2008 Washington State University Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This was a productive year for the scientists in the Washington State University (WSU) Agricultural Research Center (ARC), the subunit of the College of Agriculture, Human and Natural Resource Sciences (CAHNRS) that administers a significant fraction of the scientific research related to agriculture, broadly defined. Once again, ARC faculty and staff as a group have the largest amount of research grant funding at WSU, $32.6 million, obtained from various federal sources, state sources, crop commissions, industry, etc.. These funds cover work in a myriad of subject areas and the individual projects approach the work from a variety of perspectives. Washington state agriculture is more diverse than that of many other states, partly as the result of the different climate and soil conditions found in the state, partly because of its emphasis on meeting agricultural needs of both domestic and export markets. This report outlines a few of our major successes and documents the adaptation of the ARC and CAHNRS in response to constraints and opportunities.

Researchers on the Pullman campus, at WSU,s Research and Extension Centers and at field locations throughout Washington state are engaged in over 300 projects that address the needs of Washingtonians and the nation. Our goal is to develop and leverage basic science to ensure that our farms and industries can compete in the global economy with quality products, to protect the security of our food production, processing and distribution systems, to keep our population healthy and well nourished, to protect our natural resources and environment, and to enhance economic opportunity for individuals, businesses and communities. Our work is of high quality; WSU was listed among the top 25 schools in the world on the basis of citation impact in agricultural science by Science Watch newsletters and various plant and animal science WSU programs based primarily in CAHNRS were highly ranked in a 2007 survey published in the Chronicle for Higher Education. At another level, WSU scientists secured over 10% of the funds allocated under the 2008 USDA Specialty Crop Research Initiative and participated in grants that were awarded over 35% of the funds.

Washington State has been a leader in developing practices to support sustainable agriculture, including low erosion cultivation techniques, ways to minimize pesticide and herbicide use, and breeding for disease and pest resistance. The state has also been innovative in supporting scientific research in organic production techniques and in implementing value added marketing based on organic and limited input production systems. While some of this work has been carried out under the umbrella of the Center for Sustainable Agriculture and Natural Resources, much of it is integrated into our routine research goals. An example of this is the WSU Decision Aids system for making real time integrated pest management decisions for the tree fruit industries that is based on an expert system model developed by our scientists that integrates weather and other local data with insect growth rate and pesticide properties to advise whether or when to apply materials (http://entomology.tfrec.wsu.edu/das/).

Researchers have adapted their programs to focus more on aspects of biofuels, biomass, and bioproducts research of particular relevance to the state. These include projects to add value to straw and other ,,waste,, products, to improve the yield and stability of crops like poplars that have been identified as a potential energy crops well suited to this region and produce useful materials from various waste streams associated with food and fiber production. However, Washington is unlikely to be a major biofuels contributor in the future by growing crops for ethanol production, since this use probably will not compete well with the value of the specialty crops that are grown in the state, according to a team led by Jon Yoder (see http://wsm.wsu.edu/2009/Spring/biofuels-strategy.php) which makes the point that the state's current major ethanol crop, wine grapes, is worth much more as wine than as fuel. This study, commissioned by the state legislature, focused on the fit between various public policy objectives related to energy use and availability. By stepping back and separating longer term goals from the short-term fluctuations in the energy and agriculture markets, their report is likely to be useful in setting up incentives for lower energy use. Our contributions to bioenergy are more likely to be in areas like pyrolysis of mixed lignocellulose feedstocks or anaerobic fermentation, a focus of the new WSU Center for Bioproducts and Bioenergy. In addition to the scientists now being recruited to the Center in Richland, considerable expertise exists at the main campus in Pullman. Another focus is likely to be in the generation of higher value biofuels, such as those needed for aircraft. These must be more energy dense than ethanol and their generation from plant materials will require plants to produce more lipids, terpenes and phenylpropanoids, areas of metabolism that are represented by strong programs in the Institute of Biological Chemistry. Mike Wolcott and his colleagues Marie Laborie and Jinwen Zhang in the Wood Materials Engineering laboratory are studying how to use carbohydrate and polyalkanoate biopolymers in fabricating plastics and coatings. These and other projects are featured in http://www.arc.wsu.edu/researchimpacts/images/ARC%20Bioproducts%20Report2.pdf.

A major emphasis in CAHNRS is the Human Resource development contained in the college name. Moving the Department

of Economics from the College of Business and merging this with the Department of Agricultural Economics has inspired a flush of investment in new faculty positions to support the expanded teaching, research, and outreach activities of the new unit. Programs in Human Development and Rural Sociology focus on aspects of family and community structures that are also keys to sustainable agriculture.

The buildings being constructed on the WSU main campus and at field stations contribute to the excitement in research. The Vogel Plant Biosciences Building was opened in 2007. Funded by the state legislature, the 93,000 square foot, four story structure is located next to several older buildings in the CAHNRS precinct of the WSU Pullman campus and it contains many facilities, like climate controlled rooms and high tech laboratories, which were difficult to install in the older buildings. Space in Vogel was allocated by the need for these new facilities and not by departmental unit and there has been a secondary but important effect of mixing faculty from different areas. Vogel is the first of a planned complex of seven interconnected buildings devoted to the Life Sciences. A second building will open in summer, 2009, and will house the School of Molecular Biosciences from the College of Sciences. Funds are being identified for a second plant sciences building, especially to increase the facilities available to federal scientists. The objective is to bring state and federal scientists with both fundamental and applied research orientations closer to each other physically in order to promote collaboration in various areas of life sciences research.

The reports in the Planned Program areas reflect an overview of some of the activities in 2008. However, the reporting vehicle is not well suited to describing major changes in the Plan of Work for these areas and the Program directors were advised to try to make the configuration of the report reflect the current situation rather than simply to fill in the boxes. In particular, this affects the Program in Food Science, which is merging with the Food Science department at the University of Idaho located just across the state border. This integrated department has so far been unsuccessful in finding a new chair, at least in part because the search was suspended during a recent hiring freeze. Similar issues are foreseen in 2009, with significant budget cuts pending at the state level. Further structural changes are expected in 2009 due to the recent merger of CAHNRS with Extension, which now reports separately.

Total Actual Amount of professional FTEs/SYs for this State

Year:2008	**Extension**		**Research**	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	479.9	0.0
Actual	0.0	0.0	494.1	0.0

II. Merit Review Process

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

- Internal University Panel
- External Non-University Panel
- Expert Peer Review
- Other (individual external peer reviewers from within or without the university)

2. Brief Explanation

Agricultural Research Center (ARC) project proposals are written by individual faculty members or faculty teams and are submitted first to their department chairs. The department chair reviews the submission and ascertains whether the topic of the research is consistent with departmental and College goals and, if so, sends the project proposal to internal and/or external reviewers. These reviewers are asked whether the research represents solid science, is directed to topics of current interest, will advance the field of study, and whether the research plan is appropriate. Reviewers are invited to offer suggestions for improvement and asked to identify the strongest and weakest points of the proposal. After comments are received from the reviewers, the chair assembles the commentary and submits it to the faculty member. The faculty member then revises the project proposal. After examining these changes, the Chair submits the project proposal to the Agricultural Research Center where it is reviewed by either the Director or the Associate Director. After this review, the proposal is sent to USDA CSREES and reviewed by the appropriate National Program Leader. When approval is final, the approved project is entered into our database and into the CRIS system. In parallel, proposals for funding that may overlap these projects may be submitted to federal or state agencies or to commodity commissions. These proposals are reviewed and input, especially from the commissions, is often used in refocusing and in setting future research directions.

In addition to monitoring individual projects, the Department of Animal Sciences, the Department of Apparel, Materials, Design and Textiles and the WSU Research and Extension Centers were reviewed by teams from CSREES during 2008. These reviews were valuable in taking a longer term and more comprehensive view of some of the WSU research activities. In addition, CAHNRS participated in the university-wide Academic Affairs Program Prioritization process. While this activity focused primarily on graduate and undergraduate education, these are linked through the participation of our researchers in student training and the adjustments to be implemented as the result of program prioritization will have consequences for our Planned Programs.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals

Brief Explanation

Stakeholders in the State recognize WSU as a major asset in their industries and are often very forthcoming with suggestions and critiques. We have web pages, our phone numbers are in plain sight and our stakeholders are used to giving both formal and informal input to the leaders of the Planned Programs and to the ARC administration. One major mechanism of interaction is through various State commodity commissions, which support research at WSU through competitive processes that tend to be biased toward projects that address relatively immediate problems. In addition to researchers, the ARC Director or his representative is often present at these sessions to help the groups understand the context of the research and to get their input into the strategic planning done at WSU related to their industry. Stakeholder input is also received by the use of various advisory committees to advise departments, centers, and programs. There is College level advisory committee as well as a college level agricultural kitchen cabinet. Both of these interact with the dean, the experiment station director, and other associate deans helping to define priorities, emerging research issues, and provide feedback on the quality and relevance of our research activities.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions

Brief Explanation

Established industries tend to have formal bodies that we have worked with through the years and many of our interactions with these industries are through these constituent groups. The situation is more complex in interacting with emerging groups, particularly if these are not organized with a component that includes research support. Often the contacts with these groups are made through specific issues, like carrying out the research to certify a pesticide for a minor crop, dealing with a land use issue that is peculiar to their industry, or determining methods that can be used locally to establish sustainable production. Much of what is done in these cases is to identify what capabilities we have that can be useful and in trying to develop a plan to obtain or allocate resources. For various reasons, the ARC has relatively little funding or personnel that can be redirected rapidly so, especially for minor crops, it is important to see areas where resources can be shared through coalition building, often with other stakeholders or other universities.

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief Explanation

We go to meetings. We answer phones and read email. We listen. Established industries tend to have formal bodies that we have worked with through the years and many of our interactions with these industries are through these constituent groups. It is more complex to interact with emerging groups, particularly if these are not organized with a component that includes research support. Contacts with these groups are often made through specific issues, like carrying out the research to certify a pesticide for a minor crop, dealing with a land use issue that is peculiar to their industry, or determining methods that can be used locally to establish sustainable production. In these cases we try to identify capabilities we have that might be useful and often try to develop a plan to obtain or allocate resources. The ARC has relatively little funding or personnel that can be rapidly redirected so, especially for minor crops, it is important to see areas where resources can be shared through coalition building, often with other stakeholders or other universities. As a State institution, we also have stakeholders referred to us by the legislature or by State and county executives.

3. A statement of how the input was considered

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

Brief Explanation

The input from stakeholders enters our research programs at several levels. Through direct funding decisions and the participation of the ARC administrators or their delegates in the funding process, we see stakeholders state their priorities and allocate their own money to research at WSU and elsewhere. Sometimes a project may be structured to include objectives that are more easily supported within the ARC and those supported by the stakeholders. The ARC takes the prioritization into account in allocating resources, such as space or positions, and communicates our limitations to groups that often are better placed to obtain additional resources. As a State group, we are charged with responding to those who look to us for help, in so far as we can with the resources we have been allocated. In 2007, we began an internal grants program to direct resources toward Emerging Issues in Agriculture (http://arc.wsu.edu/info/eri/index.html). The priorities of this program were articulated with stakeholder input and stakeholders participate in the review process.

Brief Explanation of what you learned from your Stakeholders

The overwhelming message is that stakeholders want more help in research and its applications. Especially because Washington State agriculture is so diverse and has so many minor crops, the research capability at WSU can be a key to bringing new crops to profitability under local conditions. Historically, this has meant breeding more productive wheat varieties, developing methods for controlled atmosphere storage, choosing wine cultivars suited to particular sites, and developing procedures for organic and sustainable agriculture. Conflict can arise when this broad need meets the limited resources available.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	3674822	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	4490160	0
Actual Matching	0	0	21747909	0
Actual All Other	0	0	24443182	0
Total Actual Expended	0	0	50681251	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous years				
Carryover	0	0	1300884	0

V. Planned Program Table of Content

Program #1

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Food Science and Human Nutrition

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			25%	
502	New and Improved Food Products			14%	
503	Quality Maintenance in Storing and Marketing Food Products			11%	
702	Requirements and Function of Nutrients and Other Food Components			25%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			25%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	23.0	0.0
Actual	0.0	0.0	23.4	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	153383	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1387295	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	734543	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

(1) We will conduct research and disseminate results to the public, industry, and scientists on food safety and quality. (2) expand the existing pilot plant to better serve the needs of the food industry, and (3) deliver educational programs on food handling, food safety and microbiology, and good agricultural practices.

