers) to EPA, USDA-APHIS, and NIH standards to permit research with transgenic and exotic pest organisms.
- Build faculty capacity in secondary metabolism and the genomics and population genetics of complex traits.
- Fully engage in the cross-college plant molecular biology consortium to seek major grants, training grants, and graduate student recruiting. Develop CSU strategic responses and connections to new directions and needs of national organizations.
- Expand a separate cross-college graduate degree program.
- Expand involvement in a Clean Energy supercluster, Crops for Health, C2B2 and Infectious Diseases to build Plant Science program strategically.

Critical Resource Growth Needs:

- Secure funds to build/improve greenhouse and growth chamber facilities for future phases. Develop vision for long-term growth.
- Secure one endowed chair faculty position.
- Enhance contract and grant income.
- Add \$100,000 annually for first year graduate students support in the molecular plant science consortium.
- Renovate or build new office and research laboratory space for two new faculty positions.
- Add faculty positions in secondary metabolism, genomics of complex traits and population genetics of complex traits.

Accomplishments

1. Graduate Education

This Strategic Initiative has supported the development of the Program in Molecular Plant Biology (PMPB), an interdepartmental program formed with the goal to train and produce the next generation of world-class plant biologists. The PMPB is a vehicle for recruiting the very best, highly motivated graduate students into fundamental plant biology and is helping Colorado State to greatly enhance graduate education and thereby the

university's research capacity. Students interact with faculty in several departments in the College of Agricultural Sciences as well as other departments across campus before selecting mentors and research projects.

2. Research

- Biofuels: Personnel from the Strategic Initiative have been actively involved in the development of Colorado State's Clean Energy Supercluster. The Supercluster has a major emphasis on the development of biofuels. The strengths of the Strategic Initiative in plant genomics, metabolomics, and more broadly in plant molecular biology are enabling it to play a critical role in the development of the next generation of biofuel producing plants. Increased production and utilization of biofuels will enable progress toward US energy independence and the reduction in net release of the greenhouse gas CO₂ into the environment. In 2008, faculty associated with this Strategic Initiative were integral parts of teams that received in excess of \$4.4 million in biofuels research and training grants; and CSU was one of 13 land grant universities to receive "Grand Challenge" awards from USDA at their Bio-Energy Awareness Days Conference.
- Genetic Sequencing of Multiple Varieties of Rice: Important resources are being developed, including data on genome sequences of 20 comprehensively characterized rice lines, valuable rice genetic stocks and an expansive single nucleotide polymorphism (SNP) database, OryzaSNP. This publicly available, multi-varietal SNP database is becoming a powerful resource to investigate the frequency and distribution of molecular variation across the rice genome, assess evolutionary forces shaping the rice genome, and identify candidate genes controlling important traits. This year, a workshop was held at the 5th International Symposium of Rice Functional Genomics (Tsukuba, Japan) to train researchers and plant breeders in how to use the data; and analysis of the data on the 20 rice varieties continues to add important new information. In the long term, the information from this project will be used to improve rice and other crop plants (such as the close relative, wheat), and to enhance plant genomic research. Expected impacts include the development of varieties with higher nutritional value and varieties resistant to devastating plant diseases.
- Genomics of Economically Important Colorado Crops: Wheat Genomic studies are leading to Russian wheat aphid (RWA) resistance, improved end-use quality, and stress tolerance. Genomics tools are helping to identify new resistance sources, map resistance genes, improve cultivar evaluation methodology, and evaluate drought tolerant lines. One aspect of this effort is the identification of genes from unadapted wheat lines and wild wheat and barley germplasm that can then be moved into ergonomically acceptable cultivars. Already, additional wheat germplasm has been identified that is resistant to the new RWA biotypes that overcome the resistance factors in existing cultivars. This germplasm can form the basis of the development of cultivars effective against the new RWA biotypes.
- A \$1 million grant was received targeting the detection of a high risk plant pathogen in the environment using molecular signals produced in plants. Sentinel plants employing this technology are expected to offer a new tool for biosecurity efforts extending far beyond the initial model system.

Internal Linkages:

A number of members of the Fundamental Biology of Plants and Plant Pests Initiative are involved in the Infectious Disease Supercluster. Jan Leach is a leader of the plant sciences section of this supercluster. Cross linkages are expected to grow. In addition, there are active linkages with the Supercluster in Clean Energy, and there are a number of opportunities for linkages with the Cancer Supercluster. Strong linkages are already in place with the Center for Bioinformatics. Within the College of Agricultural Sciences, several recently hired faculty in Animal Sciences and Horticulture and Landscape Architecture have some interests in common with this Initiative and are expected to become involved. Faculty associated with this Strategic Initiative participated in the successful nomination of the Program in Wheat Research, Outreach, and Education as a Colorado State University Program of Research and Scholarly Excellence (PRSE). Designation as a PRSE will help strengthen

ties within that program, thus strengthening internal linkages among members of this Strategic Initiative and a range of other faculty and staff.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Expenditures:

Faculty and staff representing the Bioagricultural Sciences and Pest Management and Soil and Crop Sciences departments in the College of Agricultural Sciences dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agricultural Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	2005-06	2006-07	Change	FY 2007-08	Change
RI	\$185,228	\$249,225	\$63,997 (34.6%)	\$281,911	\$32,686 (13.1%)
AES					
State	\$317,974	\$387,381	\$69,407 (21.8%)	\$335,474	-\$51,907 (-13.4%)
Federal	\$103,092	\$117,042	\$13,950 (13.5%)	\$131,606	\$14,564 (12.4%)
Extension					
State	\$107,737	\$136,403	\$28,666 (26.6%)	\$150,446	\$14,043 (10.3%)
Federal	\$15,957	\$20,468	\$4,511 (28.3%)	\$21,459	\$991 (4.8%)
Grant/Contract	\$449,667	\$703,914	\$254,247 (56.5%)	\$559,395	-\$144,519 (-20.5%)
Cash	\$0	\$0	0%	\$5,102	\$5,102
Gift	\$1,680	\$29,898	\$28,218 (1679%)	\$72,142	\$42,244 (141%)
Totals	\$1,181,335	\$1,644,331	\$462,996 (39.2%)	\$1,557,535	-\$86,796 (-5.2%)

II. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 9 total refereed journal articles were published. For 2007, 12 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative increased by 3 from calendar year 2006 to calendar year 2007.

III. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the planning initiative participated in 15 workshop/presentations reaching more than 588 total number of participants.

- IV. Research Activities: The following AES research projects are associated with this strategic initiative:
- The Functional and Evolutionary Genomics of Drought Adaptation Networks in *Arabidopsis thaliana*
 - Genomics of Pest Insects, Plant Pathogens, and Plants
 - Environmental and Genetic Determinants of Seed Quality and Performance
 - Support and Enhancement of the C. P. Gillette Museum of Arthropod Diversity
 - Genomics of Economically Important Traits in Wheat and Barley
 - Molecular Basis of Broad Spectrum, Durable Disease Resistance in Crop Plants

External Linkages

The most productive external linkages for this strategic initiative are likely to be related to biofuels and more traditional uses of plants in agriculture. The lead in biofuels is being taken by the Clean Energy Supercluster. Discussions with both Monsanto and Bayer are ongoing regarding partnering in various ways. Opportunities for interactions with other agribusinesses entities are being pursued through College of Agricultural Sciences development efforts.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor and Steering Committee Chair: Tom Holtzer

Steering Committee Leadership: Jan Leach (BSPM) and Dan Bush (Biology)

Steering Committee Members: Nora Lapitan (SCS), Cecil Stushnoff (HLA), Sarah Ward (SCS), Craig Bond (DARE)

- A. Bioagricultural Sciences and Pest Management
Faculty: Stephen Chisholm, John McKay, Scott Nissen, Rajinder Ranu,
Post Docs: Maria Diaz, Hiromichi Ishihara, Harald Meimberg
Admin Pro.: Janice Stephens, Cory Zoetewey
- B. Horticulture and Landscape Architecture
Faculty: Harrison Hughes
- C. Soil and Crop Sciences
Faculty: Patrick Byrne
Admin. Pro.: Junhua Peng, Deborah Badillo
- D. Faculty in the Department of Biology who interact with the Initiative include: Patricia Bedinger, June Medford, Marinus Pilon, Elizabeth Pilon-Smits, A.S.N Reddy
- E. Center for Bioinformatics
Faculty: Andre Ptitsyn, Ann Hess, Richard Casey

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Crop Improvement Extended Towards Crops for Health

Goal: Colorado State University will continue undergraduate education, graduate education, applied research, and outreach in:

- genetics and breeding of cultivars for wheat, potatoes, and dry edible beans focusing on characteristics relevant to pest resistance and climatic conditions of Colorado.
- the improvement of human health attributes of crops via shared planning and purpose with those focused on the Crops for Health initiative.
- evaluating and selecting specialty crops, and appropriate production/marketing approaches for Colorado growers.
- Colorado State University will combine knowledge of phytochemistry, human nutrition and plant genetics to extend crop improvement and dietary intervention with the objective to improve human health and human disease prevention via consumption of these crops and be recognized nationally and internationally as an institution attractive to graduate students in Biomedical Agriculture.
- Crop Improvement Extended toward Crops for Health will include a new graduate education and research focus that will define Biomedical Agriculture as a new discipline.

Purpose: Non-hybrid crop plants require public investment in genetic improvement to provide cultivars which improve yield, resist environmental and pest stresses, and serve the consuming public. Colorado State has a history of providing cultivar breeding for wheat, dry beans, and potatoes to serve the industries in climatic zones represented in Colorado. Additionally, Colorado State has a history of providing crop selection and testing in other agronomic crops and fruits and vegetables to support the development of these agricultural industries in Colorado. In 2007, wheat generated \$607.8 million in commodity sales, dry beans \$20.8 million, potatoes \$181.5 million, and other agronomic crops and vegetable and fruit crops generated \$1.17 billion, in Colorado. The value of these industries to the Colorado economy through other related economic activity is at least double these combined amounts. Molecular biology presents new opportunities to extend the selection and improvement of Colorado crops to incorporate improved human nutritional characteristics. Colorado State University is in a strong position to assist with the economic development of Colorado's agricultural industry and to enhance the public health of citizens with research and education to:

- Improve crops which resist environmental and biological pests, increase price and lower cost of production
- Enhance the success of small-acreage producers who will meet the growing demand for locally produced fruits and vegetables grown organically.
- Incorporate higher human nutritional values of food crops
- Educate agricultural industry, governmental, and academic professionals in the principles of crop selection and improvement.

Molecular biological science provides opportunities to extend the selection and improvement of Colorado crops to incorporate improved human nutritional characteristic. The quantity and quality of the foods we eat have a dramatic impact on the current epidemic of metabolic diseases, e.g., cardiovascular disease, Type 2 diabetes, cancer, and obesity. Metabolites are biochemical compounds that carry out the business of cells in all organisms. Metabolites (like lipids and antioxidants) present in food and in the human body are critical to understand the development and prevention of metabolic disease. Metabolomics is the comprehensive analysis in which all of the metabolites of an organism are identified and quantified. Colorado State has invested in building the capacity to be a leader in discovery research in metabolomics by establishing an interdisciplinary research consortium to determine relationships between metabolites and disease, and to identify metabolites in animal and crop foods to help prevent disease and improve health. Colorado State University is in a strong position to assist with the economic development of Colorado's agricultural industry and to enhance the public health of citizens through research to improve crops by understanding and enhancing their human nutritional food value.

Strategic Actions:

- Identify and formalize the organization of specific “teams” to address the various areas of the initiative.
- Recruit more graduate students and post-doctoral fellows supported by grants and check-off resources.
- Add faculty positions (one an endowed chair) in plant chemistry, plant biochemistry, food chemistry and molecular genetics (metabolomics/genomics) of novel nutritional traits.
- Enhance marketplace opportunities for Crops for Health.
- Develop a proposal for graduate degree in Biomedical Agriculture.
- Pursue international connection and collaboration with Canada.
- Hire a coordinator to “drive” the areas of emphasis within the initiative.
- Secure new space for new faculty and additional lab space for existing faculty and programs.

Critical Resource Growth Needs:

- Secure substantial grant support for fundamental research linking human nutrition to the development of food crop improvement, including special/competitive opportunities.
- Secure funds for four faculty positions, including one endowed chair in the area. These include: one in plant biochemistry, one in molecular genetics, one in food chemistry and one in plant chemistry; all with responsibility to establish a research program to clarify, and more fully commercialize, the mechanisms whereby metabolites confer health-promoting attributes to dry bean, potato and wheat cultivars.
- Shepardson building renovation and labs.
- Secure funds for new space for new faculty and additional lab space for existing faculty and programs.
- Fund a coordinator position for strategic initiative.
- Secure funding for facilities at off-campus research centers, primarily San Luis Valley and Western Research Center.

Accomplishments:General Statement:

This topical area has been given high priority in planning because of the important impacts that are expected. The long term impact will be to assure the profitability of food crop production in Colorado, while establishing *Agriculture as an instrument of public health* via the disease preventing attributes of crops and their products in human diets. These are life-altering impacts that will only be felt as the cumulative result of strategic actions over many years. Initial impacts from this effort will include specific outcomes that benefit producers, as well as ones that guide well-conceived program planning and priority-setting for enhancing human health.

Accomplishments include: New crop cultivars developed by plant breeders to sustain the profitability of Colorado crop producers. This represents long-term cumulative impact.

- The potato breeding program - through increased yields, improved quality and reduced need for nitrogen and other inputs –is estimated to have added \$15M to \$18M in annual value to the Colorado crop. Approximately 50 % of the state’s total potato acreage is planted with cultivars developed and characterized by the CSU program. This positive impact is also felt nationally. Of all potato cultivars released since 1990 by the 12 U.S. breeding programs, those developed by CSU ranked first in the nation in total acreage approved for seed certification. Furthermore, three of the top 10 cultivars in the U.S. for seed were developed by CSU.
- Development of improved wheat cultivars serves the wheat industry in Colorado by reducing wheat production costs, reducing pesticide use, and providing improved marketing options. Since inception of the program in 1963, the CSU Wheat Breeding Program has released over 26 improved wheat cultivars. CSU-bred wheat cultivars account for over 50% of Colorado's 2.4 million acres (2006 crop) with the remaining acreage planted mostly with cultivars from university breeding programs in adjacent states. During this time, average wheat grain yields in Colorado have more than doubled with at least 50% of this increase attributed to improved cultivars. Estimates from Colorado wheat industry leaders indicate that end-use quality enhancements from cultivars developed at CSU provide an average of \$20 million per year increased income

for Colorado wheat producers (83 million bushels x \$0.25 per bushel price increase; 2003 dollars). Production risks have been reduced significantly and the breeding program continues to address new production risks, such as those arising from the appearance of new Russian wheat aphid biotypes or races of stripe rust.