2. Brief description of the target audience

Our target audience includes research and extension scientists in the disciplines of food sciences, food engineering, persons interested in policy, legislators, and the general public. We also have an audience in the food industry in the private sector which includes packers, growers, and producers. These areas also include Hispanic communities.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

Year	Direct Contacts Adults Target	Indirect Contacts Adults Target	Direct Contacts Youth Target	Indirect Contacts Youth Target
Plan	5	3	0	0
2008	5	3	0	0

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

Patent Applications Submitted

Year	Target
Plan:	3
2008 :	3

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	4	30	
2008	4	33	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Target	Actual
2008	23	24

Output #2

Output Measure

- Graduate students supported by experiment station funding and grants

Year	Target	Actual
2008	11	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Investigation of rapid detection systems for food contamination
2	Investigation of novel food processing and storage methods
3	Scientists and companies would use the information we have published to further their research and food production practices
4	Rapid detection systems move to a pilot plant testing phase
5	Information in published research is incorporated into production practices thus improving the safety of the food supply.
6	Novel rapid detection methods for food pathogens become available to the food and processing industries improving the safety of the food supply

Outcome #1

1. Outcome Measures

Investigation of rapid detection systems for food contamination

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food industries and food safety issues affect everyone.

What has been done

Development of a rapid method of detection for food contamination

Results

Using the new methods we can save more than 23 hours in measuring E. coli numbers in foods. We are working to establish a more stable procedure. However, the current method is very promising and helpful for both food safety and quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
501	New and Improved Food Processing Technologies

Outcome #2

1. Outcome Measures

Investigation of novel food processing and storage methods

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	3	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food Industry to improve food quality.

What has been done

Effect of microwave radiofrequency, ultrahigh pressure and pulsed electric fields on food safety and quality.

Results

Improve functionality of whey proteins as ingredients in foods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #3

1. Outcome Measures

Scientists and companies would use the information we have published to further their research and food production practices

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	11	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Improving the safety and quality of food. Foreign governments to improve food safety and defense programs and to assist them to comply with provisions of international law.

What has been done

Improve instrumental methods for detection and quantitation of food constituents and prediction of food quality; including physiological factors that impact reproductive competence. Assess the effects of processing and packaging treatments on microbial survival in food during storage. Study regulatory and market forces that impact the production of safe food and trade, particularly factors involving food defense and food security.

Results

Ours is the first research group in the world to spectroscopically characterize microbes in the injured state and be able to differentiate the type of damage sustained by microbes from heat, pH shock, chemical treatments, and stress from changes in ionic strength. We are also the first to use spectroscopic techniques to monitor changes in reproductive status of fish by measuring changes in plasma hormone levels and lipid transport proteins. This work is the basis for international collaborations. Our team has developed new strategies for microbial control in minimally processed foods.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Rapid detection systems move to a pilot plant testing phase

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Development of a new rapid method for the estimation of Escherichia coli in foods. The detection methods developed are very useful for the food industry to prevent contamination and results can be determined much faster.

What has been done

Evaluated a unique enzyme of E. coli for rapid monitoring of the microorganism in Food. Determined specificities of certain enzymes formed by residual chymosin during ripening of semi hard cheese.

Results

Continue to work on developing a 10-15 minute rapid method to enumerate E. coli in food. Elucidation of peptidase activities on casein derived bitter peptides may allow specific manipulations of lactic acid bacteria, resulting in decreased ripening times and increased cheese quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
501	New and Improved Food Processing Technologies

Outcome #5

1. Outcome Measures
Information in published research is incorporated into production practices thus improving the safety of the food supply.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The food industry in Washington and consumers.

What has been done

Training in Hazard Analysis and Critical Control Point (HACCP) analysis, safe quality foods and food sanitation. Research on food microbiology is included into these programs.

Results

Safer food production which translates to a safe food supply for consumers. Changes in food handling and packaging processes in the industry to prevent foodborne illness.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
501	New and Improved Food Processing Technologies

Outcome #6

1. Outcome Measures

Novel rapid detection methods for food pathogens become available to the food and processing industries improving the safety of the food supply

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Development of a new rapid method for the estimation of Escherichia coli in foods. The detection methods developed are very useful for the food industry to prevent contamination and results can be determined much faster.

What has been done

Evaluated a unique enzyme of E. coli for rapid monitoring of the microorganism in food. With conventional methods it took about 24 hours to measure, however we are working to develop a 10-15 minute rapid method to enumerate E. coli in food.

Results

Using these new methods, we can save more than 23 hours measuring E. coli numbers in food. This will be very helpful for food safety and quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
501	New and Improved Food Processing Technologies

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

With federal grant funding on the decline and commodity commission funding down, this has affected not only our research programs and ability to recruit new graduate students but also our ability to carry out our ongoing research. The Food Science departments of WSU and the nearby University of Idaho are fusing in order to offer more diverse training to students and expand our research capabilities by complementation. However, due to a hiring freeze, the failure to complete the search for a new Director of the School of Food Science has prevented the school from moving forward and determining the areas of research most important to the state, nation and internationally. Current cutbacks to our programs will also affect how we determine the most important direction of the school to remain competitive with current research issues. Several of our senior faculty will be retiring in the next couple of years and will cutbacks affect our ability to fill these position or will we be forced to cutback our research efforts to concentrate on teaching our courses. All of these issues will determine the future of our research.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (See below)

Evaluation Results

Peer Reviewed Publications.

Key Items of Evaluation

Program #2

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Animal Science

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			4%	
301	Reproductive Performance of Animals			28%	
302	Nutrient Utilization in Animals			14%	
303	Genetic Improvement of Animals			5%	
304	Animal Genome			11%	
305	Animal Physiological Processes			11%	
307	Animal Management Systems			6%	
308	Improved Animal Products (Before Harvest)			12%	
311	Animal Diseases			3%	
701	Nutrient Composition of Food			3%	
722	Zoonotic Diseases and Parasites Affecting Humans			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.6	0.0
Actual	0.0	0.0	21.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	368253	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	932614	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	524530	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We shall: (1) evaluate nutritional, physiological and genetic mechanisms for differences in the use of dietary energy for growth, lactation and animal maintenance, (2) evaluate sources of feedstuffs and methods of processing for enhanced rumen function and productivity in animals, (3) search for candidate genes and DNA markers for improved quality and yield of meat in beef cattle, (4) Search for candidate genes and DNA markers for enhanced reproduction and nutrient utilization in dairy and beef cattle, (5) develop new approaches and investigate the molecular and biological regulation of germ and somatic cells in mammalian spermatogenesis, (6) define the underlying mechanisms responsible for the hormonal regulation of somatic tissue growth and development in rainbow trout and other species. (7) Develop mathematical models to better understand and evaluate factors related to metabolism in the lactating dairy cow, (8) develop a vaccine for the sterilization of either male or female cattle, (9) obtain gaseous and particulate emissions data from cattle feedlots and provide credible scientific information for making air quality policy decisions, and (10) determine the basic molecular mechanisms regulating skeletal muscle growth and differentiation.

2. Brief description of the target audience

In general, the target audience for the program includes consumers of food products produced by the livestock industry. However, the pathway of information from our research program includes commercial and seed stock producers in the dairy, beef, swine and sheep industries. It also includes companies that produce feeds, pharmaceuticals, and consulting to these industries.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	2300	4500	1200	2200
2008	2300	4500	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	1

Patents listed

Compositions and methods of wastewater treatment. 2008 Jul. Patent 60/949,479. Zhang T., K. Bowers, J. Harrison, S. Chen.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	2	30	
2008	0	35	35

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	25	34

Output #2

Output Measure

- Graduate Students supported by Agricultural Research Center and other grant funds

Year	Target	Actual
2008	31	11

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Construct a whole genome association map of nuclear encoded mitochondrial genes for traits in beef cattle
2	Develop mitigation strategies to reduce the impact of animal CAFOs on air and water quality
3	Determine some keys to obesity with research conducted in fat cells
4	Enhanced agricultural sustainability through pollution mitigation strategies
5	Define mineral requirements in dairy cows to reduce mineral excretion
6	Data for CAFOs on air and water quality will be made available to allow policy decisions
7	Sulfur hexachloride tracer technologies developed for measuring methane production by free ranging livestock
8	Better understanding of of the percent of Wagyu genetics required in breed crosses of composite breeds to produce quality beef for domestic and world consumption
9	Identification of factors regulating male fertility and sire potential in cattle and swine
10	Enhance agricultural stability through increases in reproductive efficiency in cattle and swine
11	Techniques developed to accelerate the production of genetically modified animals for value-added products and biotechnology
12	Develop a whole genome association map of genes defining fertility and longevity in dairy cows
13	Enhanced understanding of nutrient utilization and mechanisms of nutrient use by animals.
14	Enhanced food quality, food safety, consumer acceptance of foods from animal sources and issues of animal and human health.
15	Identification of strategies to decrease the environmental footprint from livestock systems.
16	Enhanced reproductive efficiency of livestock.
17	Enhanced understanding of mechanisms associated with growth and differentiation of muscle cells and adipocytes.

Outcome #1

1. **Outcome Measures**
   Construct a whole genome association map of nuclear encoded mitochondrial genes for traits in beef cattle
   Not reporting on this Outcome for this Annual Report

Outcome #2

1. **Outcome Measures**
   Develop mitigation strategies to reduce the impact of animal CAFOs on air and water quality
   Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**
   Determine some keys to obesity with research conducted in fat cells
   Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**
   Enhanced agricultural sustainability through pollution mitigation strategies
   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**
   Define mineral requirements in dairy cows to reduce mineral excretion
   Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**
   Data for CAFOs on air and water quality will be made available to allow policy decisions
   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**
   Sulfur hexachloride tracer technologies developed for measuring methane production by free ranging livestock
   Not reporting on this Outcome for this Annual Report

Outcome #8

1. **Outcome Measures**
   Better understanding of of the percent of Wagyu genetics required in breed crosses of composite breeds to produce quality beef for domestic and world consumption
   Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**
   Identification of factors regulating male fertility and sire potential in cattle and swine
   Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**
   Enhance agricultural stability through increases in reproductive efficiency in cattle and swine
   Not reporting on this Outcome for this Annual Report

Outcome #11

1. **Outcome Measures**
   Techniques developed to accelerate the production of genetically modified animals for value-added products and biotechnology
   Not reporting on this Outcome for this Annual Report

Outcome #12

1. **Outcome Measures**
   Develop a whole genome association map of genes defining fertility and longevity in dairy cows
   Not reporting on this Outcome for this Annual Report

Outcome #13

1. **Outcome Measures**
   Enhanced understanding of nutrient utilization and mechanisms of nutrient use by animals.

2. **Associated Institution Types**

   •1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	55

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Identifying ways to increase the efficiency of nutrient utilization will enhance the sustainability of livestock operations from financial and environmental perspectives. Projects are contributing new information to understanding genetic links associated with nutrient use in animals is valued by the animal production and allied industries. Work in this area is also currently supported by 2 external competitive grants.

What has been done

Projects are implementing techniques to study metabolic activity and regulation at the subcellular level. As an example, gene expression techniques are being used to study lipolysis and lipogenesis in lactating cows and mitochondrial energy expenditures in beef cattle at various stages of production.

Results

25 referreed journal articles.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals

Outcome #14

1. Outcome Measures

Enhanced food quality, food safety, consumer acceptance of foods from animal sources and issues of animal and human health.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Projects are of immediate importance to consumers and producers as they impact food safety, food quality, and animal and human health issues. Results are used and valued by commercial beef industry in prevention of beef measles, by leaders in livestock production using genomic technologies for breeding and selection decisions, and by consumers making informed decisions about the quality and safety of the meat they consume. External support for this work further identifies its relevance to industry.

What has been done

Methodology to quantify fatty acids associated with meat quality has been developed and is currently evaluated for commercial applications. Identification of genetic markers that are associated with meat quality traits and animal health are being investigated. Management strategies to reduce the incidence of a costly feedlot parasite are being defined.

Results

10 referreed publications, 1 presentation at a national conference.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
304	Animal Genome

Outcome #15

1. Outcome Measures

Identification of strategies to decrease the environmental footprint from livestock systems.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The ability to quantify and monitor inputs and outputs of livestock systems is essential for sustainable production. The impact of livestock systems on water and air quality are being addressed in several projects having direct impact on the production systems as well as social impact to the community. Projects are also supported with competitive external federal funds.

What has been done

Novel techniques to measure emissions from livestock units have been developed and results are being used in establishing federal and international regulatory guidelines. Precision feeding strategies have been designed to meet animal nutrient requirements while minimizing excretion of minerals. Education tools available to mass audiences nationally, are being developed to aid producers in whole farm nutrient balance practices.

Results

4 refereed publications, input to state and national policies, 1 presentation at an International Symposium, 2 presentations at regional conferences.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
133	Pollution Prevention and Mitigation
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #16

1. Outcome Measures
Enhanced reproductive efficiency of livestock.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Reproductive performance and efficiency has many impacts on sustainable livestock production. Projects are designed to identify factors stimulating and mechanisms associated with both male and female germ cell differentiation. Impacts of this work may influence the breeding practices and reproductive performance in livestock operations producing meat and milk. Other work is designed to identify ways to manage reproduction, which has immediate impact to the animal industries. This work is also funded by external grants

What has been done

Bovine testis xenografts have been successfully used to identify factors stimulating germ cell differentiation. In vitro culture requirements for porcine and bovine uterine and testicular fibroblasts were identified and will provide necessary information for future work. A vaccine has been developed that effectively controls the reproductive hormone cycle and thus prevents pregnancy.

Results

2 refereed publications., 1 presentation at an international conference.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
301	Reproductive Performance of Animals
304	Animal Genome

Outcome #17

1. Outcome Measures

Enhanced understanding of mechanisms associated with growth and differentiation of muscle cells and adipocytes.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Endocrine control and cellular mechanisms regulating growth of muscle and adipose cells provide important new information relevant to animals and humans. One project is designed to study the role of myostatin in regulating muscle growth in rainbow trout. Another project studies the regulation and differentiation of adipocytes in the study of fat accretion in domestic species. Projects in this area have potential to make important contributions to human growth and development as well. Work in this project area is also supported with external competitive grants and industry support.

What has been done

Mechanisms of action and regulation have been identified leading to more complete understanding of muscle growth and development and adipogenesis.

Results

14 peer reviewed publications

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)
- Other (See below)

Evaluation Results

In October 2008, the Department of Animal Sciences completed a comprehensive external review led by CSREES with the goal to help identify strengths and weaknesses within the department and implement a plan to advance the department's research accomplishments and productivity. The 5 member review team, chaired by Dr. Muquarrab Qureshi, National Program Leader - Animal Genetics, USDA reviewed documents submitted by the department and visited on site for 5 days reviewing academic, research and extension programs. The department plans to use the outcomes and recommendations from the review in its strategic planning and in program and resource prioritization and will revisit the report recommendations at yearly intervals. The review report has also been provided to college and university administrators. Identified weaknesses include the limited grant support in the Program and a relatively small graduate program relative to the number of research faculty.

Key Items of Evaluation

Program #3

V(A). Planned Program (Summary)

1. Name of the Planned Program

The IMPACT Center

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			10%	
502	New and Improved Food Products			10%	
603	Market Economics			10%	
604	Marketing and Distribution Practices			10%	
606	International Trade and Development			10%	
607	Consumer Economics			10%	
609	Economic Theory and Methods			10%	
610	Domestic Policy Analysis			10%	
611	Foreign Policy and Programs			10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.3	0.0
Actual	0.0	0.0	6.6	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	164315	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	425499	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The IMPACT project suffered significant budget reduction, and the program is no longer considered independently viable. Operationally, its remaining activities, which were primarily involved in market analysis, have been folded into the Program in Economic Sciences.

2. Brief description of the target audience

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	1000	1400	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	10	40	
2008	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	40	0

Output #2

Output Measure

- Graduate students supported by experiment station and grant funding

Year	Target	Actual
2008	10	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Scientific Publications
2	Graduate students and post-docs trained
3	Research Support increased in percent.
4	Developmental Research Advanced (percent)
5	Improved research Quality in percent.

Outcome #1

1. Outcome Measures

Scientific Publications

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	40	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The IMPACT project suffered significant budget reduction, so we have nothing to report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
607	Consumer Economics
611	Foreign Policy and Programs
604	Marketing and Distribution Practices
603	Market Economics
609	Economic Theory and Methods
606	International Trade and Development
501	New and Improved Food Processing Technologies
610	Domestic Policy Analysis

Outcome #2

1. Outcome Measures

Graduate students and post-docs trained

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	15	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The IMPACT project suffered significant budget reduction, so we have nothing to report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices
502	New and Improved Food Products
611	Foreign Policy and Programs
501	New and Improved Food Processing Technologies
603	Market Economics
610	Domestic Policy Analysis
606	International Trade and Development
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
607	Consumer Economics
609	Economic Theory and Methods

Outcome #3

1. Outcome Measures

Research Support increased in percent.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The IMPACT project suffered significant budget reduction, so we have nothing to report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
611	Foreign Policy and Programs
609	Economic Theory and Methods
501	New and Improved Food Processing Technologies
606	International Trade and Development
604	Marketing and Distribution Practices
610	Domestic Policy Analysis
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
607	Consumer Economics
603	Market Economics

Outcome #4

1. Outcome Measures

Developmental Research Advanced (percent)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The IMPACT project suffered significant budget reduction, so we have nothing to report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
611	Foreign Policy and Programs
502	New and Improved Food Products
607	Consumer Economics
609	Economic Theory and Methods
603	Market Economics
610	Domestic Policy Analysis
606	International Trade and Development
604	Marketing and Distribution Practices

Outcome #5

1. Outcome Measures

Improved research Quality in percent.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	5	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The IMPACT project suffered significant budget reduction, so we have nothing to report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
611	Foreign Policy and Programs
603	Market Economics
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
607	Consumer Economics
610	Domestic Policy Analysis
609	Economic Theory and Methods
501	New and Improved Food Processing Technologies
604	Marketing and Distribution Practices
606	International Trade and Development
502	New and Improved Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The IMPACT project suffered significant budget reduction, and the program is no longer considered independently. Operationally, its activities, which were primarily involved in market analysis, have been folded into the Program in Economic Sciences.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

Key Items of Evaluation

The IMPACT project suffered significant budget reduction, and the program is no longer considered independently. Operationally, its activities, which were primarily involved in market analysis, have been folded into the Program in Economic Sciences.

Program #4

V(A). Planned Program (Summary)

1. Name of the Planned Program

Western Regional Plant Introduction Station (W-006)

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			15%	
202	Plant Genetic Resources			50%	
206	Basic Plant Biology			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			10%	
212	Pathogens and Nematodes Affecting Plants			10%	
215	Biological Control of Pests Affecting Plants			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.5	0.0
Actual	0.0	0.0	6.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	526980	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	19348	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	4061	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We acquire and conserve specific germplasm, and manage associated information. The outcome is the continued provision of quality germplasm of the species maintained by W-006 and its delivery to researchers. From the utilization of this germplasm both basic and applied research will result. This research includes developing new cultivars, production of genetic maps, analysis of diversity, new medicinal plants and ornamentals. We characterize germplasm, using morphological and molecular markers to enhance conservation management, increase utilization of collections, and incorporate the genetic data into public databases. We try to reduce genetic drift in heterogenetic accessions, through sampling procedures that maximize the effective population size. This information will be applied to regeneration programs to provide cost effective methodology to maximize effective population size during regeneration of species and accessions. We shall genotype germplasm collections for diversity analysis and duplication. Results will provide the basic information needed to characterize germplasm collections. It will be useful to scientists interested in the interaction between marker systems and DNA sampling. Characterization data will be made available to the public on GRIN. We shall characterize and enhance Kentucky bluegrass germplasm for seed production in alternative residue management systems. An enhanced understanding of turf quality and yield will provide an understanding if yield can be improved without detrimental effects on turf quality. This should assist the plant breeding community in cultivar development. We shall apply co-dominant markers, cross□taxa and species markers, and the development of parallel methods to elucidate allelic diversity across legume germplasm. This research will result in the identification of unique germplasm in each food legume taxa readily available for basic research and applied plant breeding programs. We shall conduct research on selected germplasm collections for response to close organismal associates such as microorganisms, pathogens, saprophytes, and significant insect pests and disease vectors. Completion of entomology research will identify sources of insect-resistant germplasm for use by breeding programs. We aim to detect, identify and control microorganisms that are agents of plant disease or that induce disease in humans or animals consuming these plants. The exploitation of microbial symbionts or saprophytes for enhancing desirable germplasm properties or resistance to pests and diseases. We shall transfer technology in the form of plant germplasm propagules (seed/clones), research publications and other associated information to scientists. Quality germplasm is distributed to plant researchers. Plant Introduction material is and will continue to be utilized in the development of superior cultivars. Enhanced productivity, nutritional value and alternate use of plant material will result.

2. Brief description of the target audience

The target audience for this program is plant researchers.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	30	1000	100	100
2008	0	0	21	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	3	10	
2008	0	12	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	10	12

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center or other grant funds

Year	Target	Actual
2008	1	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Completion and publication of our work in peer reviewed journals
2	Continued distribution of valuable germplasm and information
3	Development of valuable germplasm
4	Continued distribution of valuable germplasm
5	Development of new collaborative projects with state federal and international research scientists
6	Continued provision of quality germplasm of the species maintained at the Pullman site and delivered to researchers worldwide
7	Basic and applied research resulting from the sharing of germplasm--production of genetic maps, analyses of diversity, new medicinal plants, ornamentals,etc.
8	Restoration and re-patriotization of germplasm to seed banks in countries of origin. [This is difficult to predict.]

Outcome #1

1. Outcome Measures

Completion and publication of our work in peer reviewed journals

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Peer reviewed publications are valuable resources to the scientific community.

What has been done

Twelve peer reviewed publications from this research effort appeared in print in 2008.

Results

The results of these studies are available to scientists, worldwide.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Continued distribution of valuable germplasm and information

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	18000	79000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Plant germplasm forms valuable research and development materials for scientists around the world.

What has been done

In 2008, the W6 project maintained 79,137 plant accessions comprising over 3,000 species in over 700 genera.

Results

Essential plant materials were provided to hundreds of research programs worldwide.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Development of valuable germplasm

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fusarium root rot of pea is a devastating disease and causes heavy yield loss every year.

What has been done

The W6 peacollection was screened for Fusarium root rot resistance and pre-breeding work was conducted.

Results

Three germplasm lines with Fusarium root rot resistance were released for public breeding programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
215	Biological Control of Pests Affecting Plants
202	Plant Genetic Resources

Outcome #4

1. Outcome Measures

Continued distribution of valuable germplasm

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	18000	35763

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Phenotypic data of the accession will add value to the accession.

What has been done

W6 scientists, together with our collaborators, observed and recorded 151 descriptors of 21 crops.

Results

A total of 35,763 data points were added to the GRIN database.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #5

1. Outcome Measures
Development of new collaborative projects with state federal and international research scientists

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Conservation of plant species and populations is a growing concern worldwide.

What has been done

Cooperative research with scientists in the former Soviet Union has been continued.

Results

Ongoing work has resulted in a scientific publication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
211	Insects, Mites, and Other Arthropods Affecting Plants
206	Basic Plant Biology
201	Plant Genome, Genetics, and Genetic Mechanisms
215	Biological Control of Pests Affecting Plants

212 Pathogens and Nematodes Affecting Plants

Outcome #6

1. Outcome Measures

Continued provision of quality germplasm of the species maintained at the Pullman site and delivered to researchers worldwide

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	18000	27555

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Researchers in both fundamental and applied plant biology are using W6 germplasm resources.

What has been done

In 2008, W6 project distributed 27,555 seed packets to scientists worldwide.

Results

Valuable germplasm has been distributed to scientists worldwide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #7

1. Outcome Measures

Basic and applied research resulting from the sharing of germplasm--production of genetic maps, analyses of diversity, new medicinal plants, ornamentals,etc.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	12	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Genetic resources available in the W6 plant collection are vast and need to be characterized in order to make use of these materials.

What has been done

Twelve publications were produced in 2008 as a result of work

Results

Valuable information has been gained and shared with the scientific community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #8

1. Outcome Measures

Restoration and re-patriotization of germplasm to seed banks in countries of origin. [This is difficult to predict.]

Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #5

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Plant Pathology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
212	Pathogens and Nematodes Affecting Plants			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	67.8	0.0
Actual	0.0	0.0	64.9	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	691766	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	2236990	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2680526	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension activities include preparing grant proposals designing and carrying out experiments to address basic and applied aspects in plant pathology, These experiments will be conducted in laboratories, greenhouses, and in field plots. Results of these studies will be summarized, and analyzed statistically, and disseminated to producers in the State, to the lay public, and to other scientists in the discipline and in other disciplines through oral presentations at meetings, field plot tours, extension bulletins, scientific publications, newsletters, and electronically through websites. Peer-reviewed scientific papers, popular press articles, and book chapters will be published. Data will be provided to support registration of crop protection chemicals. Graduate students will be trained to conduct and disseminate research.

2. Brief description of the target audience

Targeted audience: Primary producers of and dealers involved with trade of agricultural, forestry, horticultural, seed, and nursery commodities produced in the state; Homeowners and policy makers with need for plant health information; and, other scientists conducting related research. Extension specialists and teachers involved in transmitting information to the public and students.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

Year	Direct Contacts Adults Target	Indirect Contacts Adults Target	Direct Contacts Youth Target	Indirect Contacts Youth Target
Plan	11	22	0	0
2008	16	32	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	27	57	
2008	22	69	91

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	57	69

Output #2

Output Measure

- Graduate students supported by experiment station funds

Year	Target	Actual
2008	27	24

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased numbers of publications
2	Increased graduate student enrollment
3	Reduced Fungicide Use

Outcome #1

1. Outcome Measures

Increased numbers of publications

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	57	69

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Publications provide an important avenue to share new knowledge generated with peers and stakeholders.

What has been done

Faculty have been successful in publishing extension and research articles in various outlets.

Results

Dissemination of research and extension findings to a wide audience that included peers and stakeholders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #2

1. Outcome Measures

Increased graduate student enrollment

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	27	28

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A strong and vibrant graduate program is essential for the future of the discipline and to continue serving the stakeholders.