- The Russian Wheat Aphid (RWA) is a significant economic problem for wheat growers in the western U.S., with average annual losses in Colorado estimated at \$11 million. We have developed PCR-based markers for Dn7, a gene conferring a high level of resistance to at least four new biotypes of RWA. PCR-markers to facilitate the development of new resistant wheat germplasm and cultivars. Isolation of aphid elicitors can lead to the development of innovative strategies to control the damage caused by RWA. The markers developed for the resistance genes in 2414-11 and CI2401 will be useful for marker-assisted-breeding to expedite the development of new cultivars containing one or more resistance genes to new biotypes of RWA.
- White mold is a serious problem in U.S. dry bean production areas. Locating and characterizing the genetic loci that control white mold resistance in bean and identifying linked molecular markers will help breeders develop resistant cultivars. We developed a recombinant inbred line (RIL) mapping population by crossing the white mold resistant bean line G122 with the susceptible line CO72548, and self-pollinating for four generations. We constructed a linkage map based on the marker data that covered 733 cM and included parts of all 11 bean linkage groups. Five QTLs for resistance based on the greenhouse assay were detected, one each on linkage groups B1, B2b, and B9, and two on B8. The detected QTLs individually accounted for 7 to 20% of the phenotypic variance for disease resistance, and together accounted for 48% of the variance. The resistant alleles at the QTLs were derived from both the resistant and the susceptible parent.
- Clarification of the plant breeding/cultivar development priorities at CSU, to include the importance of value-added aspects of dry bean, potato and wheat breeding for Colorado growers, especially the marketing potential in “Crops for Health”. This approach has become a focal point for research and outreach at CSU. The award of the USDA National Needs Fellowship grant in this area illustrates its growth and potential as does the early effort to obtain “supercluster” status.
- Applied research and the transfer of water-conserving technology to vegetable growers in the Arkansas Valley has enabled those producers to enhance their profitability now, and to look forward to a positive future in the face of increasing water transfers to urban areas. The key part of this has been the adoption of drip irrigation and plasticulture techniques.
- Greatly expanded service to a wide network of small acreage fruit and vegetable growers delivered by the applied research and outreach of the Specialty Crops Program (SCP), made possible by a unique partnership with the Colorado Department of Agriculture (CDA). This involves multiple teams of CSU researchers, specialists and agents throughout the state, with grower-initiated projects guided by CSU technical advisors. There have been about 60 grower grants over the last five years, providing a strong foundation for innovation and increased profitability. The Rocky Mountain Small Organic Farms Project, which demonstrates optimum cultivar selection and crop production practices, as well as marketing approaches to small acreage producers, is another key element of the SCP.
- Viticulture research and outreach has contributed to the success and growth of grape production and wine-making, especially in western Colorado, where this is now not only an important component of agriculture, but a key driver of that region’s tourism industry. This positive impact has led to program growth, made possible by the funding of a new enology position through collaboration between CSU and the wine grape industry.
- Implementation of the Interdisciplinary Studies Program in Organic Agriculture. Early student response suggests a highly viable future for this program. Viticulture & Enology has also been developed as a new concentration, with implementation expected in the next academic year.
- Organization and delivery of the 2nd Annual “Agriculture Big and Small” Conference, with emphasis on vegetable crops and organic practices.
- Facilities improvements and development of a comprehensive program plan for the San Luis Valley Research Center. A similar program plan approach has been initiated for the Western Colorado Research Center.
- Breeding programs in wheat, dry bean, and potatoes are well organized in the departments of Soil and Crops and Horticulture and Landscape Architecture with financial support from the Agricultural Experiment Station

and respective industry check-off programs. The new metabolomics initiative calls for the establishment of the Research Consortium in Agriculture and Metabolic Diseases.

- Secured faculty position in enology with responsibility to establish a program of research and outreach designed to improve the quality of wines made from Colorado-grown grapes.
- Colorado State has the highly regarded Cancer Prevention Laboratory (CPL) imbedded among strong programs of plant breeding and crop production research. There are solid “crop improvement teams” in place for dry beans, potato and wheat. The CPL is focused on diet-based approaches to cancer prevention. Research capacity was added with funding of the “metabolomics” academic enhancement program (AEP) to add mass spectrometers for small molecule chemistry, and funding of the “bioinformatics” AEP to enhance database development of the genetic foundation of metabolites in food crops.

Internal Linkages: Much of the work which has produced these impacts, and which will generate more in the future, has involved active interaction with faculty and staff from multiple disciplines, agencies and academic units. This includes notable collaborations between those in the College of Agricultural Sciences and colleagues in other Colleges at CSU, involving efforts such as: the supercluster pre-proposal, and the successful USDA National Needs Fellowship grant in Crops for Health; planning of, and teaching contributions to the Viticulture & Enology program; and involvement in chemical ecology studies that seek to add value via medical and/or agricultural applications. In addition, future work under this strategic initiative will have greater impact as CAS faculty contribute to further development of Biomedical Agriculture as a program organizing concept.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Financial Resources:

Faculty and staff representing the Horticulture and Landscape Architecture and Soil and Crop Sciences departments and the Agricultural Experiment Station in the College of Agricultural Sciences dedicated time to this strategic initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$433,110	\$454,412	\$21,302 (4.9%)	\$516,447	\$62,035 (13.7%)
AES					
State	\$942,022	\$935,465	-\$6,557 (-0.7%)	\$385,243	-\$550,222 (-58.8%)
Federal	\$314,354	\$303,803	-\$10,551 9 (-3.3%)	\$184,934	-\$118,869 (-39.1%)
Extension					
State	\$241,929	\$251,101	\$9,172 (3.8%)	\$168,647	-\$82,454 (-32.8%)
Federal	\$0	\$0	\$0	\$0	\$0 (0%)
Grants/Contracts	\$3,667,770	\$3,130,217	-\$537,553 (-14.7%)	\$2,819,224	-\$310,993 (-9.9%)
Cash	\$547,208	\$684,272	\$137,064 (25.0%)	\$773,282	\$89,010 (13%)
Gifts	\$100,609	\$88,092	-\$12,517 (-12.4%)	\$99,244	\$11,152 (12.6%)
Total	\$6,247,002	\$5,847,362	-\$399,640 (-6.4%)	\$4,947,021	-\$900,341 (-15.4%)

II. Refereed journal articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 28 total refereed journal articles were published. For 2007, 28 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative stayed the same from calendar year 2006 to calendar year 2007.

III. Outreach Activities

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in approximately 145 workshops/presentations reaching more than 5,172 total participants.

IV. Research Activities: The following AES research projects are associated with this strategic initiative:

- N-3 Polyunsaturated Fatty Acids and Human Health and Disease
- Beneficial and Adverse Effects of Natural, Bioactive Dietary Chemicals on Human Health and Food Safety
- Improvement of Quality and Performance of Colorado Wheat
- Plant Genetic Resource Conservation and Utilization
- Plants as a Source of Bioactive Molecules for the Treatment of Obesity and Diabetes
- Nutrient Bioavailability--Phytonutrients and Beyond
- Plant Antioxidants as Free Radical Scavengers: Implications for Human Health and Plant Survival
- Effect of Fish Oil Supplementation in Chronic Renal Failure (CRF) in a Feline Model of Human Disease
- Molecular-Marker-Assisted Analysis of Quantitative Traits for Breeding Wheat and Dry Beans
- Exotic Germplasm Conversion and Breeding Common Bean (*Phaseolus vulgaris* L.) for Resistance to Abiotic and Biotic Stresses and to Enhance Nutritional Value
- Soy Derived Phytoestrogens and Protection of Cardiomyocytes
- Influence of Vitamins C and E on the Thermic Effect of Feeding in Overweight and Obese Adult Humans
- Effect of dietary fat type on emerging cardiovascular risk factors in individuals with impaired glucose tolerance or type 2 diabetes
- Development of New Potato Cultivars for Colorado Via Germplasm Enhancement and Evaluation

External Linkages

There are major external linkages to numerous program elements related to Crop Improvement, reflecting the economic importance of this work to Colorado. These include the Colorado Certified Potato Growers Association, Colorado Department of Agriculture, Colorado Potato Administrative Committee, Colorado Wheat Research Foundation, the Mountain View Harvest Cooperative, the USDA-ARS, the Rocky Mountain Association of Viticulturists and Vintners, and the Colorado Wine Development Board. There are also well-established external linkages with stakeholder groups interested in the understanding and enhancement of food crop genetics for human health. In addition to federal funding agencies, and the above listed grower organizations and international research centers, there are important emerging relationships being developed with the local medical community, i.e., the Cancer Center of the Rockies (Ft. Collins) and McKee Medical Center (Loveland).

Faculty and Staff associated with the Strategic Initiative:

Administrative Advisors: Gary Peterson, Steve Wallner

Steering Committee Chairs: Henry Thompson and Mark Brick

Steering Committee Membership: Scott Haley (SCS), David Holm (HLA), Frank Stonaker (HLA), Horst Caspari (HLA), Mike Bartolo (HLA), and Jerry Johnson (SCS), Greg Graff (DARE) Pat Byrne (SCS), Chris Melby (FSHN), Jan Leach (BSPM)

A. Horticulture and Landscape Architecture

Faculty: Robert Davidson, Harrison Hughes, Harold Larsen, Jorge Vivanco, Cecil Stushnoff, Horst Caspari, Samuel Essah, Sastry Jayanty, Weiqin Jiang, Zongjian Zhu

Admin.Pro.: Kathi Nietfeld, John Ray, , Kent Sather, Mary Snell, Tiffany Weir, Dana Christensen, Teresa Rivera, Elie El Kassis, Mercy Essah, Carolyn Keller, Steven Keller,, Richard Haslar, Andrew Houser, , Elizabeth Neil, Naira Quintana, Denise Rush, Jennifer Sells, Vanessa Fitzgerald, John McGinley,

State Class.: Deanna Brown

Post Doc.: Dayakar Badri

B. Soil and Crop Sciences

Faculty: Nora Lapitan, Calvin Pearson, Junhua Peng, Sarah Ward, James Quick

Admin. Pro.: Barry Ogg, Donna Jean Rath, Scott Reid, John Stromberger, Hong Wang, Deborah Badillo, Aaron Brown, Brad Erker, James Hain, Emily Heaton, Ethan Waltermine, Alicia Davisson, Scott Siefert, Rebecca Kottke, Linda Munk

Post Doc: Shusong Zheng

C. Faculty from other Colleges at CSU: Mike Pagliossotti, Chris Henry

Annual Report
2007-08

Design and Management of Colorado Landscapes

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research, and outreach in design and management of Colorado landscapes, serve as the primary provider of new management talent for Colorado's green industry, be recognized as the primary source of knowledge for Colorado's landscape industries, and be recognized nationally for graduate education and research in green industry crop evaluation and limited-water landscape plant cultivation. This will include continuation of the nationally recognized BS degree in landscape architecture and BS degree in landscape horticulture, graduate education and research in plant selection and improvement, limited-irrigation landscape plant cultivation, and landscape policies, and outreach in landscape industry plant selection, cultivation management, and Master Gardener education and volunteer development.

Purpose: Colorado is an urban and urbanizing state in which demographic evolution is changing the scope of "agriculture." The landscape (green) industry of Colorado, and the nation, is large and growing and comprises a significant part of Colorado agriculture (the green industries have been recognized as "agriculture" by the Colorado General Assembly). The industry includes production, wholesale, and retail sales for floriculture, nursery, and tree crops, garden supplies, irrigation equipment, outdoor equipment, and development and care services for landscapes, such as golf courses, landscape design and construction, and landscape maintenance for homes, businesses, and public gardens and cemeteries. Colorado expenditures on garden-related products, landscape and lawn service, and other related green industries (irrigation, botanical gardens, and outdoor equipment) have averaged 10 percent annual growth since 1993, resulting in \$1.67 billion in direct sales, in 2002. (This generates an economic impact of \$2.1 to \$5.0 billion depending on the economic multiplier used.) The value of the Colorado golf industry alone is \$1.2 billion. The landscape-related industries of Colorado employ nearly 34,000 positions (6 percent average annual growth) with a payroll of \$825 million annually (18 percent average annual growth). Thirty percent of industry revenues are generated from out of state (domestic and international) sales. Appropriate design and management of the landscape, especially in the environmentally sensitive regions that typify subdivisions and development of ranch lands, are essential for the quality of life in Colorado and for economic development related to tourism, industry location, retention of home valuation, and the green industry itself. Community landscaping strongly influences the physical/biological environment and mitigates many aspects of urban development by moderating climate, conserving energy, using carbon dioxide, improving air quality, controlling rainfall runoff and flooding, lowering noise levels, preserving green spaces, harboring wildlife, and enhancing the attractiveness of cities.

The Department of Horticulture and Landscape Architecture offers the B.S. in Landscape Architecture (194 majors in Fall 2008-09) and the B. S. in Landscape Horticulture (113 majors in Fall 2008-09). These degree programs have excellent support from industry. Colorado State University is in a strong position to assist with the economic development of Colorado's green industry and to enhance the well-being of tourists and citizens by educating green industry professionals, researching commercial and residential issues related to ornamental plantings and landscape restoration, and providing continuing education to industry employees and citizens on best practices for plant selection, plant production and maintenance, water conservation and irrigation, pest control, and landscape design.

Strategic Actions:

- Establish a Center for Design and Management of Sustainable Landscapes with faculty and county agent working groups to maintain cohesion of teaching, research, and outreach efforts, build professional expertise, and strengthen relationships with the industry.
- Establish a concentration in golf business management.

- Grow the B.S. in Landscape Horticulture student enrollment by double the rate of Colorado population growth, or 3 percent per year.
- Implement the proposal to establish a Master of Landscape Architecture degree.
- Prepare a facilities program plan to address the need for field, greenhouse and laboratory space for Landscape Horticulture.
- Pursue the idea of campus becoming a certified member of the Audubon Cooperative Sanctuary Program/Audubon Classic Program/Audubon Sustainable Community Program. Work with students and faculty in WCNR and Facilities Services to develop a Natural Resource Management Plan.

Critical Resource Growth Needs:

- Add positions in Landscape Architecture and Landscape Management, critical resources associated with the high student: faculty ratio that threatens national accreditation of the LA at CSU, and thus the viability of the degree program.
- Add GTAs to support laboratory instruction, and the expanded enrollment in HCC100.
- Secure funds for renovation and development of the Shepardson Building (\$18 million) and the Plant and Environmental Research Center (PERC) (\$8 million).
- Secure funding to pursue Audubon certification program.

Accomplishments: The long term impact of this work will be to assure the sustainable utilization of land, water and human resources to beautify Colorado landscapes, especially those impacted by the state’s growth and development. This will be accomplished by generating and disseminating knowledge that will also foster the profitability of Colorado’s Green Industry.

This ultimate comprehensive impact will occur over time as strategic planning determines program priorities and activities. Initial impacts from the effort in “Design and Management of Colorado Landscapes” will include specific outcomes with value to the Green Industry per se and/or to the public good, as well as to the planning and priority-setting needed for wise investment of CSU resources. Impacts that can be identified now include:

- Comprehensive training of CSU Extension agents and Master Gardeners in sustainable landscape management through the team-based efforts of specialists from several disciplines. Most recently, a clear impact has been the increased capacity of agents to diagnose turfgrass management problems in local communities.
- Introduction and promotion of well-characterized ornamental plants through the Plant Select program. Such efforts will result not only in profitable products for nurseries and garden centers, but also in the planting of water-conserving, more sustainable Colorado landscapes. Future efforts will be enhanced by the recently completed organization of Plant Select as a non-profit corporation, and the hiring of its Executive Director.
- Multidisciplinary collaboration among specialists and county-based agents via the Environmental Horticulture Core Competency Area, especially the Sustainable Landscapes work team, to deliver Master Gardener training and other educational programs.
- Expanded collaboration among colleagues from multiple Colleges at CSU. Previous interactions have included the development of substantial grant-funded research programs and periodic shared teaching of selected courses. More recently, faculty from five Departments in three Colleges (CAS, CNR, CNS) are working together to develop a comprehensive approach to the teaching of introductory and general ecology, which is central to the success of numerous programs related to this planning theme.
- Field exploration and collection of saltgrass ecotypes for utilization by the Bureau of Reclamation in revegetating riparian areas in Colorado following the removal of tamarisk, thereby contributing to solution of problems associated with its invasion of native ecosystems.
- Selection, breeding, characterization and management of highly salt and drought tolerant saltgrasses with enhanced turfgrass quality attributes.
- Characterization of landscape plants’ salt tolerance, and related suitability for use in landscapes that are irrigated with reclaimed wastewater. This information has been generated with financial support from

Colorado municipalities and water providers which, along with the general public, benefit from the water savings that result.

- Use of historical records of turfgrass management practices on golf courses in the region, and contemporary measurements, to demonstrate that turfgrass-based systems have significant carbon sequestration capacity. One potential benefit of these findings is in justifying the payment of carbon-based credits to those who own/manage golf courses and other urban landscapes.
- Multidisciplinary focus on water – to include water in Colorado landscapes - through the coordinated recruiting of new faculty in four different academic departments. This has been accompanied by development of a collaborative new approach to teaching landscape irrigation.
- Curriculum design for “Golf Management” as a new concentration in the Landscape Horticulture major. The golf industry has been engaged in this process, which integrates education in business, hotel/resort management and turfgrass science. Student interest and strong demand for graduates are expected to result in high enrollment.
- In the landscape design and contracting program, faculty worked with green industry leaders to develop and deliver a new “professional practices” course as an experimental offering. Practitioners from the landscape industry served as instructors, and the Associated Landscape Contractors of Colorado provided funding. All indications are that the course was highly successful, and likely to be continued beyond the experimental stage.
- The Department’s proposal for a new Master of Landscape Architecture has been approved by the College of Agricultural Sciences and the Council of Deans. Next steps include CoSRGE and Faculty Council consideration.
- In the CSU Extension Answerlink system, ‘Gardening and Home Horticulture’ topic, which comprises an important part of this strategic initiative, was the top topic reviewed in 2007 with 56,276 questions; the next highest category (‘Insects’) had 7,056 questions. ‘Gardening and Home Horticulture’ also received 1,080 questions in 2006, the greatest number of questions for any topic – the second was ‘Insects’ with 161 questions for 2006.

Internal Linkages: The internal linkages, especially those among and between extension specialists and agents are very strong and provide effective program planning and focus. In extension, this is facilitated via the Environmental Horticulture Work Team. Horticulture agents and specialists meet together as a group several times a year to plan Master Gardener and other extension programming. The teaching of landscape ecology (part of the LA curriculum) is planned and delivered through the collaborative efforts of faculty in several departments and colleges at CSU. In research, there is an excellent team approach to the development of improved saltgrass cultivars for both turf and reclamation applications. In addition, interdisciplinary research is emerging in landscape ecology and water utilization, including that which involves renewed use of the landscape tree planting at ARDEC.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Majors:

The following table shows the trend in the number of undergraduate majors associated with this strategic initiative:

Majors (Fall Semester)	2005-06	2006-07	2007-08	2008-09
Landscape Architecture*	175	178	180	194
Landscape Horticulture	168	145	118	113
TOTALS	343	323	298	307

*Includes Pre-Landscape Architecture majors.

There are no graduate majors for this strategic initiative.

II. Financial Resources:

Faculty and staff representing the Horticulture and Landscape Architecture and Agricultural and Resource Economics departments in the College of Agricultural Sciences dedicated time to this strategic initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$582,946	\$638,090	\$55,144 (9.5%)	\$798,818	\$160,728 (25.2%)
AES					
State	\$382,606	\$386,308	\$3,702 (1.0%)	\$454,003	\$67,695 (17.5%)
Federal	\$128,352	\$149,325	\$20,973 (16.3%)	\$127,565	-\$21,760 (-14.6%)
Extension					
State	\$203,452	\$139,886	-\$63,566 (-31.2%)	\$249,731	\$109,845 (78.5%)
Federal	\$0	\$0	\$0	\$0	\$0 (0%)
Grant/Contract	\$368,261	\$403,000	\$34,739 (9.4%)	\$421,359	\$18,359 (4.6%)
Cash Accounts	\$60,682	\$63,553	\$2,871 (4.7%)	\$109,510	\$45,957 (72.3%)
Gift	\$100,333	\$134,710	\$33,710 (33.6%)	\$125,984	-\$8,726 (-6.5%)
Total	\$1,826,632	\$1,914,205	\$87,573 (4.8%)	\$2,286,970	\$372,765 (19.5%)

III. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 13 total refereed journal articles were published. For 2007, 12 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative decreased by 1 from calendar year 2006 to calendar year 2007.

IV. Juried performances/exhibits/productions/designed/built project:

For calendar year 2007, a total of 1 juried performances/exhibits/productions/ designed/ built projects were accomplished by 1 faculty and staff dedicated to this strategic initiative.

V. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in approximately 218 workshops/presentations reaching more than 11,050 total participants.

VI. Research Activities: The following AES research projects are associated with this strategic initiative:

- Sustainability of Thinning and Prescribed Fire Programs to Improve Forest Condition Along the

Front Range, Colorado

- Development and Evaluation of Turf Species and Management Strategies for Sustainable Turf Systems
- The Critical Groundwater Link between Irrigated Agricultural Water Use and Fish Habitat on the High Plains
- Forest Conditions in The Rockies: Leopold, Fire, and Aspen
- Management of Turf and Ornamental Diseases in Colorado
- Effects of Irrigated Agriculture and Riparian Vegetation on Fish Habitats in the Arikaree River Basin of Colorado
- Metal Toxicity Thresholds for Important Colorado Reclamation Plant Species
- Introduction, Adaptability, Production and Survival of Landscape Plants in Colorado
- Aspen Persistence in Multi-Aged Forest Communities on the Western Slope of Colorado
- Production Systems of Ornamental Landscape Plants in the Intermountain West of the United States
- Wastewater Reuse In Turfgrass Systems
- Strategic management of unwanted wildland large fire events by integrating the fuels program with the direct management of suppression: a systematic approach to cost control
- Spatial analysis and modeling the indirect effects of climate change on forest insects and diseases across North America
- Long-term carbon and greenhouse gas consequences of fire in montane forests and woodlands of the Colorado Front Range

External Linkages :

External linkages have always been strong in this program area. There are numerous trade industry organizations, many of which are coordinated under The Green Industries of Colorado (GreenCo). GreenCo works with CSU to sponsor an annual career day as well as numerous educational conferences and programs. The ProGreen Expo and Rocky Mountain Regional Turf Conference are prime examples.

Other specific programs that are conducted through various industry : University partnerships include PlantSelect, PlantTalk Colorado, the CSU Annual Flower Trial Garden, Landscape Architecture Days, etc. Financial contributions from various industry sources support an impressive number of scholarships and help fund applied research, especially as related to landscape water use.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: Steve Wallner

Steering Committee Chair: Tony Koski

Steering Committee Members: Joe McGrane (HLA), Zach Johnson, (HLA), Patrick Martin, (HLA), David Whiting (HLA), Jennifer Boussetout (HLA), Irene Shonle (CSU Extension), Bill Bauerle (HLA)

A. Agricultural and Resource Economics

Faculty: Jennifer Bond, Dawn Thilmany, Steve Davies, Marco Costanigro, Chris Goemans, John Loomis

B. Bioagricultural Sciences and Pest Management

Faculty: Whitney Cranshaw, William Jacobi

C. Horticulture and Landscape Architecture

Faculty: Jim Klett, Brad Goetz, Harrison Hughes, Elizabeth Mogen, Steve Newman, Merlyn Paulson, Yaling Qian, Jorge Vivanco, Christine Dianni

Post Docs: Dayakar Badri, Mohamed Shahba

Admin. Pro. Dana Christensen, Elie El Kassis, Kathi Nietfeld, Naira Quintana, John Ray, David Staats, Tiffany Weir, Sarah Wilhelm

- D. Extension Agents: Ed Page, Mike Tupa, Kipp Nye
- E. Non-College of Agricultural Sciences faculty and staff: Dave Theobald (WCNR)

Annual Report
2007-08

Science and Management of Pest Insects, Plant Pathogens and Weeds

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research, and outreach in entomology, plant pathology, and weed science; be recognized as a primary source of pest management expertise in Colorado and the Mountain West region; and be recognized internationally for research and graduate education in genetic determinants of host plant resistance, fundamental mechanisms of biological invasions, and ecology, bioinformatics, genomics, and population genetics of pests. Undergraduate education will include contributions of courses to undergraduate agricultural degrees and introductions to plants, insects, and agriculture to the university's core curriculum. Graduate education and research will provide fundamental and applied science regarding pest species (their taxonomy, genomics, population genetics, and ecology) and pest management that is environmentally sound and economically effective. Outreach will include applied research and education relevant to emerging issues of Colorado's agricultural industries, including biosecurity, safe and effective pesticide use, and implementation of effective pest management strategies that do not rely on pesticides, as well as providing the primary source of pesticide applicator training in Colorado.

Purpose: Management of weeds, insect pests and plant pathogens is one of the most costly inputs that clientele in agriculture, the green industry, and consuming households must finance every year in Colorado. A diverse and expanding pest complex requires enhanced management skills that often increase production costs. A conservative loss estimate of 5 to 10% due to plant pests could cost Colorado producers in urban and rural settings \$50 to \$100 million annually. There is a long-term need for a comprehensive, high quality, integrated pest management system encompassing the disciplines of entomology, plant pathology and weed science. Pest activity and severity are dynamic and thus demand for management education and a systems approach will be ongoing. Integrated Pest Management (IPM) is the application of disciplinary, scientifically-based knowledge to profitably solving practical problems related to management of pests in agricultural and non-crop systems and landscapes in environmentally sound ways. Special emphasis within the Pest Management Team is placed on generating and providing information related to science-based policy, pest activity, pest diagnostics and identification, pest management recommendations, pest forecasting, safe and effective pesticide use, restoration ecology, integrated vegetation management, and the appropriate relationship of pest activity to pesticide use, pesticide alternatives, and pests versus profitability. New targets for IPM programs arise constantly as exotic, invasive species are creating unanticipated challenges in both agricultural and non-agricultural environments; combined with potential biosecurity breaches and mitigation. At the undergraduate level, the Department of Bioagricultural Sciences and Pest Management offers two minors (Entomology and Plant Health). However, a much more important aspect of the department's undergraduate program is targeted at providing educational opportunities to students in majors in the College of Agricultural Sciences and across the campus in entomology, plant pathology, weed science, and pest management. In addition, the department's faculty are very active participants in the Life Sciences program (teaching sections of LIFE 102 Attributes of Living Systems and BIO 320 Ecology), and in several courses taught under the "AGRI" designation. (e.g. AGRI/IE 102 Plants and Civilizations and AGRI/PHIL 330 Agricultural Ethics.

Strategic Actions:

- Implement follow-up action items from 2007 Extension meeting addressing issues in Pest Management.
- Enhance applied research and teaching facilities and graduate student recruiting.
- Add faculty strength in Integrated Pest Management of invasive species, vegetable crops, specialty crops, organic and sustainable agriculture.
- Take the Bioagricultural invasions (insects, plant pathogens, and weeds) research and graduate degree program worldwide.
- Secure placement of the Gillette Museum in renovated/new building space.

- Develop MS degree (non-thesis) in Integrated Pest Management (modern diagnostic techniques).

Critical Resource Growth Needs:

- Renovate space for the Gillette Museum of Arthropod Diversity (\$1.8 million) and find short-term solution to space needs. Participation in new museum design process.
- Secure at least one endowed faculty chair(s) in the area and first year graduate stipends.
- Renovate or build new office and research laboratory space for two new faculty positions.