What has been done

increased efforts to recruit graduate students were undertaken.

Results

Target was accomplished.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #3

1. Outcome Measures

Reduced Fungicide Use

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Regular application of fungicides is one of the management tactics for reducing the impact of powdery mildews in grapes costing growers for the imputs and impacting the environment. Reduction in usage with more effective and efficient use of chemical control will result in increased profitability for the growers.

What has been done

A better understanding of the epidemiology of the grape powdery mildew was obtained through more sensitive air sampling methods combined with correlation with weather parameters.

Results

Adoption of this approach has resulted in refined and targeted applications of fungicides while accomplishing the same level of control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Competing Public priorities

Brief Explanation

Changes in appropriations would impact the unit's mission. Expected reduction in state allocations is likely to negative impact program delivery, and will hamper our ability to meet the needs of the program.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)
- Other (#After)

Evaluation Results

Faculty programs are evaluated annually and annual reviews of performance are prepared for each calendar year. Faculty have been productive and continued to carry out cutting edge research and in addressing disease threats to WA .

Key Items of Evaluation

Publications in refereed journals, invited review articles, extension publications, invitations to talk at national and international meetings.

Program #6

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Economic Sciences

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management			5%	
602	Business Management, Finance, and Taxation			10%	
603	Market Economics			20%	
604	Marketing and Distribution Practices			5%	
605	Natural Resource and Environmental Economics			15%	
606	International Trade and Development			5%	
607	Consumer Economics			10%	
609	Economic Theory and Methods			10%	
610	Domestic Policy Analysis			10%	
901	Program and Project Design, and Statistics			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	21.4	0.0
Actual	0.0	0.0	25.4	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	298759	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1278625	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1481445	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The outputs from this research occur in a number of different forms. One output is in the form of publications in high quality refereed journals, which validate the scientific merit of the research performed under this project, and stand as long term contributions to the inventory of knowledge in the respective areas of inquiry. In addition, a number of peer-reviewed and other research bulletins, research reports, and both peer-reviewed and invited presentations disseminating the results of the research are provided to appropriate clientele by faculty analysts themselves. In addition to outreach efforts by research faculty, which is an expectation of all faculty in the School of Economic Sciences, the research results are translated into an outreach and engagement effort through collaboration with extension faculty, and timely and relevant deliverables in this regard include extension bulletins, workshops, downloadable data, tables, and reports, and other outreach and engagement activities with appropriate clientele. The knowledge disseminated in its various forms to appropriate decisions makers in various segments of the agricultural sector, government, and in general society generate an informed decision environment and provide sufficient insights into the economic and societal consequences of decisions so that actual decisions made will enhance the sustainability of the agricultural sector, balance the need for uses and preservation of natural resources, and further good stewardship of the environment.

2. Brief description of the target audience

The target audience of the School of Economic Sciences includes decision makers across a wide array of participants in the agricultural sector, government and general society. The work of the School,s economists will also be of interest, and influence the thinking of fellow economists in academia nationally and internationally.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	750	1000	0	0
2008	1000	1500	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	7	20	
2008	7	20	27

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	20	30

Output #2

Output Measure

- Graduate students supported by experiment station and grant funds

Year	Target	Actual
2008	39	34

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number and Quality/reputation of refereed journal publications (mid-tier economics journals and above
2	Number and quality of other research bulletins, reports and presentations at major conferences
3	Degree of contribution of fundamental knowledge within the fields researched (percent increase)
4	Number and value of external grants in support of the research program (units are dollars)
5	Contribution to improved/new research methods/tools (percent of output)
6	Relevant knowledge generated for use by policy and decision makers (percent of output)
7	Number of graduate students trained and placed in the job market
8	Degree to which overall research funding is increased (percent)
9	Number of additional institutionally funded and externally funded GRAs that are studying and researching in the School

Outcome #1

1. Outcome Measures

Number and Quality/reputation of refereed journal publications (mid-tier economics journals and above

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	20	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Addressing a variety of priority issues in the Agricultural Sector, and Natural Resource and Environmental Issues.

What has been done

Publication of peer reviewed articles addressing priority topics.

Results

Aspects of economics issues and problems have been addressed and/or solved.

4. Associated Knowledge Areas

KA Code	Knowledge Area
901	Program and Project Design, and Statistics
606	International Trade and Development
605	Natural Resource and Environmental Economics
607	Consumer Economics
603	Market Economics
601	Economics of Agricultural Production and Farm Management
610	Domestic Policy Analysis
609	Economic Theory and Methods

Outcome #2

1. Outcome Measures

Number and quality of other research bulletins, reports and presentations at major conferences

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	25	61

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Addressing a variety of priority issues in the Agricultural Sector, and Natural Resource and Environmental Issues.

What has been done

Reports and presentations addressing priority topics.

Results

Aspects of economics issues and problems have been addressed and/or solved.

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
606	International Trade and Development
610	Domestic Policy Analysis
601	Economics of Agricultural Production and Farm Management
901	Program and Project Design, and Statistics
605	Natural Resource and Environmental Economics
603	Market Economics
609	Economic Theory and Methods

Outcome #3

1. Outcome Measures

Degree of contribution of fundamental knowledge within the fields researched (percent increase)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Professionals in the discipline have interest in new economic and econometric theories to address economic issues.

What has been done

Contributions to both economic and econometric theory have been made.

Results

Improved fundamental theoretical foundations for economic analysis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics
607	Consumer Economics
609	Economic Theory and Methods
901	Program and Project Design, and Statistics
610	Domestic Policy Analysis
603	Market Economics
606	International Trade and Development
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Number and value of external grants in support of the research program (units are dollars)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	850000	875000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
609	Economic Theory and Methods
610	Domestic Policy Analysis
606	International Trade and Development
605	Natural Resource and Environmental Economics
603	Market Economics
601	Economics of Agricultural Production and Farm Management
607	Consumer Economics
901	Program and Project Design, and Statistics

Outcome #5

1. Outcome Measures

Contribution to improved/new research methods/tools (percent of output)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Professionals in the discipline have interest in new quantitative methods for constructing improved economic models.

What has been done

Econometric methodological contributions to the discipline have been made.

Results

Provides new quantitative estimation/inference tools for constructing empirical economic models.

4. Associated Knowledge Areas

KA Code	Knowledge Area
606	International Trade and Development
609	Economic Theory and Methods
605	Natural Resource and Environmental Economics
607	Consumer Economics
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics
603	Market Economics
601	Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Measures

Relevant knowledge generated for use by policy and decision makers (percent of output)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Complex economic issues relating to policy determination and firm-level decisions making in the agricultural sector, as well as policy relating to the use of natural resources and the effect on the environment require that decision makers be informed through the appropriate economic intelligence with which to make effective and efficient decisions.

What has been done

A large subset of the peer-reviewed publications, reports, and professional presentations address high priority issues to policy makers and decision makers.

Results

More informed decision makers, and decisions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
606	International Trade and Development
601	Economics of Agricultural Production and Farm Management
607	Consumer Economics
603	Market Economics
610	Domestic Policy Analysis
901	Program and Project Design, and Statistics
609	Economic Theory and Methods
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

Number of graduate students trained and placed in the job market

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	12	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Provide highly trained economic professional to address societal problems and train next generation of analysts.

What has been done

Trained high quality MA (4) and PhD (8) students.

Results

Placed high quality MA and PhD students on the job market in industry, government, and academia.

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
605	Natural Resource and Environmental Economics
601	Economics of Agricultural Production and Farm Management
609	Economic Theory and Methods
901	Program and Project Design, and Statistics
606	International Trade and Development
607	Consumer Economics
603	Market Economics

Outcome #8

1. Outcome Measures

Degree to which overall research funding is increased (percent)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Needed support for addressing high priority issues in the Agricultural Sector, Resources, and the Environment.

What has been done

Efforts were expended to increase the grant and projects funding base for research programs.

Results

The School was successful in nearly maintaining the research funding base it had in the previous year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
609	Economic Theory and Methods
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
901	Program and Project Design, and Statistics
607	Consumer Economics
606	International Trade and Development

Outcome #9

1. Outcome Measures

Number of additional institutionally funded and externally funded GRAs that are studying and researching in the School

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increase the human capital base with which to accomplish high priority research, an multiply faculty effectiveness.

What has been done

Efforts were made to secure external funding for research, including funding for graduate students.

Results

A two year renewal of a Graduate School GRA enhancement grant was successful, securing 6 additional GRAs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
609	Economic Theory and Methods
605	Natural Resource and Environmental Economics
601	Economics of Agricultural Production and Farm Management
606	International Trade and Development
901	Program and Project Design, and Statistics
607	Consumer Economics
610	Domestic Policy Analysis
603	Market Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

There was a notable diminution in the capacity of the faculty to pursue research on priority economic issues facing the Agricultural Sector, Natural Resources, and the Environment due to external factors. This resulted because of the School's inability to fully replace an inordinately large number of retiring faculty due to substantial budget pressures, and because the new hires that did occur were entry level faculty at the very beginning of their research careers. This was partly to blame for the School,s inability to expand its research funding base, although the peer-reviewed publications, and other research bulletins, reports, and professional research presentations exceeded the number expected in this evaluation year.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

Program #7

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Statistics

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
901	Program and Project Design, and Statistics			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.3	0.0	0.8	0.0
Actual	0.0	0.0	0.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	84256	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	15403	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

It is expected that the results obtained from each project will be disseminated to other scientists at professional meetings through contributed or invited presentations as well as through peer reviewed publications resulting from the research conducted. Graduate student research compared two methods for analysis of resource selection data that involve a spatial component. The work resulted in a project that was presented at professional meetings. Manuscript is being revised for resubmission in January of 2009.

2. Brief description of the target audience

The target audience is other academic staticians, biologists and scientists other disciplines who are consumers of knowledge concerning statistical functions.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	20	40	0	0
2008	63	40	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	1	
2008	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed publications

Year	Target	Actual
2008	1	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Immediate dissemination of knowledge gained from research projects through talks presented and peer reviewed publications
2	Number of peer reviewed journal and proceedings papers, number of talks given
3	Implementation of statistical methodologies and procedures derived from individual research projects in our department by other scientists
4	Number of citations for articles published which are based on individual research projects

Outcome #1

1. Outcome Measures

Immediate dissemination of knowledge gained from research projects through talks presented and peer reviewed publications

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
901	Program and Project Design, and Statistics

Outcome #2

1. Outcome Measures

Number of peer reviewed journal and proceedings papers, number of talks given

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
901	Program and Project Design, and Statistics

Outcome #3

1. Outcome Measures

Implementation of statistical methodologies and procedures derived from individual research projects in our department by other scientists

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
901	Program and Project Design, and Statistics

Outcome #4

1. Outcome Measures

Number of citations for articles published which are based on individual research projects

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
901	Program and Project Design, and Statistics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (See below)

Brief Explanation

Results were shared with professional colleagues at the Joint Statistical Meetings held in Denver, Colorado in an invited presentation.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

Key Items of Evaluation

Program #8

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Community and Rural Sociology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
608	Community Resource Planning and Development			20%	
803	Sociological and Technological Change Affecting Individuals, Families and Communities			60%	
805	Community Institutions, Health, and Social Services			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.9	0.0
Actual	0.0	0.0	3.2	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	53144	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	451037	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	64361	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Programmatic activities in the Department of Community and Rural Sociology fall into three primary areas. The first, and foremost, involves a variety of activities in the social dimensions of agri-food systems. This includes research on the management strategies of various categories of agricultural producers in the State of Washington, including their marketing strategies. The latter includes a special emphasis on understanding, and developing strategies for improving, producers participation in local and regional food networks. Major sub-goals are to improve market access for small, minority and women farmers, and to improve access by local residents to health foods. A second goal of the Department's programmatic activities is to assist forest service planners and local policy makers in implementation and assessment of strategies to help rural economies transition from being dependent on resource extraction activities to a more diverse economic development strategy that also includes tourism and amenity migration. The Department's third goal is work on improving the quality of mixed-mode surveys, with special emphasis on improving the visual quality of various survey instruments.