Accomplishments

1. National Science Foundation Network

Colorado State is the home of a National Science Foundation supported Research Coordination Network that brings together about 40 scientists from all over the world with the goal of integrating the ecology and evolution of bioagricultural invasions to produce a predictive framework. This network focuses on developing a fundamental understanding of biological invasions and has clear implications for developing sound management strategies. The first meeting of the network was held in Fort Collins in August 2006. The 2008 meeting is scheduled for Prague in September.

2. Addressing Rural–Urban Water Needs

A 14 member team, including several members of this planning study, is addressing the needs for a new rural-urban water model. The study is developing and investigating cropping system options - techniques in crop planting and watering - to determine how much water can be saved. The water saved can be made available for possible urban use while at the same time sustaining viable economic returns to the agricultural and rural communities. Cropping system options include rotational cropping (fallowing of a portion of the land); deficit and partial season irrigation (applying less water, but gaining maximum yield from the water applied); water conserving practices and drought-tolerant crop varieties; adoption of optimal irrigation technology; and alternative farming practices, crops and markets. The cropping system strategies are being studied from the perspectives of farm profitability and economic activity in the agricultural and rural communities, the amount of water made available for other uses and practical feasibility. Investigating the impact of insect pests, plant pathogens, and weeds in this system is a critical component. The Strategic Initiative on managed ecosystems is also participating heavily in this effort. A major partner in the effort is the Parker Water and Sanitation District which has provided a grant to support the research, access to land for experimental purposes, and many other resources. The study is in its second field season and plans to expand the research are being pursued.

3. Invasive Weeds

a. Classical biological control is the control of exotic pests with specialized pathogens and parasites imported from the native range of the exotic pest. It is one of the most powerful and permanent solutions to the growing problems caused by invasive, weedy plants. Two issues of overriding importance in biological control are efficacy and safety. The genetics of both invasions and of plant-biological control agent interactions are thought to be an important component of both efficacy and safety. Important study systems targeted by this Strategic Initiative are diffuse and spotted knapweed, Dalmatian and yellow toadflax, leafy spurge and garlic mustard. With the knapweeds genetic material from natural populations was sampled and molecular genomic assays were conducted to quantify their genetic diversity in the native and introduced ranges and to narrow down where in the native range the invasive populations originated. The research showed that neither diffuse nor spotted knapweed experienced severe genetic bottlenecks upon introduction to North America. The origins of diffuse knapweed are unclear, while many spotted knapweed in North America appear closely related to Romanian and Bulgarian populations. Based on these findings, scientists exploring for additional biological control agents should search in Romania and Bulgaria.

b. Drought conditions have resulted in reduced recharge of many wildlife and recreational areas around Colorado. Cattails and rushes previously dominated these plant communities when water was more

abundant; however, these plant communities have been replaced by invasive species like Canada thistle. Managing Canada thistle in these locations has been very problematic because most herbicides that could reduce these weed populations are restricted to upland sites with deeper water tables. Many land managers have resorted to mowing these sites just before flowering as their primary weed control strategy. A new reduced risk herbicide can legally be used in these environments, but there was no information on long-term Canada thistle control. A five state research project showed that Canada thistle control was greater than 90% across locations, at commonly used rates. Studies are underway to evaluate the value of this control method in restoration programs designed to establish native or improved grass communities that will resist re-invasion by Canada thistle.

c. A team of researchers from the Strategic Initiative were awarded \$500,000 through the USDA competitive grants program to develop integrated ecological and economic decision support tools that will enable land managers, producers and extension specialists to (1) assess the condition of their rangeland with respect to cheatgrass invasion and its effects, (2) evaluate management inputs necessary to improve the condition of the land, (3) weigh the costs and benefits of the options under uncertain environmental conditions, and, (4) improve the ecological state of the land and economic status of the rancher.

4. Row-crop weed management

Molecular research on the mechanism conferring glyphosate resistance in Palmer amaranth is underway. Genetic studies were carried out to determine the inheritance of the resistance trait, and to see if the trait can be transferred via pollen to other pigweed species. Glyphosate (the active ingredient in Roundup™ herbicide) resistant weeds represent a tremendous threat to conservation tillage – a management strategy that has reduced soil erosion and increased water availability for crop growth in recent decades.

5. Invasive Forest Fungus

White pine blister rust (an invasive fungus from Eurasia) may induce outbreaks of mountain pine beetle on limber pine. Predictive models that provide information on the relationship between blister rust, bark beetle damage, and dwarf mistletoe may become important tools for forest management. The goal is to equip forest managers with information upon which to make science based management decisions for ponderosa pine, now that white pine blister rust has become established as an additional factor in forest systems.

6. Pathogens in Dry Bean

Research on mechanisms of resistance for major pathogens provides Colorado State's breeding program with useful genes that reduce the cost of production and the impact of pests to the bean industry. Currently, cultivars released through this effort, having multiple pest resistance, are produced on approximately 40% of the acreage in Colorado and have increased yield by 5 to 10% over cultivars they replaced. The bacterial wilt survey of dry bean showed that the plant pathogen was limited to a small portion of Colorado's dry bean acreage, thereby minimizing negative impacts on the industry's ability to freely export beans grown in other locations in Colorado to importing countries that ban imports from areas with the bacterial wilt pathogen.

7. Onion Pest Management

All registered insecticides for onion thrips have shown repeated control failures, thus threatening onion production. This is all the more critical because the newly emerging onion disease, Iris Yellow Spot Virus, is vectored by thrips. Because thrips control with insecticides is extremely problematic, other management tools are being explored. Resistant onion varieties, the use of straw mulches to reduce thrips numbers, and the use of other cultural practices to manage the disease all show promise. Together, these tools may become important keys to sustainable and profitable onion production in the region, but much research remains if these two pests are to be successfully managed.

8. Corn Rootworm Management

Corn rootworms are the most serious economic pests of corn in the United States, and basic research conducted within this Strategic Initiative on the feeding stimulants for these pests has recently resulted in new cooperative working relationships with corporations in the private sector and with the USDA-ARS to improve corn genotypes for better resistance to corn rootworm attack. Beginning in 2008, this working relationship is benefiting from a grant of \$438,000 from the USDA competitive grants program entitled “Understanding Corn Rootworm-Host Interactions toward Basic and Applied Goals.”

9. Russian Wheat Aphid Management

Russian wheat aphid (RWA) is the major insect pest of winter wheat in Colorado. Russian wheat aphid resistant varieties, developed at Colorado State have allowed producers to grow wheat without insecticides. However, the occurrence of a new RWA biotype greatly diminishes the value of currently deployed resistant varieties. In this context a number of research efforts are underway in an attempt to assure future RWA management that is both environmentally and economically sound., One approach is to identify genes that confer resistance to the new biotype and incorporate them into commercially acceptable wheat cultivars. A gene from rye, present in wheat in a unique translocation, confers superior levels of resistance to all currently existing biotypes of the RWA. Unfortunately, the presence of the rye secalin gene in the chromosome arm from rye hinders the widespread use of this gene in wheat breeding because secalin produces undesirable bread making qualities. However, progress is being made to separate the gene for resistance from the genes conferring undesirable traits using molecular gene markers.

Internal Linkages:

This strategic initiative has sought out members from many parts of campus. Within the College of Agricultural Sciences, the Departments of Horticulture and Landscape Architecture, Soil and Crop Sciences, and Agricultural and Resource Economics are included; and in the Warner College of Natural Resources, Department of Forest, Range and Watershed Stewardship were represented at the outset. (With the retirement of Wayne Leininger, there has not been representation on the Steering Committee from WCNR. However, there is a desire to reestablish this formal involvement.) Faculty associated with this Strategic Initiative participated in the successful nomination of the Program in Wheat Research, Outreach, and Education as a Colorado State University Program of Research and Scholarly Excellence (PRSE). Designation as a PRSE will help strengthen ties within that program, thus strengthening internal linkages among members of this Strategic Initiative and a range of other faculty and staff. All members of Colorado State University Extension’s Pest Management Work Team are considered vital participants in the Outreach objectives of the Strategic Initiative. Specific efforts involving the work team are: prioritizing existing pest problems for research and extension efforts and identifying potential pest threats, and implementing appropriate management strategies. Other efforts of the work team are integrated into many aspects covered elsewhere in this report.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Financial Resources:

Faculty and staff representing the Bioagricultural Sciences and Pest Management, Agricultural and Resource Economics, Horticulture and Landscape Architecture, and Soil and Crop Sciences departments and the Agriculture Experiment Station dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	2005-06	2006-07	Change	FY 2007-08	Change
RI	\$537,581	\$562,801	\$25,220 (4.7%)	\$664,540	\$101,739 (18.1%)
Ag. Exp. Station					
State	\$1,388,902	\$1,282,718	-\$106,184 (-7.6%)	\$857,409	-\$425,309 (-33.2%)
Federal	\$327,453	\$303,241	-\$24,212 (-7.4%)	\$263,932	-\$39,309 (-13.0%)
Extension					
State	\$436,465	\$417,230	-\$19,235(-4.4%)	\$413,278	-\$3,952 (0.9%)
Federal	\$80,220	\$70,851	-\$9,369 (-11.7%)	\$74,283	\$3,432 (4.8%)
Grant/Contract	\$1,406,075	\$1,493,812	\$87,737 (6.2%)	\$2,097,241	\$603,429 (40.4%)
Cash Accounts	\$185	\$1,055	\$870 (470.3%)	\$115,790	\$114,735 (1087%)
Gift	\$443,733	\$529,356	\$85,623 (19.3%)	\$558,779	\$29,423 (5.6%)
Totals	\$4,620,614	\$4,661,064	\$40,450 (0.9%)	\$5,045,252	\$384,188 (8.2%)

II. Refereed Journal Articles

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 43 total refereed journal articles were published. For 2007, 39 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative decreased by 4 from calendar year 2006 to calendar year 2007.

III. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in approximately 335 workshops/presentations reaching more than 19,742 total number of participants.

IV. Research Activities: The following AES research projects are associated with this strategic initiative:

- Insect Pest Management with Infochemicals
- Management of spider mite pests in Colorado field corn.
- Improved potato yield and quality through disease suppression and optimum certified seed potato production techniques
- Development and Integration of Pest Management Strategies for High Value Cropping Systems: Fruit and Vegetables
- Improving Economic and Environmental Sustainability in Tree-Fruit Production Through Changes in Rootstock Use
- Comparison of Traditional and Alternative Methods to Control Noxious Weeds near Cropland, Rangeland and Waterways
- The Biology, Ecology, and Molecular Genetics of Key Weeds of Colorado Row Crops and Non-Cropland
- Integrated Weed Management Strategies in Crop and Non-Crop Systems
- Improving Management of Arthropod Pests of Vegetable Crops, Nursery Crops and Landscape Plants in Colorado
- Interactions of Environmental Conditions with Forest and Shade Tree Diseases
- Understanding Plant Invasion on Colorado Rangelands

- Colorado Row and Vegetable Crop Foliar Disease Management
- Biology and Management of the Russian Wheat Aphid, *Diuraphis Noxia* (Mordvilko), in Colorado
- Invasive potential of hybrid toadflax populations
- Characterize Weed Population Dynamics for Improved Long-Term Weed Management Decision Making
- Integrating multiple biological control agents for Dalmatian toadflax and diffuse knapweed
- Ecology of Pests and Pest Management Systems
- The Ecology of Invasive Plants
- Ecology, Biology, and Management of Invasive Weeds in Colorado
- The Ecology and Genetics of Invasions and Biological Control
- Interactions among Bark Beetles, Pathogens, and Conifers in North American Forests
- Biological Control in Pest Management Systems of Plants
- Biology and Management of Iris yellow spot virus (IYSV) and Thrips in Onions
- Genetics of invasive *Centaurea* species in Colorado
- Towards an ecofriendly herbicide: (-)-catechin, a natural flavonol secreted by spotted knapweed roots, is a potent inhibitor of plant growth
- Proteome interactions mediating bacterial pathogenesis and host defense
- Improve Potato Yield and Quality through Suppression of Disease
- The Ecology and Genetics of Invasions and Biological control

External Linkages: This Strategic Initiative has numerous external linkages at the local, state, and national level. The entities with which the Initiative has the strongest linkages can be grouped under the following categories: State and Federal Agencies, Industry, and Commodity Groups. State and Federal Agency personnel who are Affiliate Faculty in BSPM are listed below. Linkages with these personnel involve both research and outreach collaborations. Strong linkages are with the Colorado Department of Agriculture, USDA ARS, USDA APHIS, USDA Forest Service, USDI National Park Service, USDI Geological Survey, USDI Bureau of Land Management, and USDHHS Center for Disease Control. Industry linkages are primarily with agrichemical and seed companies. These linkages allow the Initiative to investigate and provide to Coloradoans the latest information on product performance under Colorado Conditions. Examples include: Syngenta Crop Protection, Micro Flo Company LLC, Monsanto Company, Nufarm Americas Inc., BASF, Bayer CropScience, UAP-Loveland Industries, Inc., Valent Agricultural Products, J.R. Simplot Company/Plant Health Technologies, Wilbur-Ellis Company, Wilco Distributors, Inc., Chemtura Corporation, Rhodia Inc., E.I. DuPont de Nemours & Company, Albaugh, Inc., Colorado Water Garden Society, Colorado Turf Grass Foundation, Dow AgroSciences, LLC, and Helm Agro US Inc. The most active linkages with organized commodity groups are with those representing the following: wheat, onion, dry bean, corn, potato, turf, and other “green industries.”

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor and Steering Committee Chair: Tom Holtzer

Steering Committee Co-Chairs: Howard Schwartz, Andrew Norton

Steering Committee Members: Tony Koski (HLA), Frank Peairs (BSPM), Ned Tisserat (BSPM), Sarah Ward (SCS), Thad Gourd (CE), Cynthia Brown (BSPM), Scott Haley (SCS), James Pritchett (DARE), Scott Nissen (BSPM)

A. Bioagricultural Sciences and Pest Management

Faculty: George Beck, Louis Bjostad, Stephen Chisholm, Whitney Cranshaw, Joseph Hill, Ruth Hufbauer, Bill Jacobi, Boris Kondratieff, Jan Leach, John McKay, Paul Opler, Phil Westra, Robert Zimdahl

Res. Assoc.: Galen Brunk, Matthew Camper, Janet Hardin, Justin Herman, Michael Koch, Rhonda Koski, Jillian Lang, Mark McMillan, Kristen Otto, Terri Randolph, Jeffery Rudolph, James Sebastian, Tara Steinke, Cynthia Walker
Research Sci.: Sandra McDonald, Rick Zimmerman
Post Doc.: Maria Diaz, Hiromichi Ishihara, Rebecca Kao, Harold Meimberg, Scott Merrill,
Admin Pro: Maggie Hirko
State Class.: Janet Dill

B. Agricultural and Resource Economics
Faculty: Craig Bond

C. Horticulture and Landscape Architecture
Faculty: Robert Davidson, James Klett, Harold Larsen
Research Assoc.: Teresa Dobson, Andrew Houser, Teresa Rivera, Mary Snell
Admin. Pro.: Richard Haslar, Kent Sather
State Class.: Deanna Brown

D. Soil and Crop Sciences
Faculty: Mark Brick,

E. Agriculture Experiment Station
Research Assoc.: Ramesh Pokharel

F. County Extension Personnel (through Pest Management Work Team)
Alan Helm (District Liaison)
Mike Bartolo (District Liaison) Robert Hammon (District Liaison)
Assefa Gebre-Amlak Bruce Bosley
Randy Buhler Emily Coll
Jim Conley Roberta Cox
Karen Crumbaker Rob Davidson
Bill Ekstrom Samuel Essah
Yvette Henson Tom Hooten
Joe Julian Harold Larson
Ernest Marx Patrick McCarty
CJ Mucklow Bill Nobles
Kip Nye Carol O'Meara
Ramesh Pokharel Laurel Potts
Irene Shonle Mary Small
Alison Stoven Curt Swift

G. Other non-College of Agricultural Sciences faculty and staff:
None at this time. However, individual collaborative relationships are strong among participants in the Initiative and faculty in the Department of Biology, the Department of Forest, Range, and Watershed Stewardship, and the NREL. Efforts will continue to involve personnel from these areas on a more formal basis.

H. Federal Agencies
The following are State or Federal Agency Personnel who are actively engaged in this Initiative and who are Affiliate Faculty in BSPM:
Daniel Bean (Colorado Dept of Ag) Brian Geils (US Forest Service),

Richard Hansen (USDA, APHIS)
Ann Lynch (US Forest Service)
Jose Negron (US Forest Service)
Gary Puterka (USDA ARS)
Dale Shaner (USDA ARS)
Terrence Walters (USDA APHIS)

Linda Hanson (USDA, ARS)
Janet McAllister (USHHS, CDC)
Lee Panella (USDA ARS),
Craig Ramsey (USDA APHIS)
Melinda Sullivan (USDA APHIS)
Lori Wiles (USDA ARS)

Annual Report
2007-08

Managed Ecosystems

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research, and outreach in the long-range adaptation of agriculture in the 21st century in response to changes in demography, water availability, water and agricultural policies, environmental and land use policies, demand for recreation, and national and international markets. Colorado State University will be recognized regionally, nationally, and internationally for modern crop, range, and livestock systems in semi-arid environments. This will include disciplinary and interdisciplinary work in crop and soil sciences, economics, animal sciences, pest sciences, landscape design and policy, range science, wildlife biology and ecology, forest science, and water sciences.

Purpose: The state of Colorado can be viewed as an ecosystem with its basic parts consisting of soil, air, water, plant life, animal life, and human inhabitants. The system components are highly interrelated and each is affected by the other, e.g., the dependence of humans on soil, water, plants and animals for food and the effects of humans on land use and water availability and quality through actions and policy. The Colorado ecosystem is shared by agricultural producers, a rapidly growing urban population, and wildlife. As competition grows for finite water, land, and air resources, and as agricultural and natural resource policies and international markets change, opportunities to maximize the economic value of agriculture in Colorado will change continuously. The complex relationships of ecosystem variables must be well understood to predict these opportunities. Colorado State offers BS degrees in Soil and Crop Science (58 majors in fall 2008) and in Horticulture (66 majors in fall 2008), including pest management courses in the Department of Bioagricultural Sciences and Pest Management, and MS and PhD degrees in Soil and Crop Science and Horticulture. These college degrees prepare professionals to understand and manage economically important plants that depend on our soil and water resources. Twentieth century agriculture focused on mono-cultural production of commodity foods, however, 21st century agriculture will focus on a broader array of food products of higher value, differentiated in the marketplace and produced with much higher cost land and water resources in more crowded environments. Professional agriculturalists and agribusiness people will require much more education in overall ecosystem management. Colorado State University is in a strong position to assist with the economic development of Colorado's agricultural industries within the context of increasing population, higher competition for land and water, and changing policy environment by educating agricultural and resource industry professionals, researching technical and economic issues related to improved resource utilization, and enhancing international competitiveness by being actively involved with agricultural industries and governmental agencies to assure that the latest knowledge is incorporated in management and regulatory decisions which are important to sustain the agricultural industry with rapidly evolving competition for resources.

Strategic Actions:

- Enhance the effort of the integrated research, graduate education, and outreach program in long-range managed ecosystem dynamics, led by a faculty steering committee, incorporating disciplines in the Colleges of Agricultural Sciences, Natural Resources, Engineering, and Natural Sciences.
- Pursue the possibilities of an external program review and implement recommendations as appropriate.
- Explore connection of the IRM and Managed Ecosystems strategic initiative.
- Align research facilities for integrated plans and fill gaps in expertise through collaboration or new positions.
- Develop an Environmental Chemistry program in collaboration with BSPM and Chemistry departments.
- Continue to expand the newly created interdisciplinary program in Organic Agriculture Production and build the collaboration among the supporting departments and add an animal component to the program.

Critical Resource Growth Needs:

- Assure adequate faculty staffing in rangeland, wildlife sciences and regional and community development economics to support a comprehensive approach to the area. Pursue collaboration with University of Wyoming for range science.
- Develop additional, multi-disciplinary grant programs to provide research and travel support.
- Critical need to hire a full-time Coordinator for the Organic Agriculture Production interdisciplinary program.
- Secure adequate lab/office space for new hires and potential future hires.

Accomplishments

General statement: Obviously ecosystem function in Colorado is highly controlled by water or the lack thereof. Therefore many of the accomplishments and impacts are linked to efficient use of water, whether it is dryland or irrigated agriculture.

Accomplishments:

The Dryland Agroecosystem Project has assisted in the adoption of no-till intensive cropping systems in Colorado and the Western Great Plains. The project has helped Colorado producers convert about 1,500,000 acres from the wheat-fallow system to a wheat-summer crop-fallow system. Adoption of these principles has increased annual net return by \$22,275,000 in eastern Colorado alone and has also influenced farmers in adjacent states. Recent decreases in herbicide costs coupled with rising diesel fuel prices will further increase the profit margins of no-till systems relative to tilled fallow systems. Furthermore, these intensive cropping systems build soil organic carbon, improve soil quality, and improve both air and surface water quality because they reduce soil erosion by 80 to 99% relative to tilled wheat-fallow systems.

Precision agriculture research has improved the plant use efficiency of N fertilizer via the use of variable fertilizer application rate technology. Rates of N are altered for different management zones within a given field. CSU research has shown that net returns are increased by \$12-30 per acre using site-specific N management. Continually rising fertilizer N prices will greatly increase the benefits of precise use of N fertilizers. In addition to economic returns, nitrate leaching can be reduced by 25%, compared to uniform N fertilizer management techniques.

Scientists in this group are developing methods to accurately inventory soil carbon sequestration and assess current and future emission and sequestration levels of carbon. These inventories will assist our nation in meeting international treaty obligations. They will also help design cost-effective future carbon dioxide mitigation policies. Information obtained from this work has been included in the US national communication to the UN Framework Convention on Climate Change (UNFCCC). Improvements in inventory methodologies will be used by most countries in the world for their reporting to the UNFCCC. USDA is now using the computing tools developed at CSU to guide decisions on conservation components of national farm policy, including how to allocate Conservation Security Program participation funds to agricultural producers, in Colorado and the rest of the US.

Scientists in the group are studying the importance of biological controls on silica cycling in terrestrial environment. Silica cycling is of fundamental importance in coupling terrestrial and oceanic carbon cycles. This work suggests that geochemical behavior as well as the variability of biogenic Si within grassland ecosystems has been historically linked to climate change and grassland productivity. Given that precipitation and temperature are being impacted directly and indirectly by human activities in grasslands worldwide, data generated by this research will facilitate more robust forecasts of human impacts on global-scale processes. In the Arkansas River valley furrow and drip irrigation produced equal corn yields, even though 45% less water was applied with drip than with furrow irrigation. Drip irrigation of onions compared to furrow irrigation practices resulted in a water savings of 72%. This work demonstrates the feasibility of drip irrigation for corn and particularly onion production in the Arkansas Valley.

Subsurface drip irrigation produced comparable alfalfa hay yields to sprinkler irrigation in Southwestern Colorado. Drip tape lateral spacing of approximately 100 cm would ensure uniform water distribution and maximize hay production. Installation cost, maintenance requirements, and gopher control remain as challenges to the adoption of drip irrigation by alfalfa hay producers in southwestern Colorado.

Scientists in this group do nutrient-assessment research on biosolids application and have shown that biosolids can supply sustainable levels of plant nutrients while posing very small environmental threats. For dryland wheat in eastern Colorado, biosolids are an excellent source of plant-available N, P, and Zn.

Historically, the environmental risks associated with land-application of biosolids were largely considered to be over-application of phosphorous and heavy metals. We now know that antibiotics are not destroyed by waste water treatment practices and can be detected in biosolids materials. Application of biosolids to land introduces not only antibiotics, but antibiotic-resistant bacteria as well, to soil. A social impact could arise if humans come into contact with soil-borne bacteria carrying antibiotic resistance genes (either from direct contact with soil or from crops contaminated with soil and/or biosolids), or if antibiotic-resistant bacteria move from soil into water (surface runoff events or downward migration into groundwater) which is then consumed by humans. Managed Ecosystem scientists are currently conducting research to determine whether such risk concerns are warranted.

The amount and distribution of genetic diversity in yellow toadflax presents potential management challenges and may explain previous reports of limited control with herbicides. Current results do not show evidence of local adaptation having reduced or redistributed genetic diversity, but they do indicate that many yellow toadflax populations have the potential to evolve resistance to management strategies such as herbicide application. Reports from land managers of possible hybridization between Dalmatian and yellow toadflax have implications for bio-control strategies, since bio-control agents currently in use have species-specific feeding preferences, and it is not known how effective such agents would be on hybrid plants.

Internal Linkages

The Soil and Crop Sciences (SCS) Department has had a close linkage with the Natural Resources Ecology Laboratory (NREL) for about 25 years. The initial ties with NREL were created via the NSF funded “Great Plains Project” led by Dr. Robert Heil of the SCS Department, by Dr. Ted Elliott of the NREL, and by Dr. Vern Cole of the USDA-ARS. Currently Dr. Keith Paustian of the SCS Department works closely with NREL and is actually housed in their building. Interactions with the Department of Forest, Rangeland, and Watershed Stewardship have existed because of joint research projects over the past 20 years. Dr. Barbarick worked closely with Dr. Redente in reclamation projects involving the use of biosolids, and Dr. Kelly works with Drs. Burke and Lauenroth in regard to the NSF funded Grass Steppe LTER project. Interactions with the Department of Civil and Environmental Engineering relating to salinity management in the Arkansas Valley of Colorado have been ongoing for over 10 years. New efforts are under way to create new relationships between SCS and Animal Sciences that relate to animal-plant production systems, particularly as related to dryland cropping systems.

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic planning initiative.

I. Majors:

The following table shows the trend in the number of undergraduate majors associated with this strategic initiative:

Major (Fall Semester)	2005-06	2006-07	2007-08	2008-09
Soil and Crop Sciences	64	60	55	58
Horticulture	60	57	74	66
TOTALS	124	117	129	124

* Includes secondary majors

The following table shows the trend in the number of graduate majors associated with this strategic initiative:

Fall Semester	2005-06	2006-07	2007-08	2008-09
Soil and Crop Sciences	28	25	30	29
Horticulture	19	20	24	24
Totals	47	45	54	53

* includes MS and Ph.D. majors

II. Financial Resources:

Faculty and staff representing the departments of Agricultural and Resource Economics, Bioagricultural Sciences and Pest Management, Horticulture and Landscape Architecture, Soil and Crops Sciences and the Agricultural Experiment Station dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	2005-06	2006-07	Change	FY 2007-08	Change
RI	\$517,571	\$557,703	\$40,132 (7.8%)	\$565,408	\$7,705 (1.4%)
AES					
State	\$938,635	\$1,011,063	\$72,428 (7.7%)	\$553,335	-\$457,728 (-45.3%)
Federal	\$310,836	\$320,021	\$9,185 (3.0%)	\$354,616	\$34,595 (10.8%)
Extension					
State	\$203,242	\$210,920	\$7,678 (3.8%)	\$213,221	\$2,301 (1.1%)
Federal	\$0	\$900	\$900 (100.0%)	\$943	\$43 (4.8%)
Grant/Contract	\$2,293,467	\$2,467,782	\$174,315 (7.6%)	\$2,182,916	-\$284,866 (-11.5%)
Cash	\$448,006	\$414,940	-\$33,066 (-7.4%)	\$931,900	\$516,960 (125%)
Gift	\$780	\$8,374	\$7,594 (973.6%)	\$21,306	\$12,932 (155%)
Totals	\$4,712,537	\$4,991,703	\$279,166 (5.9%)	\$4,823,645	-\$168,058 (3.4%)

III. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 25 total refereed journal articles were published. For 2007, 51 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative increased by 26 from calendar year 2006 to calendar year 2007.

IV. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with this strategic initiative participated in approximately 138 workshops/presentations reaching more than 5,876 total number of attendees and participants.