2. Brief description of the target audience

The target audience will include policy makers at local, state, and national levels; Forest Service personnel in the Pacific Northwest and Alaska; consumers and non-profit public consumer groups; farmers in Washington State, particularly small and family farm operations; development agencies that serve women farmers, minority farmers, and small-scale farmers; and practitioners of survey research methodologies.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

Year	Direct Contacts Adults Target	Indirect Contacts Adults Target	Direct Contacts Youth Target	Indirect Contacts Youth Target
Plan	400	2500	0	0
2008	500	3670	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	6	
2008	0	7	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	6	7

Output #2

Output Measure

- Graduate students supported by Agricultural Research Center funds including grants

Year	Target	Actual
2008	2	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Steady increase in the number of state residents accessing bulletins and other stakeholder directed publications via the department website
2	Steady increase in number of state residents accessing survey results via the department website

Outcome #1

1. Outcome Measures

Steady increase in the number of state residents accessing bulletins and other stakeholder directed publications via the department website

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2500	3670

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
805	Community Institutions, Health, and Social Services
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families and Communities

Outcome #2

1. Outcome Measures

Steady increase in number of state residents accessing survey results via the department website

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	550	1710

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
805	Community Institutions, Health, and Social Services
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Population changes have been added to the list since some of our projects address the needs/interests of minority and women farmers, who are becoming an increasingly large percentage of the state,s agricultural producers.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)
- Comparisons between program participants (individuals,group,organizations) and non-participants

Evaluation Results

Information generated as a result of research project conducted by faculty in the Department of Community and Rural Sociology are in high demand, as evidenced by the increasing frequency with which outreach publications and survey results are accessed by various stakeholder groups. These groups include agricultural producers (including minority and women farmers), local and state policy makers, farmers & market managers, Forest Service personnel, food consumers, and survey research practitioners. Stakeholders such as farmers and managers use information generated by Department projects to improve their marketing practices, while other stakeholder groups use the information to help inform public policy debates. For example over 500 Washington State farmers have developed new or revised business plans as a result of Departmental programmatic efforts. While the ultimate impact of such plans, and the use of the information provided through other Departmental programs is difficult to determine because such assessments can be nearly as costly to implement as the cost of the research projects themselves, the Department is currently working on the development of an on-line survey research tool that could provide some information on those impacts.

Key Items of Evaluation

Program #9

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Agricultural Animal Health

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
307	Animal Management Systems			10%	
308	Improved Animal Products (Before Harvest)			10%	
311	Animal Diseases			10%	
312	External Parasites and Pests of Animals			10%	
313	Internal Parasites in Animals			10%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			10%	
403	Waste Disposal, Recycling, and Reuse			10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.			10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			10%	
722	Zoonotic Diseases and Parasites Affecting Humans			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual	0.0	0.0	2.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	7659	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	303525	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	179423	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

An outbreak of mycoplasma mastitis was studied in a herd. The strain that caused mastitis was the same strain found at the first herd sampling from body sites of calves of cows. Only one strain of Mycoplasma bovis caused mastitis although five strains were isolated from body sites of animals. Isolation of Mycoplasma bovis at a body sites at a prior period never preceded mastitis at a subsequent period.This suggests that a dairy herd with animals colonized by the microorganism may not be at a high risk for mastitis case.Evidence suggested the outbreak was linked to exposure of animals from another herd. We have searched for emergence of new salmonella strains in our regions and attempted to identify the location(s) where antibiotic resistant strains are selected. We identified a new clonal strain of Salmonella that is epidemic in the pacific northwest and are working to identify the means by which it is spread. We have also documented the high degree of multi-drug resistance in serovar Dublin isolated from dairy farms and heifer ranches, which indicates that the selection pressure for increased resistance is more likely occurring on these types of farms given the high degree of host specificity of this serovar.

2. Brief description of the target audience

Our target audience includes academicians, clinicians, microbiologists, public health authorities, practicing veterinarians, farmers and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	90	4000	50	100
2008	2000	10000	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	1	10	
2008	0	16	16

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	10	16

Output #2

Output Measure

- Graduate students supported on agricultural research center funds and grants

Year	Target	Actual
2008	5	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Define natural occurance and shedding patterns of E. coli O157:H7
2	Determine the extent of Salmonella typhimurium DT 104 as an emerging and zoonotic pathogen
3	Develop PCR test for mycoplasma mastitis in milk samples
4	Reduce prevalence of Mycoplasma mastitis in dairy herds from the current 8 percent to 2 percent of herds
5	Research support in dollars for the project on E. coli O157:H7

Outcome #1

1. Outcome Measures

Define natural occurance and shedding patterns of E. coli O157:H7

Not reporting on this Outcome for this Annual Report

Outcome #2

1. Outcome Measures

Determine the extent of Salmonella typhimurium DT 104 as an emerging and zoonotic pathogen

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Determine the extent of Salmonella typhimurium DT 104 as an emerging and zoonotic pathogen. Salmonella represent one of the top two bacterial foodborne infections of humans. Salmonella strains with multiple antibiotic resistance of of particular concern as they result in increased morbidity, and these strains seem to be particularly shared between cattle and humans. Therefore, understanding of the source and dissemination of this agent is of concern for physicians, public health workers, food producers and processors, veterinarians, feedlot operators, and ranchers.

What has been done

We have searched for emergence of new salmonella strains in our regions and attempted to identify the location(s) where antibiotic resistant strains are selected.

Results

We identified a new clonal strain of Salmonella that is epidemic in the pacific northwest and are working to identify the means by which it is spread. We have also documented the high degree of multi drug resistance in serovar Dublin isolated from dairy farms and heifer ranches, which indicates that the selection pressure for increased resistance is more likely occurring on these types of farms given the high degree of host specificity of this serovar.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #3

1. Outcome Measures

Develop PCR test for mycoplasma mastitis in milk samples

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Mycoplasma sp. that cause mastitis are emerging mastitis pathogens. Recent reports from Washington State University and the National Animal Health Monitoring Service concur that emergence of this disease is correlated with increasing herd size. The US dairy population is likely to continue to suffer from an increase in this disease as average herd size continues to increase in the nation. Mycoplasma mastitis normally begins with high prevalence and then a decreasing herd prevalence. Mycoplasma mastitis is an insidious disease given problems in diagnosis and the propensity for asymptomatic carriage of the agent in cattle on the farm.

What has been done

An outbreak of mycoplasma mastitis was studied in a herd. The strain that caused mastitis was the same strain found at the first herd sampling from body sites of calves of cows.

Results

Only one strain of Mycoplasma bovis caused mastitis although five strains were isolated from body sites of animals. Isolation of Mycoplasma bovis at a body sites at a prior period never preceded mastitis at a subsequent period. This suggests that a dairy herd with animals colonized by the microorganism may not be at a high risk for mastitis case. Evidence suggested the outbreak was linked to exposure of animals from another herd.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

Outcome #4

1. Outcome Measures

Reduce prevalence of Mycoplasma mastitis in dairy herds from the current 8 percent to 2 percent of herds

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

An investigation is ongoing.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #5

1. Outcome Measures

Research support in dollars for the project on E. coli O157:H7

Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

The program is currently implementing a strategy for gauging the effectiveness of using the web to share information.

Key Items of Evaluation

Program #10

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Fruit and Vegetable Development, Production and Management

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			8%	
202	Plant Genetic Resources			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			13%	
204	Plant Product Quality and Utility (Preharvest)			28%	
205	Plant Management Systems			23%	
206	Basic Plant Biology			7%	
212	Pathogens and Nematodes Affecting Plants			3%	
216	Integrated Pest Management Systems			1%	
404	Instrumentation and Control Systems			4%	
601	Economics of Agricultural Production and Farm Management			1%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	45.3	0.0
Actual	0.0	0.0	38.6	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	495725	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1848704	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1449227	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities vary across a wide range from molecular level inquiry to field based studies concerning the efficacy of horticultural production practices. These activities include: (1) basic research applying molecular biology, genetics and biochemistry to the calcium/calmodulin-mediated signal network that influences plant response to environmental factors; (2) development of data mining tools and resources for genomics research on Rosaceae; (3) studies in fruit production and biology, with an emphasis on sustainability of fruit production systems; (4) breeding and genetic studies in apple, cherry, raspberry, and strawberry, including genomics approaches to identify functional genetic markers for crop improvement; (5) studies of the anatomy and structure of grape berry during growth and development; (6) research that emphasizes the use of plant bioregulators for apple, pear, and sweet cherry, (7) studies related to the interaction of various environmental and production factors influencing yield and quality of potato tubers; (8) research focusing on environmental factors and management practices as they influence grape physiology; (9) studies of effects of deficit irrigation and partial root zone drying in apple, cherry, and grape; (10) research which focuses on the development of an understanding of factors that cause skin disorders of apples; (11) evaluation of potato cultivars for introduction into the Washington potato industry; (12) studies focusing on practical means of achieving balanced cropping; (13) effects of new clonal rootstocks on scion productivity, growth, and fruit quality in cherry; (14) research focusing on novel management strategies for high density cherry production; (15) the potential for mechanical harvest of fresh□market quality, stemless sweet cherries; and (16) the development of automation, sensing, control, and information systems for precision agriculture. The outputs of these activities will include: patents, plant variety releases, scientific journal articles, conference publications and presentations, poster presentations, field day presentations, web sites, and knowledge about production and management practices that is passed along to users in other informal settings.

2. Brief description of the target audience

The audience for this program will be other scientists, economists, agribusiness, farmers, horticulturists and the fruit, potato, and vegetable industries.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	1250	600	0	0
2008	1250	600	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	2

Patents listed

Knowles N., L. Knowles. Use of C3 to C14 aliphatic aldehydes, ketones, and primary and secondary C3 to C7 alcohols to inhibit sprouting of potato tubers. Full patent application filed in USPTO Aug. 6, 2008, serial no. 12/186,861. 2008. Patent 60/955,156.

Poovaiah B., L. Du. Size and/or growth engineering by modulation of the interaction between calmodulin, and brassinosteroid biosynthetic enzymes and orthologs thereof. 2008.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	3	21	
2008	8	57	65

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	21	46

Output #2

Output Measure

- Variety Releases

Year	Target	Actual
2008	4	6

Output #3

Output Measure

- Plant Patents

Year	Target	Actual
2008	1	2

Output #4

Output Measure

- Number of graduate students supported by Agricultural Research Center and external funds

Year	Target	Actual
2008	7	29

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	See below under Evaluation.

Outcome #1

1. Outcome Measures

See below under Evaluation.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

Breeding and development of potato varieties that are more efficient in nitrogen use (Pacific Northwest Potato Variety Development Program, PNWPVD) has reduced the use of nitrogen fertilizer, resulting in less nitrate contamination of ground water. The potential economic savings to NW potato growers was estimated to be $1.3 million or $72 per acre in 2006. Varieties released by this collaborative program accounted for 26% and 32% of potato acreage in the Pacific Northwest and WA in 2007, respectively. Farm gate value of these new varieties in WA in 2007 is estimated to be $160,000,000. It is estimated that the potato varieties developed by the PNWPVD program have returned $39 for every dollar (research & institutional) invested.

Other researchers in this program have identified the process that causes sun burning in apples, and have developed a product that reduces this disorder significantly. This discovery has the potential to save fruit growers literally tens of millions of dollars annually. It is estimated that the patented apple sunburn protectant (RAYNOXÃ‚(r)) alone saved the industry several million dollars during the past three growing seasons. The invention of RainGard to aid in the protection of cherries from cracking/splitting is also expected to have tremendous positive economic impact on the industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
601	Economics of Agricultural Production and Farm Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

A number of different measures will be used to evaluate the success of research projects described in this program at multiple points throughout the duration of the program. The short-term goal of creating new knowledge is evaluated by the extent to which this new knowledge is communicated throughout the scientific literature. The mid-term goal of communicating that knowledge to stakeholders will be evaluated based upon the success with which the information is disseminated through the use of presentations and posters given at grower sponsored conferences, workshops, and research reviews, and at university sponsored field days. The long-term goal of having direct impact on sound environmental practices and sustainable and efficient production in fruit and vegetable crops will be evaluated by the extent to which research findings are adopted throughout the industry. For those projects focusing on the investigation of production and management practices, (for example, research that emphasizes the use of plant bioregulators for apple, pear, and sweet cherry, studies related to the interaction of various environmental and production factors influencing yield and quality of potato tubers; research focusing on environmental factors and management practices as they influence grape physiology; studies of effects of deficit irrigation and partial root zone drying in apple, cherry, and grape), the extent to which recommended practices have been adopted will be used as the measure of success. In the case of research that focuses on the development of new products, such as sprays used to prevent sunburn in apple, or cracking in cherry, or the development of precision agriculture systems, the extent to which the new products or technologies are adopted for use throughout the industry will be used as a measure of success. For those projects which focus on fruit and vegetable breeding, the measure of success will be the extent to which newly released cultivars gain acceptance by growers, and begin to contribute to the agricultural economy. Most of the research projects included in this program are also funded by commodity commissions and other agricultural stakeholder organizations. Scientists present progress reports to these organizations on an annual basis as a part of the process for continuation of funding. The extent to which these projects receive continued financial support is another measure of their success.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #11

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in the Post Harvest Quality of Fruits and Vegetables

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			10%	
202	Plant Genetic Resources			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
204	Plant Product Quality and Utility (Preharvest)			15%	
205	Plant Management Systems			10%	
206	Basic Plant Biology			10%	
501	New and Improved Food Processing Technologies			15%	
502	New and Improved Food Products			10%	
503	Quality Maintenance in Storing and Marketing Food Products			5%	
701	Nutrient Composition of Food			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.0	0.0
Actual	0.0	0.0	15.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	171768	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	666673	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	522241	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities and outputs vary across a wide range from molecular level inquiry to field and lab based studies related to postharvest handling, storage, and processing of horticultural crops. These activities will include: basic research which focuses on the application of molecular biology, genetics and biochemistry, related to the biological, chemical, and physiological mechanisms that explain postharvest phenomenon in horticultural crops, studies directed at the identification of CA storage regimes for apples and other fruits, investigation of flavor chemistry in apples, studies of the post-harvest/processing quality component of Tri-State Variety trials in potatoes, research aimed at the identification of evaluation factors for potato processing quality, research directed toward the identification of strategies for storage of seed potatoes, research focused on the mechanical harvest and subsequent handling and storage requirements in asparagus, studies which address the use of microwave-vacuum drying technology for fruits and vegetables, studies which focus on lenticel breakdown and fruit finish in apples, and research which focuses on crop management factors that affect postharvest fruit and vegetable quality.