V. Research Activities: The following AES research projects are associated with this strategic initiative:

- Crops and Cropping Systems in Western Colorado for Traditional/Alternative and Industrial/Bioenergy Uses
- Crop Management and Sorghum Improvement
- Enhancing Field Crop Production in the Arkansas River Valley
- Assessing the Primary Controls on Soil Biogeochemistry in Grass Dominated Ecosystems
- Sustainable Nutrient Management of Soils to Enhance Productivity and Environmental Quality.
- Impact of Land Use Management on Soil Microbial Structural and Functional Diversity
- Imagining landscapes of the future: predicting the impacts of climate change, insect outbreaks, and fire on Colorado forests
- Disturbance, Invasion, Restoration, and Rangeland Health
- Crop and Soil Management Systems in Water Limited Agroecosystems
- Multi-state Evaluation of Winegrape Cultivars and Clones
- UV-B Monitoring and Research Program
- Benchmark Soils to Predict Effects of Climatic Change in the Western USA
- Estimation of Soil Moisture in Intensively-Irrigated Areas Using Remote-Sensing
- Predicting the Severity of Low Flows and Droughts for Agricultural Systems in Colorado
- Reducing Barriers to Adoption of Microirrigation
- Precision Management on Site-Specific Management Zones for Farm Profitability and Environment Sustainability
- Monitoring Colorado's Climate for Applications in Agriculture and Natural Resources
- Defining and Engineering Solutions for Agroecological Threats from Salinity and Selenium in an Irrigated River Valley
- Vegetable Crop Management in the Arkansas Valley
- Management of Forages in Colorado for Improved Yield and Quality
- Development of cultivar specific management profiles for new and existing potato cultivars.
- Agricultural Soils Mitigation of Greenhouse Gases in Colorado and the US
- Estimating Nutrient Loads for Water Quality Management
- Vegetation Change and Risk in Management of Rangeland Plants
- Organic Cropping Management Systems
- Characterizing Mass and Energy Transport at Different Scales
- Augmentation Accounting in the South Platte Using South Platte Mapping and Analysis Program (SPMAP)

External Linkages

The Managed Ecosystems program is closely linked with three USDA-ARS units: 1) The Great Plains Systems Unit located in Fort Collins, whose leader is Laj Ahuja; 2) The Water Management Unit located in Fort Collins, whose leader is Tom Trout; and 3) The Central Great Plains Research Station located at Akron, CO, whose leader is Merle Vigil.

The Great Plains Systems unit has had cooperative agreements with the SCS Department continuously since 1985. These agreements have provided backbone financial support to the cooperatively operated Dryland Agroecosystems Project. This project has had significant impact on agricultural practices in the West Central Great Plains and is internationally recognized by scientific peers. The Water Management unit had a cooperative agreement with the SCS Department for a period of 5 years that emphasized Precision Agriculture. At present this ARS unit is forming a new cooperative agreement with SCS that involves water use in limited irrigation. The Central Great Plains Research Station has worked cooperatively with the SCS Department on a variety of dryland management projects over the past 40 years. All of their scientists hold adjunct appointments in the SCS Department. The SCS Department has worked cooperatively with USDA-NRCS for over 40 years in the state soil survey project.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: Gary Peterson

Steering Committee Lieutenant(s): Frank Peairs and Reagan Waskom

Steering Committee Members: Neil Hansen (SCS), Eugene Kelly (SCS), Mary Stromberger (SCS), Kraig Peel (AS), Bill Wailes (AS), Dana Hoag (DARE), Patrick Martin (HLA), Bruce Bosley (CE), Luis Garcia(Civ. Engr.), Lou Swanson (VPOSP), Del Benson (FW B), Mark Paschke (FRWS),

A. Agricultural and Resource Economics

Faculty: Marshall Frasier, Gorm Kipperberg, James Pritchett, Paul Huszer

B. Horticulture and Landscape Architecture

Faculty: Horst Caspari, Harrison Hughes, Steve Newman, Yaling Qian,

Admin. Pro.: Michael Bartolo, Mercy Essah, Samuel Essah

C. Soil and Crop Sciences

Faculty: Allan Andales, Ken Barbarick, Thomas Borch, Joe Brummer, Greg Butters, Jessica Davis, Jack Fenwick, James Ippolito, Raj Khosla, Keith Paustian, Dwayne Westfall

Admin. Pro.: Saseendran Anapalli, Troy Bauder, Abdelfettah Berrada, Adriane Elliott, Ron Godin, Jerry Johnson, Kevin Larson, Matthew Neibauer, Kimberly Schultz, Timothy Shaver, Caroline Yonker, Mary Schumm, James Self

D. Agricultural Experiment Station

Faculty: Lee Sommers

Admin. Pro.: Mark Stack, James Valliant

E. Extension

Agents: Alan Helms

Area Specialists: Merle Dillon, Joel Schneekloth

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2007-08

Economics, Management, Policy and Trade for Agribusiness and Communities

Goal: Colorado State University will enhance its focus and depth in undergraduate education, graduate education, research, and outreach in the economic and business aspects of agriculture, its' business firms, industries and policy issues, and be recognized nationally for these contributions. This will include experiential learning in the BS degree in Agribusiness offered on its own, or as a double major with agricultural sciences, natural resources, and human nutrition. Research and graduate education will focus on marketing strategy, financial and risk management, and firm responses to agricultural and trade policies. Moreover, the educational focus will be additionally on the role of natural resources in policy and agricultural performance. Outreach will include marketing, finance, risk and production management, and policy responses for agricultural input, production, and processing/merchandizing businesses of Colorado.

Purpose: Production agriculture is a \$6 billion enterprise in Colorado and, with related input, processing, and merchandising support industries, agriculture is a \$16 billion component of the Colorado economy. Production agriculture has changed over the years. Price and income supports are no longer the centerpiece of U. S. farm policy and with the new round of international trade negotiations, these supports likely will be of less value in the future. Agricultural producers now operate in a market-oriented, individual-responsibility environment. Producers, individually or in groups, are finding greater profitability in differentiated, consumer-oriented products requiring knowledge of supply and marketing chains, product differentiation, consumer product marketing, corporate accounting, and new risk and financial management tools. The newest themes for farmers, local commodity handlers, processors, and rural businesses are "total resource management" and "rural entrepreneurship." Also, the Census of Agriculture reports that there are decreasing numbers of mid- and large-sized farms and a significant increase in the number of small farms; the latter category of individuals frequently does not contain much agricultural business knowledge.

The Department of Agricultural and Resource Economics offers the B. S. in Agribusiness (217 majors in Fall 2008) and the B. S. in Agricultural Economics (15 majors in Fall 2008). With changes in curricula in the Equine Science and Animal Science majors, additional purposeful effort to develop secondary majors with Horticulture and Landscape Architecture and Forest, Rangeland, and Watershed Stewardship is being examined. With the recent growth in student interest in double majors, plus the differential tuition charges for courses in the College of Business, the demand for agribusiness courses is expected to grow rapidly. Colorado State University is in a strong position to assist with the economic development of Colorado's agricultural and rural industries, and to enhance the viability of agricultural and rural business by educating professionals for the agricultural industries with knowledge of modern business practices, researching technical and economic issues related to differentiated agricultural products in the ever-changing domestic and international market place, and by being actively involved with agricultural industry personnel and governmental agencies to assure that land managers and communities can evaluate a broad range of opportunities to enhance viability.

Strategic Actions:

- Grow the faculty to reflect growth in student demand and increased university emphasis on economic development and outreach.
- Strategically develop double majors with other disciplines and on-line courses (certification and degree completion). Potential areas include Natural Resources and Horticulture and Landscape Architecture.
- Host a high-profile policy conference attracting regional and national figures by 2010.
- Enhance the connection between the department and the Office of Economic Development and the Community Development Core Area in Extension.
- Promote and enhance closer connections with the College of Business.

Critical Resource Growth Needs:

- Add three faculty positions in agribusiness (economic development identified as one) to reflect student demand, increased emphasis on economic development and outreach, and complement the graduate program with differentiated Ph.D. classes.
- Add a \$100,000 annual fund to support graduate student first year stipends.
- Secure two endowed chair positions for the Department of Agricultural and Resource Economics.
- Enhance departmental operating support by \$70,000 annually.
- Upgrade facilities and computer support for faculty and staff. Specifically upgrade space for graduate students. Estimated cost is \$75,000.

Accomplishments:

1. Beef and other livestock research and outreach

One of the key focuses of faculty is in beef and other animal systems. We do work on the supply chain, demand analyses, and agribusiness and policy analyses of the main issues in animal agriculture. During the past year, a large USDA Livestock and Meat Marketing Study, mandated by Congress and funded through the USDA Grain Inspection Packers and Stockyards Administration, essentially was finished. The \$4.3 million project provided a comprehensive look at alternative marketing arrangements within the livestock and meat industry. (Koontz participated in this study). Results from this study have started coming out as fact sheets and journal articles during this past year.

Faculty also played a role in the analysis of several major policy issues in the livestock system. Our faculty were nationally recognized in areas of animal traceability and ID issues, and related issues, such as Country of Origin Labeling (COOL) and infectious disease outbreaks (Koontz, Pendell and Parsons). Also, Koontz presented numerous agricultural outlook presentations looking at both livestock and grains. Given the rapid rise in commodity prices and the role of ethanol demand and its impact on grain and livestock markets, forecasting commodity prices has become much more visible nationally. For example, Koontz was interviewed for the television program, "The News Hour" which is broadcast on National Public Television. Our forecasts have also been presented at the Governor's Agricultural Forum in February 2007 and in a special session organized by the Colorado Commissioner of Agriculture with members of the Colorado Livestock Association, Colorado Cattlemen's Association and other stakeholders in the livestock sector. Pendell has presented results of research looking at regional effects of outbreaks of Foot and Mouth disease at APHIS, USDA offices in Washington D.C and also in various agricultural magazines. Additionally, he looked at the effects of a National Animal Identification System (NAIS) on packers and renderers, and also presented this research to the same stakeholder groups. Parsons has had a number of contracts looking at identification systems for sheep and goats.

The ABM team, Norm Dalsted and Steve Koontz do much work on the financial and profitability analysis of various livestock production and feeding options with our regional extension specialists, John Deering, Dennis Kaan, Rod Sharp and Jeff Tranel. An ongoing feature of this interaction is the annual Agricultural Lender's tour, in which a range of topics, including outlook and financial issues, are presented at four areas throughout the state.

Finally, the *Fed Cattle Market Simulator* has been used for many years as role-playing exercise in seminars, classes and meeting settings with various groups and organizations. This program is national in scope and intensive two-day seminars have been conducted with agribusiness professionals across the country.

2. Other Agribusiness and Farm Production Research and Outreach:

The department engages in ongoing work on a variety of industry studies, demand analyses and producer research and outreach activities. These are similar in nature to much of the work in the beef section, but are often related to other commodities and issues. The major areas of effort are listed below.

Risk Management Activities: One substantial program is RightRisk, where approximately of 24 programs were given in 7 states, with 355 on-site workshop participants, during 2007. The RightRisk Education program continues to grow with the development of Ag Survivor scenarios, more work in the arena of insurance products, and the on-going development of the RightRisk Navigator curriculum. Dana Hoag and Catherine Keske developed a program for women and delivered it at Hayden, Steamboat Springs and Greeley. This was a full-day program and additionally, a booklet was sent targeting Navigator for women to about 300 additional women. Also, using expertise in futures and options for price risk management programs, education on market risk management methods, and synthesis and delivery of education material on agricultural market and price-risk management, Koontz provides another dimension on risk management education research and outreach. Dalsted does considerable outreach work in estate planning, to add another dimension of risk management assessments done in the EMPTAC planning area. Pritchett has worked with others in crop insurance analyses over the past year.

Marketing in nonconventional (organic, natural, humane, alternative crops) and local food systems: Faculty (D. Thilmany, J. Bond and M. Costanigro) provide presentations, programming and technical support to agricultural and specialty food producers in niche marketing, agribusiness management and distribution/retailing activities. These activities have increased our department's and Extension's impact among producers with non-commodity and alternative production and marketing interests, as well as professionals and businesses in specific segments of the broader food industry (chefs, small food processors, specialty retailers). This area has garnered an NRI project entitled "Organic, Locality, and Food Miles – Implications for Trade, Supply Chains, Environment, and Consumer Welfare" with and has been visible in outreach to small, new and direct marketing producers through several venues, including the Specialty Crops Farm Site, Southwest Marketing Network, Boulder County's New Farmer program (which we hope to replicate in other counties), development of a new set of organic and CSA enterprise budgets and partnering with the Colorado Dept of Agriculture to bring the National Market Maker program to this state. M. Costanigro and D. Thilmany have been undertaking research in the wine industry that has been well received in research outlets and by the industry itself.

Consumer Demand for Alternative Food Product and Local Food Purchases: We have looked at consumer segmentation, relative importance of various product attributes and some willingness to pay assessments for a variety of organic and other crops. C. Bond, J. Bond and D. Thilmany have done outreach and research on these issues in fresh produce, on value-added agricultural economic development through natural meat marketing strategies based on consumer segmentation, agrotourism based analysis. We have done a number of feasibility studies on onion nuggets, fresh potatoes and the wine industry. (We have also looked at bison, yaks, and organic goat products, just to name a few alternative products.) J. Bond has also looked spillover effects of generic advertising on specialty and non-commodity potatoes for the US Potato Board.

Organics: Dr. Thilmany's position as National Program leader last year for the USDA's Organic Program will lead to an exploration of some of the market forces, supply chain issues and marketing policy challenges facing this fast growing sector of the food industry. A related dimension has been in the area of demand analysis for beef attributes, and consumer willingness to pay for natural meat. Thilmany and others have also done value-added agricultural economic development analyses and outreach using natural meat marketing strategies based on consumer segmentation, and better pricing and marketing strategies based on consumer interest in food attributes, including country-of-origin labeling, traceability and tenderness. Our faculty are also participating in the development of new Organics program in Soil and Crop Science, advisory board, guest lecture in freshman

course Fall 2006 and 2007. Will team teach the course capstone in Spring 2008 which was under development during Fall 2007.

General Agricultural Marketing: Aside from the beef industry activities described earlier, the EMPTAC strategic planning area focuses on some key areas of the agricultural economy. We have strengths in our interactions with Cooperatives, as the department provides train each year to managers of Cooperatives in Colorado. J. Bond analyzed the failure of a rice cooperative in California in reach with a similar focus. Also, we have received a grant to look at the future of Colorado Agriculture, which will focus on the outlook for most of the major commodities in the state.

3. Natural resources policy and valuation

The policy, economic and business development work done by faculty related to natural resources is presented in this section. The key resources of interest are the water, land and forest resources in Colorado, but international dimensions, with both policy and business issues, are at times addressed by our faculty. This area of focus is one of the largest and most productive in our department. Over half of our journal articles, book chapters and contract dollars are in this area. Also, about half of the faculty members within this strategic initiative are in this area.

Our faculty makes a very significant contribution nationally in the area of valuation of a resource's attributes, ranging across methodological, empirical and topical perspectives. As examples, work has been done on: the value of prescribed fires on the urban wild land interface; willingness to pay of Native Americans and the general population for fuel reduction policies; the use and passive values in river and lake restoration; sea otter expansion in California; how the economic contribution of angling and rafting changes with instream flow variations; the value of ecological support functions ecosystem goods and services, among others (See Loomis and Seidl's work). Many papers have had a methodological contribution, as articles addressed issues such as the following: testing the convergent validity of videotape survey administration and phone interviews in contingent valuation; panel estimators that combine travel cost and contingent behavior data sets for evaluating protected areas; and benefit transfer using meta analysis in recreation economic valuation.

Many policy and economic development issues naturally are linked in these kinds of resource studies. The value of agricultural land preservation has been investigated in detail in Routt County by faculty (Seidl and Loomis). The role of conservation easements in environmental control and economic development have also been a focus of DARE faculty recently as well (Hoag and Keske).

Business technical assistance materials for agritourism enterprises emerging in the West have been developed by Thilmany and Onozaka, and this will be a growing area for outreach within the planning area. The socioeconomic evaluation of land use alternatives in the Little Snake Field Office of BLM has shown clear links between economic development and land uses such as agriculture, oil and gas activity versus recreation (Davies, Loomis and Seidl). Hoag has a long standing interest in soil conservation policies and has recently studied working lands in the short grass steppe environment.

In the water area, research and outreach has been varied as well and has had significant links to agricultural production, water transfers from agricultural to urban uses, and environmental issues. Pritchett gave nearly thirty presentations throughout the state related to water transfer issues, the economic effects of drying up wells in Eastern Colorado, and the economic effects of changing augmentation rules; he also received more than one million dollars in contracts and grants in this area. The \$200,000 contract with the Western Regional Aquaculture Committee, led by Craig Bond, which relates agribusiness to water usage, is currently underway. Our newly hired assistant professor, Chris Goemans, has been working in partnership with Aurora, Colorado, as he finished the first stage of a multi-stage project analyzing the effectiveness of various components of Aurora's drought and conservation programs. He is also working on projects to investigate the medium term impacts of natural disasters (frequently floods) on the opportunities for schooling in Brazil, and investigations of impacts

associated with observed changes in the timing of runoff (possibly associated with climate change) on various water rights holders. Pritchett, Jha, Goemans and Frasier will be influential participants in the new Afghanistan water project, listed above.

Several other resources and environmental areas are being investigated as well.

Kipperberg has worked with the Seattle public utilities investigating many dimensions of household recycling options and values. This work has been circulated to European Union policymakers in their European Commission DG Environment News Alert project which aims at providing relevant scientific information to policy makers on a weekly basis. (http://ec.europa.eu/environment/integration/research/research_alert_en.htm).

Loomis data sets are being used in books on non-market valuation (Haab and McConnell book on Valuing Environmental and Natural Resource) by the U.S. Bureau of Reclamation (in training economists on CVM) and the US Forest Service (his recreation value studies are on their website).

4. Our international orientation is growing and has a diverse range of outputs. During the past year, we had non market valuation studies related to Forest Fire Prevention in Vietnam, the Eduardo Avaroa Reserve in Bolivia, and the Koshi Tappu Wildlife Reserve in Nepal. We look to ongoing research relationships in Costa Rica, Brazil and Mexico to provide opportunities for faculty and foreign student recruitment in those locations. Also, Seidl looked at the performance of Cruise tourism in Costa Rica in a regional economics context.

We also are beginning to engage in more contract and grant work and some teaching activities overseas. The Afghanistan Water, Agriculture and Technology transfer project is a \$5.0 million project from USAID, and was one of the twenty largest submitted projects in the university last year. (It may be the largest grant obtained during this year by the university.) Seidl will continue to work on research projects with INCAE in Cost Rica (and Stanford) personnel. The USDA Faculty Exchange Program (“Russia”) program is an ongoing investment in international development work that may bear fruit for our students somewhere along the line. This project is remarkably in its twelfth year of activity, and gives us the experience and opportunity to travel that will permit us to realize better relations with Saratov State Agrarian University, for example. Our degree completion program, with ten courses from DARE that are being developed online, will have international dimensions once the curricula and approaches have been developed. Fayoum University in Egypt and several Afghan universities may be possible candidates for international additions of this approach. Finally, Loomis is finishing a \$ 1.0 million project looking at ecological issues in Puerto Rico.

Special Teaching Activities and Awards:

- Loomis regularly teaches a course to BLM mangers entitled “Economic Impact versus Economic Efficiency Analysis, Non market valuation techniques”, at the National Training Center, Phoenix, AZ in November, 2007.
- Lindsey Ellingson received the Shepardson Award for Outstanding Graduate Student Teaching. She also won 2nd place in the new AAEA Extension Graduate Student Competition for students with significant outreach interests and activities in their graduate programs.
- A number of faculty members also worked on the FFA-Marketing Competition during the past year, and Bond and Pendell also managed a department activity, the Agribusiness Association (ABA), which is a major committment.
- Finally, Thilmany helped in development of new Organics program in Soil and Crop Science and was on its advisory board.

Other Awards: The Food Distribution Research Society Journal Award, 2007; Thilmany as Farm Foundation Fellow, 2006-08

Internal Linkages:

The strategic planning area currently interacts with many entities across campus. Faculties in the Departments of Agricultural and Resource Economics, Accounting, Finance and Real Estate, Natural Resources Recreation and Tourism, Economics, Soil and Crop Sciences, Horticulture, Food Science and Human Nutrition work together in support of this planning area. Also, faculty work closely with many business and financial applications in Extension through our close work and joint appointments with regional economists. We also have significant linkages between specialists and agents in Extension, as our agro tourism and land use planning areas include both agents and specialists in a long term and growing partnership. Personnel also work with many entities within the university. In fact, members work with most of the institutions assembled under the Office of Outreach and Strategic Partnerships. For the purposes of this area, Colorado Extension, the Water Center of Colorado State University, and the Office of Economic Development are main institutions with which we work. These efforts together suggest a number of multidisciplinary linkages. Three main linkages are strong: (1) linkages with water resources faculty throughout the university, and related linkages to crop production faculty and regional economics; (2) linkages to natural resources faculty and Extension specialists and agents working on land use policies; and (3) linkages with faculty and Extension specialists who are interested in marketing, restaurants and others in the food system. This has included links with meat science, and faculty in the College of Applied Human Sciences and Business.

Analysis of Outcome Measures

Outcome measures have been established to monitor the progress and growth of this strategic initiative.

I. Majors:

The following table shows the trend in the number of undergraduate majors associated with this strategic initiative:

Major (Fall Semester)	2005-06	2006-07	2007-08	2008-09
Agricultural Business*	209	217	223	217
Agricultural Economics*	17	18	16	15
TOTALS	226	235	239	232

* Includes secondary majors

The following table shows the trend in the number of graduate majors associated with this strategic initiative:

Fall Semester	2005-06	2006-07	2007-08	2008-09
Masters	11	18	18	19
Ph.D.	17	14	13	20
Totals	28	32	31	39

II. Financial Resources:

Faculty and staff representing the Agricultural and Resource Economics department in the College of Agricultural Sciences dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident tuition, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	FY 2005-06	FY 2006-07	Change	FY 2007-08	Change
RI	\$483,387	\$551,056	\$67,669 (14.0%)	\$590,081	\$39,025 (7.1%)
Ag. Exp. Station					
State	\$250,403	\$262,427	\$12,024 (4.8%)	\$295,590	\$33,163 (12.6%)
Federal	\$106,376	\$114,187	\$7,811 (7.3%)	\$114,187	\$0 (0%)
Extension					
State	\$189,496	\$231,472	\$41,976 (22.2%)	\$285,481	\$54,009 (23.3%)
Federal	\$0	\$0	\$0 (0%)	\$0	\$0 (0%)
Contract/Grants	\$321,135	\$608,270	\$287,135 (89.4%)	\$979,850	\$371,580 (61.1%)
Cash Accounts	\$0	\$155	\$155	\$85	-\$70 (-45.2%)
Gift	\$0	\$0	\$0 (0%)	\$7,317	\$7317
Total	\$1,350,797	\$1,767,567	\$416,770 (30.9%)	\$2,272,591	\$505,024 (28.6%)

III. Refereed Journal Articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 14 total refereed journal articles were published. For 2007, 18 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative increased by 4 from calendar year 2006 to calendar year 2007.

IV. Outreach Activities:

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with this strategic initiative participated in approximately 144 workshops/presentations reaching more than 3,641 total participants.

V. Research Activities: The following AES research projects are associated with this strategic initiative:

- Benefits and Costs of Natural Resources Policies Affecting Public and Private Lands
- Water Management and Western Irrigated Agriculture: Opportunities and Consequences
- Rural Change: Markets, Governance and Quality of Life
- Understanding, Evaluating and Enhancing Community-based Collaboratives and Participatory Research Processes on Colorado Rangelands
- Market and Policy Analyses of Colorado Products Using Time Series and Panel Data Models
- Interfacing Technological, Economic, and Institutional Principles for Managing Inter-sector Mobilization of Water
- Fruit and Vegetable Marketing Innovations and Demand Assessment

External Linkages: Federal and State Agencies: The personnel associated with this strategic plan area are engaged with a number of Federal agencies. We have close connections with the USDA, as Thilmany has been the USDA Integrated Organic Program Grants Panel and National Program Leader and has been on the USDA Rural Development NRI and SBIR Programs. Loomis and Bond work with the US Forest Service, a part of the USDA. Hoag has worked with administrators at RMA and CSREES, groups within the USDA, in Washington, D.C. in the course of his RightRisk contract work. Loomis, Seidl and Davies also have links with the BLM. The Colorado Department of Ag, through a Federal State Marketing Improvement program grant, helped

provide funding for a national market survey, and also has provided funding for our Future of Colorado Agriculture study. Both Thilmany and Keeling-Bond sit on the CDA's Market's advisory board. Kipperberg has worked with the Seattle public utilities investigating many dimensions of household recycling options and values. The Ag Adventure program has been cited as a model for a well-crafted program that relies on a rigorous standards-based curriculum that promotes learning for students and connects with teachers in K-12 educational institutions. We also are becoming closer with regard to USAID with our AWATT project.

Private sector, non governmental and external academic interactions: Faculty provide presentations, programming and technical support to agricultural and specialty food producers in niche marketing, agribusiness management and distribution/retailing activities. Koontz has worked with the Livestock Marketing Information Center as a Tactical Advisory Committee member. Faculty in EMPTAC are also tied to external contacts via numerous academic contacts. Jay Parsons serves as member of the NAIS Sheep Working Committee and Colorado Animal ID Working Committee. Many of our faculty sat on regional research and Extension committees: Norm Dalsted was an advisory Committee member for the Western Center for Risk Management, and member of the Advisory Board, Northern Colorado Agribusiness Association, Inc. Steve Koontz coordinated the NCCC-134 Project annual meetings. Catherine Keske is a board member for Evergreen's Mountain Area Land Trust. Jennifer Keeling-Bond was CSU representative to NCERA-194 and WERA-72, and an Organization Committee Member, Farmer Cooperative Conference.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: Steve Davies

Steering Committee Co-Chairs: Dana Hoag and Stephen Koontz

Steering Committee Members: DARE Executive Committee: Marshall Frasier, Stephen Koontz, James Pritchett, Andy Seidl, Dawn Thilmany, Steve Shulman, Bill Wailes (AS), Lisa Youngblade (FHNS)

A. Agricultural and Resource Economics

Faculty: Craig Bond, Norm Dalsted, Paul Huszar, Jennifer Keeling, Catherine Keske, Gorm Kipperberg, John Loomis, Yuko Onozaka, Jay Parsons, Dustin Pendell, Wendy Umberger

B. Extension: John Deering, Dennis Kaan, Rod Sharp, Jeff Tranel

C. College of Business: Sue Hine, John Olienyk

Annual Report
2007-08

Sustainable Community Development

Goal: Colorado State University will enhance its focus and depth in graduate education, applied research, and outreach in analyses related to sustainable community development and be recognized by municipal, county, state, and federal agencies, nongovernmental organizations, and citizens as a leading source of information and analysis promoting community development. This will include community impact analyses of economic activity, community organization for progress, evaluation of the drivers of local development, and workforce professional and personal development.

Purpose: Colorado communities are changing rapidly as a result of external influences, like loss of agricultural water, influx of retirement populations, development and demise of mineral extraction industries, changes in military deployments, and changes in cultural composition of residents. Communities struggle to develop and maintain resources: human, financial, physical, social, environmental, and political. They also are challenged to provide the organizational capacity to assess, plan, and implement activities to address resource development and management. These issues especially are acute in smaller rural communities. Colorado's communities are relatively unique in terms of sparse populations, a high natural amenity and public lands base, a transitory population, and relatively low public service provision. People in rural areas tend to be older, poorer, more likely to be uninsured, and less educated than their urban counterparts. Communities require knowledge to evaluate their resource base, their economic and social service alternatives, and their futures.

Strategic Actions:

- Coalesce the personnel resources in the rural community development area to create significant programs in rural tourism, public and private land use, alternative energy systems, contributions of rural finance to economic development, and workforce professional distance education opportunities.
- Work with multi-county, rural regions to assess opportunities and organization for future development.
- Develop relationships with the Colorado State University's Office of Economic Development and the School of Public Health to provide an outreach component for these enterprises.
- Develop Strategic partnerships with various groups, i.e. legislative relationship with Ken Salazar's office, Colorado Rural Development Council, etc.
- Develop a Center for Rural Development.
- Develop an earmark initiative of \$500,000 per year in the area of Rural Development.

Critical Resource Growth Needs:

- Generate small amounts of seed capital to initiate team efforts to assess opportunities and organization for rural regions.
- Assess best use of funds generated by community development research associate.
- Enhance grant resources in the areas of rural tourism development, and assistance and agency contracts for workforce development distance education.
- Develop in-service training for Extension agents.
- Provide resources to enhance public finance expertise, secure faculty position (endowed chair) in Rural Finance or Regional Development and expand capability in assessing the role of rural finance to economic development.
- Secure faculty position in regional/international development.