2. Brief description of the target audience

The target audience will be scientists in the area of postharvest quality of fruits and vegtables, agribusiness, economists, and the participating vegetable and fruit industries (in particular the stone and pome fruit industries, and the potato industry).

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	500	300	0	0
2008	500	300	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	1

Patents listed

Knowles N., L. Knowles. Use of C3 to C14 aliphatic aldehydes, ketones, and primary and secondary C3 to C7 alcohols to inhibit sprouting of potato tubers. Full patent application filed in USPTO Aug. 6, 2008, serial no. 12/186,861. 2008. Patent 60/955,156

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	12	
2008	0	17	18

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	12	15

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center and external funding

Year	Target	Actual
2008	4	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Please see written paragraph under evaluation.

Outcome #1

1. Outcome Measures

Please see written paragraph under evaluation.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
501	New and Improved Food Processing Technologies
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
503	Quality Maintenance in Storing and Marketing Food Products
502	New and Improved Food Products
701	Nutrient Composition of Food

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

A number of different measures will be used to evaluate the success of research projects described in this program at multiple points throughout the duration of the program. The short-term goal of creating new knowledge is evaluated by the extent to which this new knowledge is communicated throughout the scientific literature. The mid-term goal of communicating that knowledge to stakeholders will be evaluated based upon the success with which the information is disseminated through the use of presentations and posters given at grower sponsored conferences, workshops, and research reviews, and at university sponsored field days. The long-term goal to enhance quality of postharvest products in fruit and vegetable crops, and to identify new technologies that can be used in food storage and processing will be evaluated by the extent to which research findings are adopted throughout the industry. For those projects focusing on the investigation of improved storage practices, the extent to which recommended practices have been adopted by the food storage and processing industries will be used as the measure of success. In the case of research that focuses on the development of new products, such as material that is applied to potato tubers to suppress sprouting during storage, the extent to which the new products are adopted for use throughout the industry will be used as a measure of success. For those projects which focus on the selection of fruit and vegetable cultivars that have good potential for value added contributions, the measure of success will be the extent to which newly released cultivars gain acceptance by growers, and begin to contribute to the agricultural economy. Most of the research projects in this program are also funded by commodity commissions and other agricultural stakeholder organizations. Scientists make progress reports on an annual basis to these organizations as a part of the process of applying for continuation of funding. The extent to which these projects receive continued financial support is another measure of their success.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #12

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Environmental Horticulture

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
124	Urban Forestry			10%	
134	Outdoor Recreation			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			25%	
212	Pathogens and Nematodes Affecting Plants			25%	
724	Healthy Lifestyle			10%	
802	Human Development and Family Well-Being			10%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.3	0.0
Actual	0.0	0.0	11.9	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	172531	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	620299	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	710911	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Specific activities that are part of this program include: investigations of the effects of cultural practices on plant root health and the establishment of landscape plants, research focusing on the development of an understanding or environmental and cultural factors that affect water stress and cold hardiness in landscape plants, research focusing on the identification of superior ornamental landscape plants for urban environments, studies of the influence of human experience in the development of perceptions related to urban landscapes, and research aimed at developing further understanding of the relationships between physical environments and human behavior.

2. Brief description of the target audience

The target audience for this program consists of other scientists in the discipline, extension personnel,social scientists, landscape horticulture industry, and the consumer/gardener.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	600	100	0	0
2008	600	100	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	9	
2008	30	7	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	9	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	See below under Evaluation.

Outcome #1

1. Outcome Measures

See below under Evaluation.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry
724	Healthy Lifestyle
802	Human Development and Family Well-Being

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #13

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Entomology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
121	Management of Range Resources			2%	
135	Aquatic and Terrestrial Wildlife			2%	
136	Conservation of Biological Diversity			6%	
211	Insects, Mites, and Other Arthropods Affecting Plants			20%	
215	Biological Control of Pests Affecting Plants			15%	
216	Integrated Pest Management Systems			35%	
304	Animal Genome			8%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.			12%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	56.6	0.0
Actual	0.0	0.0	55.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	306058	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	2023071	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1983596	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Both basic and applied research will be conducted. Results of research efforts will be disseminated through refereed publications, general interest publications, Extension outlets, and presentations at scientific, stakeholder, and general public venues. A minimal amount of infrastructure will be constructed and equipment will be purchased during the plan of work period. All programs will involve the training of graduate students. Specific activities will include or produce a better understanding of biological diversity of native and disturbed habitats in Washington and the greater Pacific Northwest. Specimens collected and prepared during studies will be deposited in the James Entomological Collection. Studies of native and exotic species of arthropods will be conductedin order to evaluate their potential for the control of and impact upon non-native, rangeland weed species.

Studies directed at the management of direct and indirect pests through traditional technologies. Studies of basic biological and ecological principles as they relate to the management of pest and beneficialarthropods. Development and implementation of biological control and integrated pest management strategies for the management of pest arthropods, especially insects. Genomic studies of primarily honey bees and parasitic wasps to better enhance their beneficial potentials. The development and implementation of methods that measure and monitor agricultural chemicals in the environment. The development of methods that test the toxicological effects of agricultural chemicals on non-target organisms.

2. Brief description of the target audience

Target audiences for our work in the Department of Entomology include scientists in various related disciplines, farmers, extension, agribusiness, public policy makers, legislators, government agencies, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	5500	1500	1000	100
2008	6384	5700	1243	138

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	20	30	
2008	32	43	75

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	30	43

Output #2

Output Measure

- Graduate Students supported on Agricultural Research Center and other external funds

Year	Target	Actual
2008	21	21

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Percent of holdings that are implementing changes to IPM based on research findings
2	Percent decrease in pesticide use

Outcome #1

1. Outcome Measures

Percent of holdings that are implementing changes to IPM based on research findings

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	60	65

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Changes from a strict, chemical regime to one of integrated pest management in which a number of low input and often sustainable methods are used to manage pests has positive environmental and health benefits.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
216	Integrated Pest Management Systems
215	Biological Control of Pests Affecting Plants
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #2

1. Outcome Measures

Percent decrease in pesticide use

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	4	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems
136	Conservation of Biological Diversity
215	Biological Control of Pests Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

Key Items of Evaluation

Program #14

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Natural Resource Sciences

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management			20%	
121	Management of Range Resources			10%	
123	Management and Sustainability of Forest Resources			15%	
135	Aquatic and Terrestrial Wildlife			40%	
136	Conservation of Biological Diversity			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	12.7	0.0
Actual	0.0	0.0	14.8	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	13008	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	744561	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1227419	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research in various areas of Natural Resource Sciences is carried out through laboratory and field experiments. Data is collected and analyzed. Papers, books, book chapters and reports are written. Presentations are given in local, national and international venues. Graduate students and undergraduate students are mentored and trained. Curriculum is revised and developed.

2. Brief description of the target audience

Our target audience includes other researchers within and without the discipline of natural resource sciences including extension educators, persons in industry, economics, policy makers and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	0	100	0	0
2008	0	100	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	10	
2008	0	13	13

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed Publications

Year	Target	Actual
2008	10	13

Output #2

Output Measure

- Graduate students supported on experiment station and grant funds

Year	Target	Actual
2008	15	17

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	graduate students and post-docs trained
2	Percent increase in research support
3	New personnel in research positions

Outcome #1

1. Outcome Measures

graduate students and post-docs trained

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	5	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research completed by our graduate students was of interest to the Washington State Department of Fish and Wildlife and the Department of Ecology as well as various federal ageencies in the Pacific Notrthwest. Our cougar research was also the subject of legislative hearings in the State of Washington and the State of Oregon.

What has been done

Research was completed on cougar predator/prey behavior, pygmy rabbit reintroduction techniques, cattle/elk grazing tradeoffs, mule deer nutrition, and basic physiological aspects of grizzy bears in hiberation.

Results

As a result of the cougar research, state hunting regulations for cougars were changed in the State of Washington.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
136	Conservation of Biological Diversity
135	Aquatic and Terrestrial Wildlife
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Percent increase in research support

Not reporting on this Outcome for this Annual Report

Outcome #3

1. Outcome Measures

New personnel in research positions

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

No personnel changes except for the normal turnover on graduate students due to funding limitations.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (See below)

Evaluation Results

Key Items of Evaluation

Program #15

V(A). Planned Program (Summary)

1. Name of the Planned Program

Wood Materials Engineering Laboratory

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
511	New and Improved Non-Food Products and Processes			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.9	0.0
Actual	0.0	0.0	4.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	8306	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	234781	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	166170	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

For the past year, the investigation was focused on the manufacturing and properties of several natural fiber/biobased polyester composites in their solid forms. This phase of research is necessary to evaluate the mechanical, thermal mechanical, and rheological properties of various natural fiber composite materials. This study provides important guidelines and references for the foaming of these composites. The natural fibers used in this study included wood flour, nano cellulose whiskers, sugar beet pulp, and bamboo fibers. The biobased polyesters used were poly(lactic acid), poly(3-hydroxybutyrate) and poly(3-hydroxybutyrate-co-3-hydroxyvalerate). All three are cornstarch based polymers.The effects of fiber length, size, L/D ratio and compatibilization on the morphology and properties of the composites were studied. Mechanisms of reinforcing and toughening were investigated.

2. Brief description of the target audience

The target audience for this program will be the forest products, composites ,packaging materials, transportation, and construction industries.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	150	3000	2	0
2008	150	3000	0	0

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	2

Patents listed

1. E. Brown and M.-P. Laborie. (08/2008). Method of in situ bioproduction and composition of bacterial cellulose nanocomposites, US patent No 60/957,279. 2. M.-P. Laborie. (11/2008). Surface activations of wood plastic composites, US Provisional patent No Provisional app #: 60/985,440

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	2	3	
2008	0	5	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed journal Articles

Year	Target	Actual
2008	3	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Methods to improve the compatibility of natural fiber and biopolyesters and melt strength of biocomposities, knowledge of composition-morphology-property relationships of composites
2	Microcellular foaming extrusion process design and processing optimization of biocomposites; characterization of composition-morphology-property relationships of microcellular foam
3	Product application development of microcellular foaming technology of biocomposites
4	Develop and characterize hybrid lignocellulosic composites with novel biopolyester resin systems.
5	Develop novel lignocellulosic nanomaterials.

Outcome #1

1. Outcome Measures

Methods to improve the compatibility of natural fiber and biopolyesters and melt strength of biocomposities, knowledge of composition-morphology-property relationships of composites

Not reporting on this Outcome for this Annual Report

Outcome #2

1. Outcome Measures

Microcellular foaming extrusion process design and processing optimization of biocomposites; characterization of composition-morphology-property relationships of microcellular foam

Not reporting on this Outcome for this Annual Report

Outcome #3

1. Outcome Measures

Product application development of microcellular foaming technology of biocomposites

Not reporting on this Outcome for this Annual Report

Outcome #4

1. Outcome Measures

Develop and characterize hybrid lignocellulosic composites with novel biopolyester resin systems.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A fundamental understanding of the manufacturing and structure-property relationship of microcellular foam of natural fiber-reinforced biopolyester composite is essential for commercialization. With the development of the microcellular foam technology, bioproducts will be produced with cost effectiveness and energy efficiency. It will enable the bioproducts to compete with fossil carbon based products both in performance and economics. Several fundamental problems in the preparation of microcellular foam of biopolyesters and biocomposites will be solved. Prototypes of extruded foam products of biopolyester and biocomposites will be obtained at the completion of the project, and they will provide important information for the commercialization of this technology in future.

What has been done

Results

In the study of PHBV/bamoo pulp fiber composites, the crystallization ability, tensile strength and modulus, flexural strength and modulus were increased substantially by the addition of bamboo fiber. Tensile and flexural elongations were also increased moderately at low fiber content (<20%). Adding boron nitride (BN) was found to increase the overall properties of the neat polymer and the composites due to the refined crystalline structure. Maleic anhydride grafted PHBV improved polymer/fiber adhesion and hence resulted in increased strength and modulus. However, the toughness of the composites was reduced with improved adhesion because of the hindrance to fiber pullout. In our sugar beet pulp (SBP)/PLA composites, we successfully prepared composites with high fiber content which demonstrated high levels of mechanical and physical properties. By utilizing the porous structure of the SBP and improving the interfacial adhesion, we were able to retain 89 and 83% of the high neat PLA strength at 30 and 50% SBP, respectively. The composites displayed excellent waster resistance. We also made significant progress with other natural fiber biocomposites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Develop novel lignocellulosic nanomaterials.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nanotechnology utilizes a bottom up approach to design materials which differs from traditional manufacturing techniques that work from the top down. Nanotechnology offers the potential to develop novel generations of materials provided that one can tailor and thus characterize the properties of the building blocks and their assembling. The application of nanotechnology to lignocellulosics could have enormous impact on the forest products industry. Fundamental insights on lignocellulosics will be achieved that can enable the design of novel man-made materials with unique performance. New nanomaterials with improved performance over traditional lignocellulosic composites can open new applications and markets.