Accomplishments: Sustainable Community Development activities can be grouped into four different areas of impacts:

1. Land Use Planning and Evaluation: We have a full range of efforts in this area including:
 - The value of agricultural land preservation in Routt County (Seidl and Loomis), which led to a second place Graduate Student Extension Award by at the 2007 American Agricultural Economics Association meetings in Portland.
 - The role of conservation easements in environmental control and economic development have also been a focus of faculty recently (Hoag and Keske). Keske will have her dissertation, which was done on this topic, published during the coming year.
 - A lodging tax analysis, designed to assist growth in tourism, resulted in a ballot measure in Huerfano County, and a working group to further investigate a ballot measure in Custer County (which has now been authorized by the County Commissioners in Custer County). The Huerfano measure passed with a 70% vote in favor, having lost with only 40% in favor just 2 years ago.
 - The socioeconomic evaluation of land use alternatives in the Little Snake Field Office of BLM has shown clear links between economic development and land uses such as agriculture, oil and gas activity versus recreation. This was presented at the Governor's Agricultural Forum in 2008. (Davies, Loomis and Seidl).
 - Our faculty members make a very significant contribution in the area of valuation of a whole variety of resources that might not have markets. As examples, work has been done on the value of forest fire prevention in Vietnam; distance effects on recreation valuation; non-market valuation techniques for the Eduardo Avaroa Reserve, Bolivia; local cost of protecting Koshi Tappu Wildlife Reserve, Nepal; and the value of ecological support functions of wildlife, among others (See Loomis and Seidl's work).

Key Impacts: The lodging tax analysis has been a good example of analysis that can be used across the state. Based on the two success stories, we will distribute a general analysis to the Regional and County directors in Extension to see if there are other areas where these analyses would be useful.

The BLM project had three fact sheets come out this year and we had strong support in the Bureau to conduct more sophisticated analyses. Unfortunately, the political setting regarding oil and gas development in BLM is too controversial for them to want to fund a major, impartial examination of these issues, so we will go elsewhere to look for funding.

2. Industry Studies

- Economics of the Wine Industry in Colorado: The economic impact analysis of the Colorado wine industry examined agriculture outside of its traditional commodity framework. Because of the importance of Colorado's unique consumers and geography, the impact analysis and assessment of tourism potential specific to this state was very important. This report garnered lots of publicity for the industry (and CSU as a research partner). The project was modeled on an earlier golf industry study, as is the forthcoming aquaculture project (Bond, PI). We are thus building a good reputation around these projects, and they are being used as part of cost-benefit analyses for some publicly run industry development programs..
- Marketing in nonconventional (organic, natural, humane) and local food systems: DARE (Thilmany) provides presentations, programming and technical support to agricultural and specialty food producers in niche marketing, agribusiness management and distribution/retailing activities throughout the Southwest region, and she now serves on the eXtension committees for Economics of organic agriculture and is chair of the regional research committee on fruit and vegetable marketing, adding objectives focused on local supply chains.. These activities have increased our department's and Extension's impact among producers with non-commodity and alternative production and marketing interests, as well as professionals and businesses in specific segments of the broader food industry (chefs, small food processors, specialty retailers).

- We have implemented a number of feasibility studies as well, including corn mazes, wineries, onion nuggets, tilapia, and many others through the AREC 428 capstone course and Extension interactions (J. Bond, D. Thilmany and James Pritchett). This class is currently being extended to an online presentation by James Pritchett in anticipation of its use in our online degree program, and in applications with possible multistate activity such as a Four Corners' initiative and use in the development of an agribusiness evaluation capacity in our Afghanistan project.
 - Business technical assistance materials for agrotourism enterprises emerging in the West have been developed by Thilmany and Sullins, and this will be a growing area for outreach within the planning area
 - A publication looking at the economics effects of cruise tourism in Costa Rica was undertaken by Andy Seidl over the past year.
3. Rural Banking and Economic Development: Last year we presented Jerold Harris, CEO of US AgBank, with the College of Agricultural Sciences Distinguished alumnus award. This year we made several new steps to create linkages with the rural banking sector:
- Frasier, Pritchett and Thilmany started two internship programs with Farm Credit Services in Greeley and Colorado Springs. The latter sets up a unique Student Advisory Board which will review and propose solutions to selected issues perceived as important by the various branch banks, and students will travel to the branches and will receive a stipend at the end if they active. A White Paper will be done on a selected issue each year.
 - Jerold Harris, former CEO of US AgBank and Distinguished alumnus of CAS, was the College of Agricultural Sciences commencement speaker this spring, and in his honor, we hosted a roundtable workshop on the role of rural agricultural banks and economic development. This was generally thought to be a success and there have been enquiries regarding the next steps.
 - Many undergraduates join the rural banking sector and so our contacts grow in that sector consistently; we also run an agricultural lender's tour each fall.
 - We are receiving inquiries for our proposed Center for Rural Development, which will focus on enhancing the capabilities of institutions that are prominent in rural economies, including rural banks. We feel that some momentum is occurring in this area and hope to have funding within a year from now.
4. Institutional contacts and support:
- Office of Economic Development: Martin Shields, the economist with Office, is part of the "regional economists" group between DARE and the Economics Department.
 - Colorado Rural Development Council: This group is totally revising its approach, with CSU being part of this new view; CSU's liaison through Davies will help.
 - USDA:
 - USDA Integrated Organic Program Grants Panel and National Program Leader
 - USDA Rural Development NRI Program
 - USDA SBIR Program
 - *Economic Efficiency Analysis* (Loomis presented annually to BLM Social & Economic Aspects of Planning, Boise, Idaho)
 - Managed Midwest Rural Development tour and Entrepreneurship conference for Farm Foundation
 - US Forest Service
 - Colorado State Patrol
 - Colorado Rural Development Council
 - Chaffee County, Colorado: A study of its economic base was completed and DARE extension reports were added to our website
 - Capital improvement planning projections were done for most Colorado counties and municipalities during 2007 by Griswold and Seidl and were also added to the DARE website.

Internal Linkages: The strategic planning area currently interacts with many entities across campus. Faculties in the Departments of Agricultural and Resource Economics, Natural Resources Recreation and Tourism, Economics, Soil and Crop Sciences, Horticulture, Food Science and Human Nutrition work together in support of this planning area. Also, expertise within this area in the sustainable community development area has begun with Cooperative Extension’s Core Competency Area Work Team, and has expanded through relationships with other university faculty. We also have significant linkages between specialists and agents in Extension, as our agro tourism and land use planning areas include both agents and specialists in a long term and growing partnership. Personnel also work with many entities within the university. We have interaction between specialists and the Extension/Department of Local Affairs Community Technical Assistance Program. It might even be possible to design modules that can be used in 4-H to examine economic development opportunities in rural areas. Thilmany joined the Center for Fair and Alternative Trade Center at CSU as an associate focusing on the economic development aspects of food certification programs.

The Office of Economic Development is working closely with Jeff Ballweber and Martin Shields who are members of the Steering Committee. Davies is working with the same Office to assess what CSU can do for rural areas, following a request by President Penley. In fact, members work with most of the institutions assembled under the Office of Outreach and Strategic Partnerships. For the purposes of this area, CSU’s Extension, Water Center and the Office of Economic Development are the main institutions with which we work. These efforts together suggest a number of multidisciplinary linkages. Three main linkages are strong: (1) linkages with water resources faculty throughout the university, and related linkages to crop production faculty and regional economics; (2) linkages to natural resources faculty and Extension specialists and agents working on land use policies; and (3) linkages with faculty and Extension specialists who are interested in marketers, restaurants and others in the food system. This latter effort has included links with meat science and faculty in the College of Applied Human Sciences

Analysis of Outcome Measures

Outcome measures have been established to determine the progress and growth of this strategic initiative.

I. Financial Resources:

Faculty and staff representing the department of Agricultural and Resource Economics dedicated time to this planning initiative (at varying percentages) during fiscal years 2005-06, 2006-07 and 2007-08. Expenditures from resident instruction, state and Federal Agriculture Experiment Station, state and Federal Extension, grant/contract, cash and gift accounts associated with this strategic initiative were evaluated to determine the level of financial resources dedicated to this strategic initiative. The following table demonstrates the relevant activity within these areas:

Fund Type	2005-06	2006-07	Change	FY 2007-08	Change
RI	\$103,057	\$107,475	\$4,418 (4.3%)	\$115,087	\$7,612 (7.1%)
AES					
State	\$53,385	\$51,183	-\$2,202 (-4.1%)	\$57,651	\$6,468 (12.6%)
Federal	\$22,679	\$22,271	-\$408 (-1.8%)	\$22,271	\$0 (0%)
Extension					
State	\$40,400	\$45,145	\$4,745 (11.7%)	\$55,679	\$10,534 (23.3%)
Federal	\$0	\$0	\$0 (0%)	\$0	\$0 (0%)
Grant/Contract	\$133,625	\$220,985	\$87,360 (65.4%)	\$335,107	\$114,122 (51.6%)
Cash	\$0	\$0	\$0 (0%)	\$8,992	\$8,992 (100%)
Gift	\$5,500	\$7,355	\$1,855 (33.7%)	\$4,726	-\$2,629 (-35.7%)
Totals					
	\$358,646	\$454,414	\$95,768 (26.7%)	\$599,513	\$145,099 (31.9%)

II. Refereed journal articles:

Refereed journal articles from faculty and staff dedicated to this strategic initiative were counted for calendar years 2006 and 2007. For 2006, 6 total refereed journal articles were published. For 2007, 5 total refereed journal articles were published.

Analysis: Refereed journal articles published for this strategic initiative decreased by 1 from calendar year 2006 to calendar year 2007.

III. Outreach Activities

Participation in Workshops and Presentations:

Based on reported activities and total number of participants for each activity, faculty and staff associated with the strategic initiative participated in approximately 33 workshops/presentations reaching more than 692 total participants.

IV. Research Activities: The following AES research projects are associated with this strategic initiative:

- Textile Materials and Technologies Addressing Energy, Health and Other National Security Issues
- Water Banking in the Arkansas Valley
- Parent and Household Influences on Calcium Intake Among Preadolescents
- Improving Drainage of Agricultural Lands for Salinity Problem in the Lower Arkansas Valley
- Mediating Exposure To Environmental Hazards Through Textile Systems
- Interaction of Diet and Exercise on Chronic Disease Risk
- An Integrated Approach to Promoting the Production, Safe Handling, and Marketing of Specialty Leafy Green Vegetables in Colorado

External Linkages:

- Local government Interactions: The value of agricultural land preservation in *Routt County* has been a continuing interaction with a local government unit, as has the Ford Foundation's Community Forestry project, which led to significant outreach efforts in Delta and Montrose Counties. The lodging tax analysis, designed to assist growth in tourism, resulted in analyses for Huerfano County and Custer Counties. The Huerfano measure passed with a 70% vote in favor, having lost with only 40% in favor just 2 years ago. With Lou Swanson, Hunt Lambert and other CSU personnel, the Washington County development analysis to discuss alternative economic development opportunities for the County. The Agritourism projects led by Martha Sullins and Dawn Thilmany engaged several local governmental representatives, and supported efforts to secure resources for community development in the area of agritourism.
- Federal and State Agencies: The personnel associated with this strategic plan area are engaged with a number of Federal agencies. We have close connections with the USDA, as Thilmany has been the USDA Integrated Organic Program Grants Panel and National Program Leader and has been on the USDA Rural Development NRI and SBIR Programs. We are looking for opportunities to work with USDA-Rural Development to achieve our SCD initiatives. Loomis and Bond work with the US Forest Service, a part of the USDA. Loomis, Seidl and Davies also have links with the BLM. Kip Nye, in Extension, work closely on training needs with the Colorado State Patrol. The Colorado Department of Ag, through a Federal State Marketing Improvement program grant, helped provide funding for a national market survey going out in early 2007. We also are developing a link with the Colorado Department of Agriculture Markets Division in the joint funding and promotion of a marketing tool, *Marketmaker*, developed by the University of Illinois Extension.
- Private sector and government interactions: The economic impact analysis of the Colorado *wine industry* examined agriculture outside of its traditional commodity framework. This report garnered lots of

publicity for CSU as a research partner, and was modeled on an earlier golf industry study, as is the forthcoming aquaculture project (Bond, PI). We are thus building a good reputation with these industries from these projects. DARE (Thilmany) provides presentations, programming and technical support to agricultural and specialty food producers in niche marketing, agribusiness management and distribution/retailing activities. This year we hosted Jerold Harris, former CEO of US AgBank and College of Agricultural Sciences Distinguished alumnus and feel that we are making progress on working with the Farm Credit System. We will be using these contacts and links to propose a Center for Rural Development.

- Non-Profit organizations: This strategic planning area also has significant links to non-profit groups interested in sustainable economic development. The Colorado Rural Development Council is totally revising its approach, with CSU continuing to be a significant part of this new view. With FSNE faculty and staff, an interactive geographic information system mapping program for use by Food Bank of the Rockies and other regional food banks is being developed to measure how well current food distribution is meeting client needs. Thilmany is a Farm Foundation Fellow for Rural Community Vitality, on the Larimer County and State of Colorado Food Policy Council Exploratory Committees and advises several other food and nutrition policy groups on occasion. Catherine Keske is a Board Member for Evergreen's Mountain Area Land Trust.

Faculty and Staff associated with the Strategic Initiative

Administrative Advisor: Steve Davies

Steering Committee Chair(s): Craig Bond, Andy Seidl

Steering Committee Members: Jeff Ballweber (CE/DARE), Dale Edwards(CE), Mike Tupa (CE), CJ Mucklow (CE), Dennis Kaan (CE), Lou Swanson (VPOSP), Lyn Kathlene (CIPP), James Pritchett (DARE), Martin Shields(OED/Economics), Dawn Thilmany (DARE), Stephen Weiler (Economics)

A. Agricultural and Resource Economics

Faculty: Dana Hoag, Catherine Keske, John Loomis,
Admin. Pro.: Martha Sullins

B. Extension Agents: Deb Alpe, Dan Hernandez, Kip Nye, Dale Edwards

C. Economics

Faculty: Harvey Cutler, David Mushinski