What has been done

Results

A novel biosynthetic approach that combines the biosynthesis of cellulose nanofibers with a blending step in a polymer matrix has been developed. This method allows tailoring the composition and morphology of the so-produced nanocomposites. As a result one can also manipulate the physical and mechanical properties of the cellulosic nanocomposites. The nanocomposites produced are biocompatible and can be produced in various shapes. One possible application resides in blood vessel implants thus providing individuals suffering from coronary diseases with novel materials alternatives for bypass surgery etc. Additionally a bottom up approach has also been developed to produce thermosetting adhesives such as epoxy and phenolic resins with cellulose nanocrystals reinforcement. It is proposed that by incorporating cellulose nanocrystals in such thermosetting matrices, nanocomposite resins with improved performance can be produced. Such materials could be used in many applications, including the transportation and construction fields.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #16

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Biological Systems Engineering

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			5%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			5%	
133	Pollution Prevention and Mitigation			5%	
205	Plant Management Systems			10%	
402	Engineering Systems and Equipment			10%	
403	Waste Disposal, Recycling, and Reuse			15%	
404	Instrumentation and Control Systems			5%	
501	New and Improved Food Processing Technologies			15%	
502	New and Improved Food Products			5%	
503	Quality Maintenance in Storing and Marketing Food Products			5%	
511	New and Improved Non-Food Products and Processes			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	37.9	0.0
Actual	0.0	0.0	30.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	345925	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1072869	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2165365	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We plan to support a vigorous graduate research program crucial to the development of high quality research in our focal areas of interest. We will develop and evaluate innovative water/soil management practices that mitigate the effects of uncertain water resources (both precipitation and irrigation) and other factors associated with climate change and atmospheric CO2 elevation. We will develop a roadmap for bioproducts and bioenergy technology that is specific to the region,s energy needs and to the crops/biomass grown in the region. We will develop food processing technologies that provide nutritious new products, increase the safety of existing products, and help improve the overall health of the population.We will work on improving the technology of sensors in various aspects of agriculture in order to improve efficiency in production and in the use of resources.

2. Brief description of the target audience

The target audience is the scientific community in biological systems engineering, general agriculture, agribusiness, extension personnel, growers in the region, state and national agencies, and non-governmental agencies.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	80	200	30	60
2008	80	200	30	60

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

Patent Applications Submitted

Year	Target
Plan:	1
2008 :	2

Patents listed

Jiang, A., Zhang, T., Frear, C., and Chen, S. (2008) Combined nutrient recovery and biogas scrubbing system integrated in series with animal manure anaerobic digester. US Patent Application: 61/029,961.
Zhang T., Bowers, K. E., Harrison J.H., and Chen, S. (2008) Compositions and Methods for Wastewater Treatment. US Patent Application: 12/172,884.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	42	
2008	5	58	63

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer Reviewed Journal Articles

Year	Target	Actual
2008	42	58

Output #2

Output Measure

- Graduate Students supported on Agricultural Research Center and grant funds

Year	Target	Actual
2008	21	28

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Initiate laboratory bench research on processing two agricultural feedstocks to produce new products, new energy sources, etc.
2	Initiate pilot scale research on processing of two agricultural feedstocks to produce new products or energy sources
3	Processing technology of one agricultural commodity to produce new products or energy sources available for transfer
4	Process Technology Development at the laboratory bench for first three years; 4th year to the pilot scale; 5th year to the industry
5	Development of computer models or modules to existing models and Best Management Practices (BMPs)
6	Hire one faculty member ot expand research in biofuels and bioproducts engineering

Outcome #1

1. Outcome Measures

Initiate laboratory bench research on processing two agricultural feedstocks to produce new products, new energy sources, etc.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to producers in developing new uses for products and to consumers in developing new ways to produce energy sources and other useful products.

What has been done

The department and the college have made substantial progress in creating a new analytical laboratory to characterize pyrolysis oils. Researchers have studied the effect of pre-treatment conditions on biomass structure and its effects on the yields of sugar obtained by fast pyrolysis. Work continues on improving anaerobic digestors to produce useful products from animal manure in confined animal facilities.

Results

The research has shown that yields of pyrolytic sugars from wheat straw and cellulose can be increased if the biomass is pretreated at temperatures between 200 and 240 degrees C. Research also has confirmed that the yields of pyrolytic sugars can be enhanced when pyrolysis is carried out at temperatures around 400 degrees C. The sugars so produced can be further hydrolyzed, detoxified, and fermented to produce ethanol. Pilot-scale research on nutrient extraction from manure processed through anaerobic digestors has resulted in a patent application for a process that extracts phosphorus and for a process that extracts ammonia.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Initiate pilot scale research on processing of two agricultural feedstocks to produce new products or energy sources

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to growers in developing new uses for products and to consumers in developing new ways to produce energy sources.

What has been done

Feedstocks under study are bark from trees commonly harvested in forests in Washington and manure from a dairy. The work on bark has just begun with work as noted above. The work on manure has proceeded to the point of applying for patents on recovering phosphorus and ammonia nitrogen.

Results

We are beginning to understand the process of converting bark to fuel and to useful products. Technology to extract phosphorus and ammonia from manure using anaerobic digestion has proceeded to the application of patents, making it available for technology transfer to producers using anaerobic digesters in confined animal operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Processing technology of one agricultural commodity to produce new products or energy sources available for transfer

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Adding agricultural feedstocks to produce new products and energy sources will be of significant benefit to growers in developing new uses for products and to consumers in developing new ways to produce energy sources.

What has been done

Work at the pilot scale has resulted in the development of patents for technology to extract phosphorus and ammonia from anaerobic digestion of manure from dairy herds.

Results

This technology is now ready for technology transfer.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
402	Engineering Systems and Equipment

Outcome #4

1. Outcome Measures

Process Technology Development at the laboratory bench for first three years; 4th year to the pilot scale; 5th year to the industry

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The development of technologies in food engineering will improve food processing, making processed food safer, healthier, and more flavorful. These developments are especially important in maintaining the competitiveness of the food industry in the United States in the midst of international competition.

What has been done

Research continues on the application of 915 MHz microwave energy to the sterilization of food products. The goal is to have Food and Drug Administration approval of this technology. The use of radio frequency energy to kill insects in foods being exported to other countries continues in an effort to provide alternatives to chemical treatment. In all cases, researchers are first determining dielectric properties of both the food and the insects before proceeding to work on protocols to ensure killing the insects without damaging the food product. +Work is farthest advanced in mangoes treated with RF energy in a water bath. Results show the killing of insects in a water bath at 48 degrees C for 6 minutes while producing firmer fruit than the approved method of treatment in water at 46.1 degrees C for 90 minutes. The hope is to translate this research to other tropical fruits. Other research not as far advanced is on the processing of legumes using RF energy. Other research is on maintaining bioactive compounds in the food matrices during processing with a current emphasis on red raspberries. Research on selected food powders focused on sieve analysis and particle size modeling of selected food powders as a part of determining the impact of particle size on compressibility, a key factor in the characterization of the ability of powders to flow.

Results

The scientists leading the research on microwave technology applied to the FDA for approval of the use of this energy source in food sterilization in late 2008. Preliminary discussions have begun with the USDA. Studies of RF treatment of mangoes showed that it is possible to kill infesting insects and still have firm fruit without using chemicals, an important element in the export of food products from the United States. Work on other fruits and on legumes likewise is proceeding toward recommendations on the use of RF energy to control insect infestations. The preliminary work on bioactive compounds in red raspberries is starting to show the transition to various states as the berries are processed as a step toward optimizing the retention of these compounds. Work on food powders has identified the best mathematical models to use in these studies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #5

1. Outcome Measures

Development of computer models or modules to existing models and Best Management Practices (BMPs)

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The development of computer models is of substantial benefit to people making decisions in a variety of ways regarding agriculture. Producers can make better decisions about potential for developing crops or for changing practices. Models provide better information to people making decisions about the use of land and about conserving resources such as soil, water, and nutrients.

What has been done

Development of computer models continues with a farming system model including dairy operations near completion. Also under study and completed or nearly completed are tree fruit and greenhouse crops models, a simulation-based assessment of the impact of climate change on agriculture in Eastern Washington, and models that consider freezing and thawing when calculating likely runoff from fields and forests. An air quality study produced recommendations for the mitigation of ammonia emissions from concentrated animal feeding operations. A related study is examining the effects of traces of organic compounds on fish for contaminants in surface water and in sediments. This research has determined the level at which 50% of rainbow trout exposed to a particular contaminant are killed as well as beginning to determine the effects on fish of sublethal doses of organic compounds that are new pollutants of waterways.

Results

The models produced and the recommendations for best management practices have been published and made available for use by producers, by government agencies, and by other people making decisions regarding agriculture, especially agriculture and climate change. The work on pollutants of waterways will, in the long run, help to develop standards for exposure of fish to these contaminants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
111	Conservation and Efficient Use of Water
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management

Outcome #6

1. Outcome Measures
Hire one faculty member ot expand research in biofuels and bioproducts engineering

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The department needs another faculty member in this area in order to provide sufficient expertise to move forward in this general area of research.

What has been done

The department conducted a search, as reported in last year's report.

Results

A faculty member in this area of research began working for the university in August 2007 and has begun work. He has contributed to the results described above in other areas.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Changes in Market)

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.

Evaluation Results

Key Items of Evaluation

Program #17

V(A). Planned Program (Summary)

1. Name of the Planned Program

Institute of Biological Chemistry

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			18%	
202	Plant Genetic Resources			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			19%	
204	Plant Product Quality and Utility (Preharvest)			3%	
205	Plant Management Systems			4%	
206	Basic Plant Biology			34%	
211	Insects, Mites, and Other Arthropods Affecting Plants			8%	
511	New and Improved Non-Food Products and Processes			6%	
701	Nutrient Composition of Food			6%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	**Extension**		**Research**	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	63.0	0.0
Actual	0.0	0.0	62.1	0.0

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

Extension		**Research**	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	120511	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2551804	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4411366	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Institute of Biological Chemistry faculty have a most vigorous graduate research and training program. This leads to the graduation and placement of its highly trained (Ph.D./M.S.) scientists, to publications in high quality journals, to developing patents and working with industry to implement the technologies developed, as well as carrying out needed outreach activities (e.g. to focus groups, high school students, general public, etc.).

2. Brief description of the target audience

The primary target audience of the Institute of Biological Chemistry are scientists within various disciplines in plant biotechnology, particularly plant biochemistry. Their research activities attract attention within biofuels/bioenergy, biochemical, forest products, agricultural, and pharmacuetical industries.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	2
2008 :	1

Patents listed

Browse, J, Lu, C and Xin, Z. 2008 'A Plant Gene Encoding a Novel Enzyme of Lipid Metabolism and Methods of Use'. US Provisional Patent Application 61/033,742, filed March 4, 2008.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	40	
2008	0	32	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2008	40	32

Output #2

Output Measure

- Supporting graduate students on Agricultural Research Center and External Funding

Year	Target	Actual
2008	34	32

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increase numbers of students
2	Patents
3	External Funding in millions of dollars
4	Peer reviewed journal articles

Outcome #1

1. Outcome Measures

Increase numbers of students

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	34	29

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Students at the IBC earn PhDs in Molecular Plant Sciences, in Biochemistry, (School of Molecular Biosciences), Chemical Engineering, and in Chemistry of Biological Systems; these are generally multidisciplinary programs. Additional (quality) students will result in more highly trained plant researchers for both Washington State and the United States, addressing topical/priority areas, such as bioenergy/biofuel and bioproducts development, photosynthesis, nutritional improvement of protein, starch and lipid quality in seeds and plants, understanding of metabolic pathways (enabling one to re-engineer plant forms to enhance formation of metabolites with health related significance) and other potentially useful basic research. Such areas are critical to plant productivity, human health and nutrition, bioenergy/bioproducts research, as well as to allied industries.

What has been done

The Department of Chemistry at Washington State University began a new graduate program this year entitled 'Chemistry in Biological Systems.' This program recruits students with strong chemistry backgrounds, with an interest in biological systems, to Washington State University. In turn, those interested in plants are drawn into (bio)chemistry-related research programs at the IBC, and this is being used for future active recruiting of chemistry/biology-oriented students. Chemistry holds a recruitment program in March and we also recruit many of our current students through the Molecular Plant Sciences (MPS) Graduate program, and to a lesser extent in the School of Molecular Biosciences (SMB) and Chemical Engineering. MPS holds an Integrated Plant Sciences Retreat and recruitment program each February, as does SMB. Top ranked students in the nation who have applied to these programs are invited to meet with faculty at the retreat. Students with strong biochemistry backgrounds may directly enter IBC laboratories as a result (without undergoing a rotation through various faculty labs during the first year of graduate school) under a program called, Accelerated PhD. To help support and recruit these students, most of the IBC faculty are also involved in a NIH-supported Protein Biotechnology grant. Other methods of recruitment involves mailing recruitment posters to various (often including land-grant) universities in the United States. Prospective students also contact IBC researchers directly, e.g. via email.

Results

Graduate student numbers per faculty member are anticipated to increase. Currently, the IBC has nine faculty researchers, of which three are Assistant Professors (the newest joining in 2009), one is on 50% phased retirement, and another is in a full-time administrative position within the College's Agricultural Research Center. As the newer members begin to obtain additional extramural funding, the IBC expects to be able to support more graduate students thereby leveraging existing resources. Included in the 9 faculty members is one individual who no longer takes graduate students and will retire in 2011.

Within the last few years, many of the students entering the Molecular Plant Sciences program have had weak biochemistry backgrounds, and accordingly have not fared as well in IBC research programs. The new Biological Systems in Chemistry program may recruit students with better educational backgrounds and preparation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

701	Nutrient Composition of Food
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

Outcome #2

1. Outcome Measures

Patents

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The award of patents for research protects intellectual property. If licenses are obtained by other entities to use the research, this generally results in royalties and/or contracts coming to the University, the IBC and, to some extent, the researcher. Novel and useful research results are an indication that researchers are making important discoveries.

What has been done

Patents awarded in 2008 are evidence of important discoveries made in previous years. Members of the Institute have a long history of successfully filing patent applications and continue to do so.

Results

Awarded patents for 2008, besides those applied for:
Patents 2008
1) Croteau, R., Long, R.M. and Jennewein, S. 2008 P450 Oxygenases and Methods of Use. [#7,402,417]
2) Lewis, N.G., Davin, L.B., Kim, S.-J., Vassao, D.G., Patten, A.M. and Eichinger, D. Genes encoding chavicol/eugenol synthase from the creosote bush Larrea tridentata. Int'l Application No. PCT/US2007/069911; International Patent No. WO 2008/005631 A2; issued January 10, 2008.
The patent for #1, 'P456 Oxygenases and Methods of use,' covers methods of producing (among other things) the anti-cancer drug, paclitaxel (also known as Taxol). The patent for #2, 'Genes encoding chavicol...' provided among other things, novel methods for redirecting carbon allocation in plants and cell cultures to make them more useful and tractable, and to facilitate for example, the generation of biofuels.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

External Funding in millions of dollars

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	6116231

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Generally, extramural funds are necessary for financing research at the Institute of Biological Chemistry, and about 57% of all activities.

What has been done

Principal Investigators submit competitive research proposals to federal agencies such as the National Science Foundation, United States Department of Agriculture, Department of Energy and the National Institutes of Health, as well as negotiating contracts with private industries (Monsanto, Dow Chemical, Bayer, Boeing, Philip Morris, etc.).

Results

Fiscal year extramural funds July 1 2007-June 30, 2008, $6,116,231. Fiscal year extramural funds July 1, 2008-June 30, 2009 -as of 2/19/09 are $6,066,743.
Since fiscal year 2000, extramural funds have increased from $4.8 million to $6.1 million, a positive change of 27%. Tenured/tenure track faculty FTEs receiving a salary through the Institute is 6.5. One additional FTE from Agricultural Research Center also maintains a program in the Institute. Average funding per tenured/tenure track faculty in 2008 was $6,116,231/7.5 = $815,497.47.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
202	Plant Genetic Resources
206	Basic Plant Biology
204	Plant Product Quality and Utility (Preharvest)
511	New and Improved Non-Food Products and Processes
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
201	Plant Genome, Genetics, and Genetic Mechanisms
701	Nutrient Composition of Food

Outcome #4

1. Outcome Measures
Peer reviewed journal articles

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	40	32

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Peer reviewed journal articles are important because they generate research results that meet certain standards - experiments are repeatable, results are understandable, and the article has been reviewed by credible individuals in one's own field. When published in quality journals, these articles generally represent evidence of substantial progress in research.

What has been done

Tenured/tenure-track faculty work with undergraduates, graduate students, postdoctoral research associates and collaborators to write thorough and accurate reports of research and research findings. Graduate students or postdoctoral research associates may be first listed authors who have had the opportunity to learn how to translate their research into scientific publication ('products') under the mentoring of the research leader. When complete, an article is submitted to an appropriate journal, such as Phytochemistry or Plant Cell, etc., and is reviewed on its own merit. Articles may be returned to the authors with recommendations for further research before publishing, or for revisions.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
701	Nutrient Composition of Food
511	New and Improved Non-Food Products and Processes
202	Plant Genetic Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

;The cost of gasoline and diesel was at an all-time high in 2008, making research in biofuels and bioenergy appear more attractive. Some funding opportunities in 2008 were partially affected (increased) by a nationwide interest in biofuel development, resulting in several grants and contracts to IBC researchers. The IBC is in an excellent position to conduct research directed to development of potential feedstocks, such as biofuels from and other species. All indications are that this will continue to be a federal/state high priority for future (energy-related) research.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #18

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Crop Genetics and Breeding

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			66%	
202	Plant Genetic Resources			10%	
204	Plant Product Quality and Utility (Preharvest)			24%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	50.0	0.0
Actual	0.0	0.0	39.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	245025	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1251122	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2495106	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Develop, test, PVP and release new commercial cultivars of wheat and barley. Publish journal papers on the development of new breeding techniques that improve efficiency by using genetic markers. Establish patents on biologically unique organisms and processes. Publish journal papers on wheat and barley genomes, genome structure and function. Develop and adapt cultivars for specific management systems, such as direct seed, organic, perennial or animal-based systems. Publish papers and advance technology transfer of novel end use purposes for food, bioproduct and bioenergy applications for commercial adaptation.

2. Brief description of the target audience

The target audience includes other crop scientists, economists, commodity commissions, policy makers, legislators, agribusiness, food processors, and farmers.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	2300	2500	100	1000
2008	2800	68000	60	500

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	2	31	
2008	2	29	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Target	Actual
2008	31	29

Output #2

Output Measure

- Graduate students supported on Agricultural Research Center or other external funds

Year	Target	Actual
2008	21	18

Output #3

Output Measure

- Plant Patents and plant variety protections (PVPs)

Year	Target	Actual
2008	2	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Publications on improved knowledge of wheat, barley genetics, genome, new breeding tools impacting the national, international breeding, and genetic scientific community
2	Commercial cultivar releases that are adapted regionally.

Outcome #1

1. Outcome Measures

Publications on improved knowledge of wheat, barley genetics, genome, new breeding tools impacting the national, international breeding, and genetic scientific community

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	31	29

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Publications on aspects of genetics and breeding affect the international community of cereal geneticists and breeders. Expanded knowledge in these areas allows progress in understanding genes, genetic mechanisms, and breeding processes, particularly in barley and wheat.

What has been done

Reports have been made on herbicide resistance in weeds and crops; inheritance of seed dormancy and pre-harvest sprouting in barley; wheat and barley end use quality; new systems approaches in genetic analysis; genetic analyses of wheat and barley rust and Septoria resistance, wheat chromosome pairing, and wheat coleoptile length; and breeding methodologies for low input and perennial wheat production systems.

Results

New information has been gained to better understand the genes involved and inheritance patterns of wheat and barley rust and Septoria resistance; wheat and barley end use quality, coleoptile length, and chromosome pairing; herbicide resistance genes in crops and weeds; and genes for dormancy and pre-harvest sprouting in barley. In the latter case the genes have been mapped and molecular markers identified, which will aid in breeding of improved balance between dormancy and pre-harvest sprouting in barley and potentially wheat. New knowledge also will aid small grain breeding for low input and perennial production systems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
202	Plant Genetic Resources
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #2

1. Outcome Measures

Commercial cultivar releases that are adapted regionally.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

New grain cultivars carry improvements over existing cultivars, which benefit farmers, processors, exporters, and/or end users. Variety development is followed closely, especially by farmers and processors.

What has been done

Four new wheat cultivars were released in 2008 (two spring and two winter types).

Results

The new cultivars will give more options for farmers to plant in their rotations. They will also provide new export opportunities. In 2008, in Washington State, about 53% of the 2,420,000 acres sown to wheat were WSU cultivars, while about 15% of the 205,000 acres sown to barley were WSU cultivars. The proportional earnings from WSU wheat and barley cultivars harvested were estimated at $530 and $8 million, respectively. The WSU cereal variety testing program provided information to growers, which enabled them to select improved cultivars vs. average cultivars. It was estimated that this information has a value of $25 million/yr to farmers in terms of increased yield and quality returns.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
202	Plant Genetic Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Major factors in 2008 include continuing drought, which impacted field results and the total loss of several test sites. The Iraq war negatively impacted the economy; and especially the budget process delay and reduction of special grants and earmarks in the federal budget impeded progress.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

An internal/external review of the wheat breeding programs was conducted in 2007, which resulted in 2008 implementation of recommendations for improvement including better communication and innovation among the scientists. Communication was enhanced by formation and implementation of an industry-university advisory committee to address and resolve contentious issues.

Key Items of Evaluation

Program #19

V(A). Planned Program (Summary)

1. Name of the Planned Program

Program in Sustainable Crop and Soil Managment

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	39.9	0.0
Actual	0.0	0.0	68.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	511359	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3876020	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	3201990	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Develop bioproducts from crop residues Demonstrate high quality and safe food from organic and sustainable production systems Document environmental services provided by sustainable cropping systems. Improve efficiency and safety of waste recycling systems in agricultural production Identify soil biological organisms important in crop production, residue decomposition and soil building. Develop soil management programs for new crop species and cultivars of evolving cropping systems in collaboration with crop genetic and breeding teams. •

Publish journal papers on unique findings related to the above topics.

•

Establish patents on biologically unique organisms and processes.

Disseminate information on the above systems to facilitate adoption and commercialization

2. Brief description of the target audience

The target audience includes other soil scientists, economists, commodity commissions, policy makers, legislators, agribusiness, and farmers.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

Year	Direct Contacts Adults Target	Indirect Contacts Adults Target	Direct Contacts Youth Target	Indirect Contacts Youth Target
Plan	2400	2000	0	0
2008	20000	77000	350	100

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	2	47	
2008	9	39	48

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal publications

Year	Target	Actual
2008	47	39

Output #2

Output Measure

- Graduate students supported by Agricultural Research Center and other external funds

Year	Target	Actual
2008	20	38

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Publications dealing with improved knowledge of crop rotations, nutrient cycling, soil building and carbon sequestration, fertility management, soil structure and soil water movement, chemical movement in soils, tools for spatial monitoring and management.

Outcome #1

1. Outcome Measures

Publications dealing with improved knowledge of crop rotations, nutrient cycling, soil building and carbon sequestration, fertility management, soil structure and soil water movement, chemical movement in soils, tools for spatial monitoring and management.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	26	39

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Publications on these aspects of sustainable crop and soil management affect the international community of agronomists and soil scientists. Expanded knowledge in these areas allows progress in understanding basic aspects of crop production. This in turn allows progress in developing best management practices, which directly benefits farmers and their success, and indirectly the greater public, as the environment improves and food production costs are kept low.

What has been done

Reports have been made on weed control in crops; fertilization of crops; fertilization effects on grain and residue composition, decomposition, and processing; organic crop production methods; crop rotation and direct seeding / reduced tillage methods and their effects on production and economics; and improved methods of measuring soil physical, chemical, and microbial parameters.

Results

Better understanding has been gained of the ecology and control of weeds in Washington crops and environments. It was estimated that the adoption of one new herbicide alone would save farmers approximately $2 million across the state, and reduce the chemical load in the environment by approximately 120,000 lbs. The cost of soil erosion in the Palouse alone has been >$70 million/yr due to lowered crop yields, lost nutrients, and cleanup. Adoption of reduced tillage methods has reduced erosion by 25-50% with a cost savings of up to $35 million/yr. This has improved water and air quality for all as well. Improved fertilizer application methods in cereals, forages, potato, grape, onion, and turfgrass production has reduced production costs and nutrient runoff and leaching with a cost savings of >$6 million/yr in dryland areas alone. Organic agriculture production has risen dramatically in Washington partly due to increased demand and partly due to WSU's emphasis on education and production methods research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Major factors in 2008 include continuing drought, which impacted field research results; the Iraq war negatively impacted the economy, which affected production input costs, which in turn puts downward pressure on farmer adoption of new technologies, especially soil conservation measures; and especially the reduction in special grant funds as the federal budget tightened. Increased costs of inputs affecting farmers also affect researchers.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation