

2007 West Virginia University Research Annual Report

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2007 West Virginia University Research Annual Report

I. Report Overview

1. Executive Summary

Planned programs in the West Virginia Agricultural and Forestry Experiment Station include:

- Economic Development and Quality of Life in Rural Communities
- Environmental Quality and Stewardship
- Fundamental Plant and Animal Systems
- Human Health with an Adequate, Safe, and Quality Food Supply
- Production Agriculture
- Production Forestry
- Wildlife Management

Due to state needs, all reserach programs conducted within the West Virginia Agruciutural and Forestry Experiment Station are related, at least some extent, and frequently a significant extent, to the development of economic opportunities for citizens in rural areas of West Virginia.

The planned program in Economic Development and Quality of Live in rural Communities emphasizes economic activities for which rural state entrepreneurs have some degree of competitive advantage.Examples include cool water aquaculture, pasture raised and finished beef, tourism featuring outdoor activities, use of federal/state/local recreational activity opportunities, etc.An additional focus is on elements of local infrastructure which attract and sustain desirable business opportunities and which contribute to increased quality of life in rural West Virginia communities.

Research in 2007 reported alternative species and strains of cool water fish which perform well (and not well) in year-round production systems, developed a low cost, low weight alternative to concrete suitable for the construction of fish raceways, established feeding programs for pasture raised and finished beef which are successful with severe winter conditions, and established consumer preferences and willingness to pay for grass fed beef.

Surveys at state welcome centers showed unexpectedly high awareness and appreciation for "eco" or green tourism.Related studies showed area health care expenditures were directly related to physical inactivity, developed successful walking programs in a national historic part, and evaluated motivations and constraints for non-traditional, and currently, low frequency users (ethnic/ration minorities, persons with handicaps, etc.) of US National Parks.

Protection of environmental resources is critically important in a state having extensive economic activity related to eco-tourism, outdoor recreation, wildlife observation, etc.Primary focus areas in this planned reserach program include developing optimum procedures for restoration of environmentally compromised sites, developing legal requirements for environmental protection based on scientific research, minimizing environmental contamination caused by agricultural and forestry activities, and investigating contamination involving soil, water and their interface.

Results in 2007 showed little to no effect of topsoil application in the process of reclaiming surface mined sites as required by law.In contrast, there were significant differences in the survival and growth of 11 different hardwood species according to degree of soil surface compaction.Legal requirement for planting native West Virginia plants along new and renovated state highways also were evaluated.Results showed little or no effects of fertilizer treatments to 300 kg/ha of 10-20-10 but significant impacts of surface preparation were observed.

Individual projects seeking to better understand the fundamental processes of plant and animal systems are uniformly directed toward state economic development and/or improved quality of life for state citizens at some point in the future.Station scientists are determining locations and specific functions of genes controlling flower growth and senescence, cold tolerance in plants and ergot alkaloid toxin production in grasses. Other studies are determining functions of ubiquitin and understanding modes of infection for phytophthora and Chestnut blight.Significant results in the past year include:

- Modification of early uterine environment in sheep resulted in marked reductions in the thickness of left ventricular wall of the heart;
- Genes controlling cold shock domain proteins in plants were found to be highly expressed during early stages of embryo development and normally depressed under conditions conducive to floral induction;
- Ergot alkaloids are not produced in the vegetative mycelium of the opportunistic human pathogen, *Aspergillus fumigatus*, but rather exclusively on conidia, suggesting ergot alkaloids are not important to the invasive stages or human or animal infection.

Research projects in human nutrition and food quality/safety include programs to reduce state incidence of obesity, cardiovascular disease, stroke, diabetes, and osteoporosis.Other projects seek to enhance consumption of nutritionally beneficial substances (e.g., DHA), while still others seek to improve processing and preservation of foods.Most projects include both an educational component aimed at preventing problems as well as a component to develop effective treatment strategies. Specific

results from 2007 showed Body Mass Index (BMI) of preschool children was related to mother's BMI for both sons and daughters, and father's BMI for daughters but not sons. A study using rats to evaluate the impact of exercise in postmenopausal women showed loss of ovarian function coupled with lack of exercise reduced bone mineral density and strength more than loss of ovarian function alone. Finally, a continuous production system producing docosahexaenoic acid (DHA) from the marine algae, *C. cohnii*, showed increases from 3.7% to 14.0% in lipid content and from 15.7% to 36.7% in DHA content.

Research to improve production efficiency of both plants and animals is included in the planned program on "Production Agriculture" with emphasis, as indicated previously, on economic activities for which state producers have competitive advantage. Examples include cool water aquaculture, organic production of vegetables and livestock, and pasture production of beef, lamb and wool. Specific findings in the past year included development of a low-cost alternative to concrete raceways for fish production, implementation of alternative systems for fish waste removal from raceway effluent and its use as a nutrient in producing greenhouse plants, and devising methods for producing organic poultry without synthetic methionine and organic lamb with internal parasites controlled by pasture rotation based on the life cycle of parasites. Additionally, station scientists developed a new "paper pad" method for fumigating honey bee hives with 50% formic acid which costs \$1.35 per hive, takes five minutes to apply, is complete within 24 hours and has average control of varroa mites in capped brood cells of approximately 96%.

A focus rural economic development also exists among projects in our planned program on "Production Forestry", a program which includes efforts to develop new uses for hardwoods in addition to developing and testing optimum practices for timber management and harvest. Examples of the latter include the development of polynomial taper models which estimate volume, diameter, weight and merchantable cubic volume more accurately than any in existence for the Appalachian region. Additionally a #D optimal bucking system developed by Station scientists for the Appalachian region could increase value per stem 26 to 43%.

Wildlife Management research at the West Virginia Station is conducted almost exclusively with the West Virginia Division of Natural Resources, USGS, US Fish and Wildlife Service and the Wildlife Management Institute. Recent results have related largely to appropriate habitat and general environment for songbirds and fish, emphasizing alterations in habitat caused by human activities. A considerable proportion of the research includes a component of mathematical modeling and much of it incorporates GPS spatial data.

Total Actual Amount of professional FTEs/SYs for this State

Year:2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	35.4	0.0
Actual	0.0	0.0	39.8	0.0

II. Merit Review Process

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

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

Individuals (three) with expertise in the fields of science addressed in the proposal are selected by the Experiment Station Director or designee and asked to judge technical merit, likelihood of achieving stated objectives, and potential impacts for each proposed project. Competitively awarded grants requiring peer review or contract research requiring grantor approval are exempt from this process. A more complete description of the processes is given at http://caf.wvu.edu/wvafes/policies_peer.htm

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey specifically with non-traditional groups

Brief Explanation

Most stakeholder input has been collected in conjunction with West Virginia University Extension (administratively distinct from the College of Agriculture, Forestry and Consumer Sciences) since we share a large majority of stakeholders. We discontinued special meetings which had as their sole purpose, the gathering of stakeholder input and instead, have more recently relied upon input gathered at meetings with other primary purposes (annual or regular meetings of West Virginia Farm Bureau, West Virginia Forestry Association, West Virginia Grasslands Steering Committee, State Aquaculture Forum, Organic Research Project annual meeting, etc. This year we added the West Virginia Shepherd's Association and the newly formed West Virginia Farmer's Market Association.). We find the new procedure much more efficient and, when suggestions from all meetings are combined, to represent a much larger and more diverse segment of our stakeholders.

Input also originates from various advisory groups associated with specific interest areas within College Divisions (e.g., Organic Research Project Steering Committee within the Division of Plant and Soil Sciences; Appalachian Hardwood Council Advisory Board in the Division of Forestry, etc.) as well as from advisory groups established at the College/Station level (Davis College Visiting Committee; Experiment Station Advisory Board). Examples ranging from the very specific (Organic Research Project Steering Committee) to the very broad (Experiment Station Advisory Board) will serve to illustrate the process.

The Organic Research Project has a Steering Committee of organic producers chosen by the Mountain State Organic Growers and Buyers Association. The Steering Committee, with members from West Virginia, Pennsylvania and Maryland, meets twice yearly to review planned research, develop new research areas, suggest changes to improve farming systems and production practices. The Committee also helps communicate results to other growers.

A majority of suggestions from the Steering Committee are suggestions of research projects which are thought likely to contribute to producer profitability. Examples of suggestions from the Steering Committee acted upon by the project team include suggestions to conduct research trials to investigate the impact of growing disease resistant and susceptible varieties as companion plantings, to study control of insects using compost tea, to compare yields from monocultures and from companion plantings of differing species. A more recent recommendation, which has been acted upon, is to develop and distribute cost-of-production and income budgets for individual vegetables in addition to those for the entire "market garden" as had been the previous practice.

The West Virginia Agriculture and Forestry Advisory Board is appointed based on suggestions originating from Divisions in the College to represent the broad range of industries and disciplines served by the Davis College and West Virginia Experiment Station. The Board meets twice annually with an agenda focused on research issues but which usually broadens to include many academic and outreach concerns which are linked to research. A suggestion from the Advisory Board which has been adopted, strongly encouraged Davis College administration to work more effectively with their counterparts in WVU Extension to develop procedures and processes to better integrate College and Extension programs. Additional suggestions have been to focus on fewer research areas in the College/Station; to incorporate a list of questions provided by the Board to assist faculty in preparing research reports, and to anchor our Station Plan of Work on clearly defined and uniformly understood vision and mission statements from the College/Station and from each Division in the College.

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

Brief Explanation

Directors of College Divisions along with faculty suggest individuals to serve on College and Experiment Station advisory groups. Individuals on the boards or steering groups of specific industry groups are selected by their membership; we select the groups based on contribution or potential contribution to the state's rural economy.

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
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups

Brief Explanation

As indicated above, a majority is solicited at meetings of various industry groups or at meetings of appointed College and Station advisory groups. A smaller but meaningful number of suggestions comes from individual producers.

3. A statement of how the input was considered

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

Brief Explanation

Stakeholder input which relates to College/Station research portfolio is discussed regularly with College advisory groups and with College administrative groups, particularly when work or strategic plans are being prepared and when staffing decisions are pending.

Brief Explanation of what you learned from your Stakeholders

Although there are strongly competing uses for College/Station resources, with funding and personnel insufficient to meet existing demands, it is important to listen to the requests of new and smaller, but potentially growing interest groups. Most recently we have instituted procedures to routinely gather information from the representatives of state industries producing lamb, organic produce and livestock, and selling products directly to consumers through farmers market, community sponsored agriculture agreements and direct commercial contracts (primarily grocery stores and restaurants).

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	4355939	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	2143426	0
Actual Matching	0	0	4818072	0
Actual All Other	0	0	5172002	0
Total Actual Expended	0	0	12133500	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous years				
Carryover	0	0	460587	0

V. Planned Program Table of Content

S. NO.	PROGRAM NAME
1	Fundamental Plant and Animal Systems
2	Production Agriculture
3	Production Forestry - Timber Management and Wood Utilization
4	Environmental Quality and Stewardship
5	Economic Development and Quality of Life in Rural Communities
6	Human Nutrition and Health with an Adequate, Safe, and High Quality Food Supply
7	Wildlife Management

Program #1

V(A). Planned Program (Summary)

1. Name of the Planned Program

Fundamental Plant and Animal Systems

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			25%	
206	Basic Plant Biology			15%	
301	Reproductive Performance of Animals			25%	
302	Nutrient Utilization in Animals			15%	
304	Animal Genome			10%	
305	Animal Physiological Processes			10%	
Total				100%	

V(C). Planned Program (Inputs)

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

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.2	0.0
Actual	0.0	0.0	5.6	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	327517	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	682642	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	488357	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish / present results

Research involving fundamental systems in animals is to increase our understanding of reproductive, nutritional and general physiological systems and processes. Practical problems addressed include embryonic mortality in sheep and cattle, limiting amino acids in animal rations, health and disease resistance in poultry. In plants, program emphasis varies from determining functions of ubiquitin and other polypeptide tags, to understanding basic mechanisms of flower senescence and cold shock adaptation, to combating the impacts of phytophthora and Chestnut blight, to defining and eliminating negative effects on grazing animals of ergot alkaloids produced by fungi symbiotic with pasture grasses.

Perturbations of fetal growth can lead to a programmed dysfunction of the cardiovascular system resulting in hypertension, heart disease, atherosclerosis, premature stiffening of carotid arteries, etc., and result from intrauterine growth restrictions. Results of one project within this program was able, through modification of early uterine environment, to increase embryo growth and birth weight and to make a marked reduction in thickness of the left ventricular wall of the heart, which suggests dramatic alterations in cardiovascular physiology. A related study is to determine the impact of low progesterone concentrations on pregnancy rates in dairy cattle. Results have shown that hepatocytes cultured in the presence of insulin exhibited reduced progesterone catabolism resulting from lowered hepatic cytochrome P450 activity. The goal is to decrease progesterone catabolism through dietary modifications and thereby increase pregnancy rates.

Fundamental research in poultry is to establish a model of oxidative stress and determine the efficacy of elevated plasma uric acid concentrations as a protectant against oxidative stress. One of the products of oxidative stress in animal tissue is the glycation endproduct, pentosidine. Recent studies have shown a linear correlation between the age of individual birds and the accumulation of pentosidine in skin samples of deceased birds and, in a later study, no significant differences between skin and breast tissue concentrations of pentosidine in living birds.

Basic genetic work in plants is to determine structure and conservation of cold shock domain protein, conduct functional analyses of ubiquitin-specific proteases, to better understand and control flower senescence, and to eliminate ergot alkaloids toxic to grazing animals from symbiotic pasture grass/fungi associations or to humans for fungi like *Aspergillus fumigatus*. Results in the preceding year found (1) all cold shock genes examined to be highly expressed during early stages of embryo development and declining thereafter and normally depressed under conditions typically conducive to floral induction; (2) ubiquitin specific protease (UBP; involved in dismantling polyubiquitin chains and detaching ubiquitin from target proteins), subfamily 3/4 (UBP3/4) which are seemingly important for second mitotic cell division in the male gametophyte, exhibit some ubp3/ubp4 pollen which appears to undergo pollen mitosis II and to germinate; (3) ergot alkaloids are not produced in the vegetative mycelium of the opportunistic human pathogen, *Aspergillus fumigatus*, but rather exclusively on conidia (meaning ergot alkaloids are not likely important to the invasive stage of human or animal infection); and (4) chlorophyll accumulation and number of chloroplasts in carnation flowers decreased throughout development and senescence in epidermal cells in the lower part of petals suggesting a role in flower senescence.

2. Brief description of the target audience

Primarily researchers; professional practitioners, regulators, some producers

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
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Research presentations

Year	Target	Actual
2007	6	3

Output #2

Output Measure

- Refereed scientific manuscripts

Year	Target	Actual
2007	4	11

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Reduced embryonic mortality in cattle and sheep %
2	Increased efficiency of amino acid utilization in ruminants %
3	Identify genes coding for cold shock proteins in plants
4	Identify and map genes affecting flower senescence
5	Decrease mortality in poultry production %
6	Develop ergot alkaloid deficient grasses with wild-type vigor
7	Successfully develop and employ hypovirus as a biological control agent for Chestnut blight

Outcome #1**1. Outcome Measures**

Reduced embryonic mortality in cattle and sheep %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
301	Reproductive Performance of Animals

Outcome #2**1. Outcome Measures**

Increased efficiency of amino acid utilization in ruminants %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
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Outcome #3**1. Outcome Measures**

Identify genes coding for cold shock proteins in plants

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
206	Basic Plant Biology
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #4**1. Outcome Measures**

Identify and map genes affecting flower senescence

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #5**1. Outcome Measures**

Decrease mortality in poultry production %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
305	Animal Physiological Processes

Outcome #6**1. Outcome Measures**

Develop ergot alkaloid deficient grasses with wild-type vigor

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #7**1. Outcome Measures**

Successfully develop and employ hypovirus as a biological control agent for Chestnut blight

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
206	Basic Plant Biology
201	Plant Genome, Genetics, and Genetic Mechanisms

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Competing Programmatic Challenges
- Other (Failure to measure relevant statistics)

Brief Explanation

Several outcome measures are not routinely measured and will be revised.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

- Before-After (before and after program)

Evaluation Results

None beyond measurement of outcomes.

Key Items of Evaluation

The relationship of fetal growth and subsequent cardiovascular disease is potentially quite significant due to human health implications.

Program #2**V(A). Planned Program (Summary)****1. Name of the Planned Program**

Production Agriculture

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			5%	
205	Plant Management Systems			15%	
211	Insects, Mites, and Other Arthropods Affecting Plants			15%	
212	Pathogens and Nematodes Affecting Plants			10%	
301	Reproductive Performance of Animals			20%	
302	Nutrient Utilization in Animals			10%	
303	Genetic Improvement of Animals			5%	
304				5%	
307	Animal Management Systems			15%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.0	0.0
Actual	0.0	0.0	9.0	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	520610	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1795817	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1815722	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Conduct research; report results in scientific manuscripts and technical presentations; provide technology to users in popular publications and lay presentations

Both plant and animal agricultural production units in West Virginia are poorly positioned to compete in commodity markets for fruits, vegetables, field crops and livestock products due to a variety of circumstances including small acreages and generally limited land resources, difficult terrain, relatively high prices for land suitable for row crops, limited availability and high cost of labor, etc. To remain viable, West Virginia producers typically must improve production efficiency either by increasing the value of what they produce, or by producing at a meaningfully lower price, or both. Specific strategies, reflected in the West Virginia Station's research portfolio, include avoiding enterprises which require extensive amounts of mechanical tillage or harvest; reducing costs of major inputs such as feed, labor and facilities; focusing on higher priced products such as those with ornamental or recreational use; increasing real or perceived product value in specialty, niche or out-of-season markets; diversifying product offerings; taking advantage of proximity to large urban markets, etc. Said another way, our research activities focus on economic activities for which West Virginia producers have competitive advantage or at least are not competitively disadvantaged. Specific examples include cool water aquaculture, pasture raised and finished beef, out of season lamb production with predator control and internet marketing, organic production of vegetables and livestock, etc.

Aquaculture research in 2007 showed a heat tolerant strain of Rainbow Trout as well as striped bass, to perform well in a year-around operation while hybrid bluegill has high mortality rates and largemouth bass grew poorly. A low-cost alternative to concrete construction for continuous-flow, raceway rearing systems was developed and a raceway economic and management simulation system for raceway production was tested and improved. Testing of alternative systems of utilizing waste, removed from fish raceway effluent, as nutrients for greenhouse plants were completed and technology developed for the recovery of significant proportions of fish lipid and protein currently discarded during processing.

Results of Station work to develop management systems for raising beef, birth to market, using pasture only has shown several systems able to achieve a target 0.45 kg/hd/day gain under mild winter conditions but only one system (stockpiled forage + orchard grass haylage) that could do so under more severe winter conditions. Shopper surveys showed grass fed beef to be preferred by large majorities of consumers when served as both steak (74%) and ground beef (82%) if consumers are provided with nutritional information along with cooked samples for taste testing. Data suggested that grass-fed specialty meat products would have notable consumer acceptance at \$4.00 to \$11.00/kg above conventional beef prices. Supporting research is correlating pasture productivity with soil physical characteristics such as penetration resistance, texture, bulk density, etc.

Compost in the form of 10 tons/acre composted dairy manure compared with green manure from cover crops in the completely organic production of vegetables and livestock (sheep) and poultry showed higher soil organic matter, greater yields of potato, pumpkin, spinach and tomato, significantly lower incidence of spinach root rot, more lamb gain per acre, as well as higher soil levels of phosphorus, potassium, calcium and magnesium. Transplanting of pea and spinach avoids most root rot while planting seeds in compost layered in furrows produced best emergence and highest yields of the cultural practices examined. Organic poultry (broiler) production was successful without synthetic methionine and lamb infection with internal parasites was minimized through pasture rotations based on the parasite's life cycle. Additionally, lambs from ewes that received protein supplements prior to lambing were less likely to require anthelmintics, but lambs in flocks that were creep grazed were slightly more likely to require anthelmintics.

Station scientists have developed a new "paper pad" technique for fumigating honey bee hives with 50% formic acid. The treatment costs about \$1.35 per hive, takes five minutes to apply, is complete in 24 hours or less, requires only one trip to the hives (all residuals are removed by bees), and exhibits average control of varroa mites in capped brood cells exceeding 96%.

A coordinated sheep breeding and management project has developed, refined, and assisted breeders with out-of-season breeding (for higher market price), ram soundness evaluation, pregnancy diagnosis (using ultrasound), predator control, parasite management, financial management, marketing, and pasture management. Pregnancy diagnoses suggest 2/3rd to 80% of sheep are bred out-of-season. "Breeding age" and "all" sheep in West Virginia increased 1000 and 2000 head, respectively, while nationally the latter decreased by more than 100,000 head.

Neither embryonic nor fetal loss nor differences in pregnancy or prolificacy was associated with age of oldest follicle in sheep, in contrast to results in cattle. Microarray analysis of the CL in non-lactating beef cows revealed 134 up-regulated and 39 down-regulated genes and also determined up- and down-regulated genes for subcategories of genes involved in metabolism, transcription regulation and RNA processing, protein biosynthesis and modification, conferring antioxidant properties, encoding extracellular matrix and cytoskeletal protein, signal transduction, protein degradation, and DNA replication and modulation.

Understanding and control flowering and flower senescence would be of great benefit for producers of all crops (extending time for pollination) and ornamental flowers. Current research is examining the role of CEBP (nuclear encoded chloroplast protein expressed at a decreasing rate throughout flowering) as a possible flower senescence regulator. Recent results showed

chlorophyll accumulation and number of chloroplasts decrease throughout flower development and senescence in epidermal cells in the lower part of flower petals (carnation) in a pattern reminiscent of CEBP accumulation and localization.

Environmentally friendly methods of controlling brown stink bugs in peach and apple orchards using pheromone baited traps, with and without the presence of mullein host plants, demonstrated that stink bugs will aggregate in a small areal surrounding a baited trap but few will subsequently move from host plants to the trap in response to the pheromone. It was also shown that reducing the size of traps to the point of saving 43% of trap cost, did not significantly lower capture numbers. Similarly no difference in capture rate was found between branch mounted and suspended traps providing flexibility in trap deployment without reducing their effectiveness.

2. Brief description of the target audience

Producers, extension specialists, consultants, regulators, policy makers, researchers, rural 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	0	0	0
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	1

Patents listed

Light weight alternative to concrete constructed fish raceway.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	4	0

V(F). State Defined Outputs

Output Target

Output #1**Output Measure**

- Research manuscripts

Year	Target	Actual
2007	4	10

Output #2**Output Measure**

- Scientific presentations

Year	Target	Actual
2007	8	8

Output #3**Output Measure**

- Popular articles

Year	Target	Actual
2007	0	4

Output #4**Output Measure**

- Producer presentations, workshops, etc.

Year	Target	Actual
2007	0	0

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Growth in state production of beef and lamb %
2	Increase in production/consumption of pasture finished beef %
3	Increase in state aquaculture industry %
4	Increase state production and sales of organically produced vegetables %
5	Growth in state's ornamental horticulture industry %
6	Develop and market organic control for honey bee mites - adoption %

Outcome #1**1. Outcome Measures**

Growth in state production of beef and lamb %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	23

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)****What has been done****Results****4. Associated Knowledge Areas**

KA Code	Knowledge Area
307	Animal Management Systems
303	Genetic Improvement of Animals
301	Reproductive Performance of Animals

Outcome #2**1. Outcome Measures**

Increase in production/consumption of pasture finished beef %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
205	Plant Management Systems
303	Genetic Improvement of Animals
307	Animal Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals

Outcome #3**1. Outcome Measures**

Increase in state aquaculture industry %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	140

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
302	Nutrient Utilization in Animals

Outcome #4**1. Outcome Measures**

Increase state production and sales of organically produced vegetables %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
205	Plant Management Systems

Outcome #5

1. Outcome Measures

Growth in state's ornamental horticulture industry %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

Not measureable

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources

Outcome #6

1. Outcome Measures

Develop and market organic control for honey bee mites - adoption %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	10	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
307	Animal Management Systems
212	Pathogens and Nematodes Affecting Plants

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Economy
- Competing Programmatic Challenges
- Other (Changes/inconsistencies in measures of impacts.)

Brief Explanation

Two outcome measures were not measurable while two others need to be collected for additional years in order to arrive at definitions consistent across time and to demonstrate reliably accurate trends; adjustments will be made as necessary.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

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

Evaluation Results

None beyond measures of outcomes

Key Items of Evaluation

Environmentally friendly and healthy pasture finished beef was shown to have notable consumer acceptance with educated consumers willing to pay from \$4.00 – 11.00/kg above conventional beef prices.

Station scientists have developed a new technique for fumigating honey bee hives with 50% formic acid – a treatment which costs about \$135 per hive, takes five minutes to apply, is complete within 24 hours or less, requires only one trip to the hives, with average control of varroa mites in capped brood cells exceeding 96%.

Program #3

V(A). Planned Program (Summary)

1. Name of the Planned Program

Production Forestry - Timber Management and Wood Utilization

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			100%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.6	0.0
Actual	0.0	0.0	7.4	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	128686	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	536089	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1086102	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research, report results, assist with technology transfer

This program includes research to develop optimum procedures for hardwood timber management and harvest, to increase the efficiency of wood utilization while developing new uses for hardwoods, and to devise means and processes to efficiently utilize wood and timber resources in the production of renewable bio-energy and bio-products. Timber management research includes specifically the development of models to predict yields, protection of forest resources from insect pests, disease, and invasive species; harvest management for optimum regeneration and re-growth; use of harvest and processing wastes to efficiently produce bio-energy; responding to research needs and concerns of corporate and private owners; and providing economic comparisons among alternative management and harvest methods.

Wood utilization research likewise is focused on hardwoods with a goal of maximizing hardwood timber to lumber throughput, reducing the impact of brown rot fungi; development of non-destructive methods to determine lumber strength and stiffness, expanding uses for Appalachian hardwoods; and devising sawmill systems for moderate sized to small operations. Additional research will develop systems for use at harvest to optimize bucking; develop new uses for low quality hardwoods, use ground penetrating radar to develop non-destructive scanning methods to identify subsurface defects in hardwood logs and incorporate cellulose nanocrystals into biopolymer composites to determine the effect on mechanical properties.

Recent survey results indicate that place of residence and aesthetic enjoyment were the two most important reasons for private forest land ownership. Most private landowners are not actively managing their forest lands; 12% have a written management plan with only 13% conducting any sort of management activity during the year preceding the survey. Approximately 4% of respondents indicated attendance at educational workshop within the last year.

Alternative taper models predicting yield for yellow poplar, red maple and red pine were developed. This project has allowed the development of accurate volume, diameter and weight estimating functions for hardwoods grown in the Appalachian region. These polynomial taper systems have been found to be the most accurate in existence for the region, providing merchantable cubic volume and weight estimates to any merchantability limit.

Results from a project to develop optimal sawing systems for small scale sawmills has shown sawmills are consistently over-edging and thus losing clear wood and money in the process.

Seven species of Phytophthora (*P. ramorum* is the causative agent for sudden oak death) were isolated in a multistate survey for soil borne Phytophthoras, two of which may be novel species. Pathogenicity tests indicated the species tested were more damaging to roots than stems with seedling mortality occurring mostly in the first four months. *P. cinnamomi* and *P. citricola* were most aggressive in stem inoculation trials while all species were similarly aggressive to the fine and taproots in soil infestations tests.

The hardwood utilization project in West Virginia has initiated seven research projects over the last four years. The effort has resulted in a 3D optimal bucking system for Appalachian hardwood species which could increase value per tree stem 26 to 43%; a procedure under development to utilize low-value oak species to expand or develop new plants to produce OSB; described differences in morphologies and dimensions of cellulose nanocrystals from avicel and recycled pulp; shown cellulose nanocrystals to vary with nature of the raw material; and demonstrated the ability of GPR to detect subsurface defects such as metals, knots and decays.

2. Brief description of the target audience

Private and corporate commercial producers, managers, consultants, extension educators, regulators, policy makers

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
2007	0	0	0	0

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

Patent Applications Submitted

Year Target
Plan: 0

2007 : 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Refereed, scientific manuscripts

Year	Target	Actual
2007	4	7

Output #2

Output Measure

- Scientific presentations

Year	Target	Actual
2007	5	2

Output #3

Output Measure

- Producer workshops & technical assistance

Year	Target	Actual
2007	3	1

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Adoption of BMP management and harvesting procedures %
2	Ability to more accurately predict yields of OSB, Paralam and additional wood species from measures on standing timber - new models
3	Development and adoption of field based, computer assisted systems to aid optimal bucking - use %
4	Process for commercial production of a high quality, oak OSB panels
5	Increased use of timber harvest residue. - %

Outcome #1**1. Outcome Measures**

Adoption of BMP management and harvesting procedures %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	5	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
123	Management and Sustainability of Forest Resources

Outcome #2**1. Outcome Measures**

Ability to more accurately predict yields of OSB, Paralam and additional wood species from measures on standing timber - new models

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
123	Management and Sustainability of Forest Resources

Outcome #3**1. Outcome Measures**

Development and adoption of field based, computer assisted systems to aid optimal bucking - use %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
123	Management and Sustainability of Forest Resources

Outcome #4**1. Outcome Measures**

Process for commercial production of a high quality, oak OSB panels

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
123	Management and Sustainability of Forest Resources

Outcome #5**1. Outcome Measures**

Increased use of timber harvest residue. - %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Economy
- Appropriations changes

Brief Explanation

None of the outcome measures is being, or will be, measured on a consistent and routine basis. The new OSB process from oak will be a patent when it occurs and others are replaced by an index of forest and wood product industries, specifically, year-to-year changes in total employee compensation in each industry. If necessary, we will develop our own measures.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

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

Evaluation Results

None beyond what is measured by outcomes.

Key Items of Evaluation

Program #4

V(A). Planned Program (Summary)

1. Name of the Planned Program

Environmental Quality and Stewardship

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			20%	
102	Soil, Plant, Water, Nutrient Relationships			15%	
133	Pollution Prevention and Mitigation			30%	
403	Waste Disposal, Recycling, and Reuse			20%	
605	Natural Resource and Environmental Economics			15%	
Total				100%	

V(C). Planned Program (Inputs)

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

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.7	0.0
Actual	0.0	0.0	5.8	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	419266	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	578469	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	502942	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish/present results

Research to support preservation of West Virginia's soil, water, forest and wildlife resources is a high priority in the West Virginia Station. The focus of our research is on protecting soil and water quality while developing economically effective and environmentally sustainable management practices for agriculture, forestry and other points of interaction of man and environment. Contamination of soil and eventually ground water with acid mine drainage from abandoned mines, and from more recent surface mining, is a growing state concern. Research is being conducted to characterize the nature and scope of these problems and to develop effective and cost effective remediation programs.

The development of environmentally sustainable practices for managing farms and forests is an important component of overall Station goals to position state producers to compete more effectively in organic or "green" markets and to preserve West Virginia lands, forests, wildlife, soil and water resources for future generations.

Developing optimum methods for the restoration of environmentally compromised areas of soil and water is a primary emphasis of Station research. Focus areas include restoration of surface mine sites, areas adjacent to newly constructed and older state highways, impacted state streams and waterways, and areas compromised by agricultural and forest industry waste and activity.

Research in 2007 evaluated legal requirements for reclaiming surfaced mined areas by comparing alternative topsoil applications (legally required) and various degrees of surface compaction on the growth of 11 hardwood species. Results showed little to no impact from alternative topsoil applications but significant differences in survival and growth with differences in extent of surface compaction (with non-compacted areas being superior). A companion project is evaluating the effectiveness of current mitigation practices and natural ecological succession in recovering lost aquatic ecosystem functions on reclaimed mine sites. Similar legal requirements for native plant establishment along newly constructed and older reclaimed highway sites were evaluated by comparing alternative methods of planting native species. Results showed little to no effects of fertilizer treatments to 300 kg/ha of 10-20-10 but significant impacts from surface preparation were observed. In newly seeded areas, seeding native species with non-native yielded only about 25% coverage for native grasses after two years. In reclaimed areas, it was necessary to disturb (till) existing non-native plants in order to achieve meaningful native populations within two years. In a separate study, data are being collected on populations of amphibians, birds and invertebrates, as well as information on vegetation, water quality and soils in mitigated and natural wetlands, in order to determine the success of restored and created wetlands.

Poultry litter is a primary agricultural waste in West Virginia and several studies are aimed at minimizing its impact on water quality. One study is comparing costs and benefits for alternative methods of utilizing excess manure in the Chesapeake Bay drainage area. Mathematical programming is being used to compare land application (farm or forest) with composting, pelletization and use for the generation of electricity. A second study is a feasibility and cost effectiveness analysis of a waste to energy system utilizing poultry litter as a fuel and a fixed-bed gasifier as a medium to convert litter to energy. Finally, an economic analysis of off-farm transport of poultry litter from areas of excess to areas of nutrient deficiency is being conducted to determine both economic and environmental consequences of the program. Supporting studies are analyzing rep-PCR fingerprints of 600 E. coli isolates from animal wastes to test the hypothesis of differences in fingerprint patterns related to source. Results support the presence of multiple E. coli strains among the various animals and suggest that distinct strains are obtained based on production practices employed.

Virtually all Station soil and water quality research is based on results from on-going soil survey work. One focus area in on-going work is the use of digital soil mapping techniques to represent soil-forming factors for the purpose of quantitatively modeling the distribution of soil properties. Results to date have shown that the distribution of surface and subsurface rock fragments can be successfully modeled while other physical and morphological properties (e.g., soil particle size, carbon content, depth to depletion, extractable Al and Fe) were much more difficult to predict accurately. A second study is examining water table fluctuations at sites where soil morphology and observed or inferred hydrology do not agree. A specific application has been to study the preferential flow of phosphorus through undisturbed soil profiles of three state benchmark soils. Soil dye staining showed preferential flow across all test sites with variation influenced by skeletal soils and the presence of argillic horizons, fragipans and lithologic discontinuities, with increased staining above each of these interfaces.

2. Brief description of the target audience

Commercial producers and foresters, managers, consultants, policy makers, governmental regulators.

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
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Refereed, scientific manuscripts

Year	Target	Actual
2007	4	8

Output #2

Output Measure

- Science-based articles for lay audiences

Year	Target	Actual
2007	4	0

Output #3

Output Measure

- Presentations of research results

Year	Target	Actual
2007	5	5

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Map Phosporus Adsorption Capacity for West Virginia soils - %
2	Knowledge of soil properties (pH, bulk density, electrical conductivity, etc.) required to grow native species on disturbed land - # new species
3	Increased use of poultry litter in turf grass culture- %

Outcome #1**1. Outcome Measures**

Map Phosphorus Adsorption Capacity for West Virginia soils - %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	10	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Amount unknown; statistic is not measured

What has been done**Results****4. Associated Knowledge Areas**

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships

Outcome #2**1. Outcome Measures**

Knowledge of soil properties (pH, bulk density, electrical conductivity, etc.) required to grow native species on disturbed land - # new species

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Unknown; not routinely measured

What has been done**Results**

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
102	Soil, Plant, Water, Nutrient Relationships
101	Appraisal of Soil Resources

Outcome #3**1. Outcome Measures**

Increased use of poultry litter in turf grass culture- %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	10	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Unknown unmeasured.

What has been done**Results****4. Associated Knowledge Areas**

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Other (Limited state collection of data related to environmental conditions)

Brief Explanation

None of the state defined outcome measures for this program are, or will be routinely measured in the future. These outcomes have been replaced in the Plan of Work with "Percent of state streams classified as 'impaired'" and "Percent of impaired streams impaired due to agricultural or forest production practices". We believe these reflect long-term success or failure of the program and plans exist for their measurement.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

- Before-After (before and after program)

Evaluation Results

None beyond those needed to measure outcomes

Key Items of Evaluation

Differences in rep-PCR fingerprint results for strains of *E. coli* suggest bacterial tracking may be considerably more specific than previously thought.

Variation in P flow rates through alternative soil types, structures, etc. can have significant meaning for interpretation of soil vs. water content of P at given times.

Program #5**V(A). Planned Program (Summary)****1. Name of the Planned Program**

Economic Development and Quality of Life in Rural Communities

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
131	Alternative Uses of Land			15%	
605	Natural Resource and Environmental Economics			20%	
608	Community Resource Planning and Development			35%	
806	Youth Development			30%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.6	0.0
Actual	0.0	0.0	6.8	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	376607	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	694104	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	638025	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Conduct research; publish results in scientific journals and popular press. Make presentations at scientific, professional and end-user meetings and workshops.

Stagnant or declining per capita income, population outflow and unemployment are chronic problems for many rural West Virginia communities. Research to develop technologies and management systems which promote rural economic development consequently represents a high priority in the West Virginia Station. Additionally, research which supports improvements in factors independent of income which either encourage economic development or affect quality of life in rural communities may be equally important in stemming outflows of human capital. The focus of program research is on economic activities for which state producers have competitive advantage.

Natural advantages available to most West Virginia entrepreneurs include an abundance of low cost pasture for low-cost production of grazing animals, numerous sources of constant temperature, cool waters for breeding and growing cool water fish for consumption and recreation, natural forest landscapes with abundant wildlife to support tourism and outdoor recreation, proximity to large urban markets with growing demand for locally grown and/or organically produced foods and native plants, and a rich history and culture to support tourism with rural, historical, and cultural themes.

Aquaculture research in 2007 showed a heat tolerant strain of Rainbow Trout as well as striped bass, to perform well in a year-around operation while hybrid bluegill has high mortality rates and largemouth bass grew poorly. A low-cost alternative to concrete construction for continuous-flow, raceway rearing systems was developed and a raceway economic and management simulation system for raceway production was tested and improved. Testing of alternative systems of utilizing waste removed from fish raceway effluent as nutrients for greenhouse plants were completed and technology developed for the recovery of significant proportions of fish lipid and protein currently discarded during processing.

Results of Station work to develop management systems for raising beef, birth to market, using pasture only has shown several systems able to achieve a target 0.45 kg/hd/day gain under mild winter conditions but only one system (stockpiled forage + orchard grass haylage) that could do so under more severe winter conditions. Shopper surveys showed grass fed beef as preferred by strong majorities when served as both steak (74%) and ground beef (82%) if consumers are provided with nutritional information along with cooked samples for taste testing. Data suggested that grass-fed specialty meat products would have notable consumer acceptance at \$4.00 to \$11.00/kg above conventional beef prices.

Surveys at four state welcome centers have led to the development of procedures for mapping and marketing areas for increased ecotourism. More than one-third of those surveyed self-identified as an "eco-tourist" which is significant for West Virginia given that the state has begun initiation of a Travel Green Certificate program. A recently completed study showed area health care expenditures to be positively related to rates of physical inactivity while outdoor recreational opportunities were inversely related to rates of physical inactivity. Cooperative work is underway to increase the use of C&O Canal National Historic Park for health benefits, determine impacts of motorized vehicles in National Parks, and to evaluate motivations, constraints, negotiation strategies and experiences from non-traditional users (ethnic/racial minorities, persons with handicaps, etc.) of US National Parks.

Recent years have seen growing interest in producing plants native to West Virginia and to the Appalachian region. For some species like the American Chestnut, efforts are underway to treat for, and breed resistance to, chestnut blight. In 2007, hypovirus, used as biological control agents against chestnut blight, were detected in the blight canker thallus at a rate increased relative to previous years. Transgenic hypovirus strains also were detected in plots where they had not been introduced. Additionally, tissue culture methods have been developed for the efficient propagation of four native plants as well as a protocol for synthetic seed production in goldenseal.

Many counties in rural Appalachia are in dire need of economic growth and development. A recent study of 418 Appalachian counties showed that employment growth in a county is positively affected by growth in surrounding counties, that mean household income growth in a county is negatively affected by growth rate of both employment and mean household income in surrounding counties, and that counties with higher population concentration experience significant business growth. These results suggest counties may enhance economic growth by pooling resources and jointly touting their positive climate for business. A related study is measuring the role of natural and recreational amenities in rural economic growth while another has shown urban forests and street trees to generate significant amenity benefits relative to planting and maintenance costs with a benefit to cost ratio of 2.25:1.

Food assistance programs such as the Food Stamp Program assist many rural Appalachian families meet their basic needs. A study underway is to determine factors which influence variation in program participation and, hence, help in understanding declines in program participation.

2. Brief description of the target audience

Community managers, planners, policy makers, consultants, local development committees or groups

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
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Refereed research manuscripts

Year	Target	Actual
2007	3	6

Output #2

Output Measure

- Presentations to colleagues and end-users

Year	Target	Actual
2007	6	16

Output #3

Output Measure

- Team consultations with community action groups

Year	Target	Actual
2007	2	3

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Expansion of economic activity in targeted state industries: pasture raised beef and sheep, aquaculture, organic vegetables, tourism and outdoor recreational activities; ornamental horticulture, etc. - % growth
2	Customized designs for enhanced economic development adopted and implemented by state rural communities

Outcome #1**1. Outcome Measures**

Expansion of economic activity in targeted state industries: pasture raised beef and sheep, aquaculture, organic vegetables, tourism and outdoor recreational activities; ornamental horticulture, etc. - % growth

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	5	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
608	Community Resource Planning and Development
806	Youth Development
605	Natural Resource and Environmental Economics

Outcome #2**1. Outcome Measures**

Customized designs for enhanced economic development adopted and implemented by state rural communities

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results**4. Associated Knowledge Areas**

KA Code	Knowledge Area
131	Alternative Uses of Land
608	Community Resource Planning and Development
605	Natural Resource and Environmental Economics
806	Youth Development

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Economy

Brief Explanation

Completion and adoption of community economic development plans was a successful outcome. Growth in key, measured state industries was positive but considerably less than hoped for, possibly due to the impact of rising fuel and other costs on the general economy.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

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

Evaluation Results

None completed beyond monitoring key economic statistics compiled by others.

Key Items of Evaluation

Our Community Design Team has experienced notable successes in contributing to economic development and quality of life in small, rural communities in the state. Long overdue work on adapting programs in our National Park system to appeal to minority and disabled citizens is underway.

Program #6**V(A). Planned Program (Summary)****1. Name of the Planned Program**

Human Nutrition and Health with an Adequate, Safe, and High Quality Food Supply

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components			20%	
703	Nutrition Education and Behavior			40%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			40%	
Total				100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.3	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	334433	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	469144	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	194699	0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Conduct research; publish results in scientific, peer reviewed research journals and popular press; make presentations to colleagues at professional meetings and to end-user meetings and workshops

West Virginia is among the most overweight states in the nation and above national averages for incidence of diabetes, high blood pressure, and cardiovascular disease, as well as for osteopenia and osteoporosis. Station research in the human nutrition aspect of this program is focused on determining the current and potential impacts of diet, nutritional education and dietary intervention on obesity and obesity related conditions (diabetes, elevated cholesterol and plasma lipids, heart attack, stroke and some cancers). The program also is testing the efficacy and safety of alternatives to estrogen replacement therapy for controlling osteoporosis in post-menopausal women and is developing omega-3 DHA enhanced diets and educational programs to support their adoption.

A second aspect to this program includes research to enhance the safety and quality of the food supply for our state and nation. Emphasis is on processing and cryopreservation with electron beam treatment of fish, muscle foods and fresh vegetables which are difficult or impossible to heat sanitize. Also under development are industrial scope methods to efficiently use fish processing wastes in the production of protein and lipid by products.

Preschool aged children from two rural West Virginia counties were recruited from Head Start programs and categorized as exhibiting "healthy weight", "at risk for overweight" or "overweight" based on BMI percentages from CDC growth charts. Results showed boys more likely to be overweight but girls more likely at risk for overweight. Familial factors associated with child's BMI included mother's BMI for both sons and daughters and fathers BMI for daughters, but not son's, BMI. Results were shared with Head Start administrators and teachers in West Virginia, Pennsylvania and Maryland (300 people) and with pediatricians, medical students, and nurses at the WVU School of Medicine and simultaneously broadcast to pediatricians in remote areas of the state.

Studies evaluating the impact of exercise on osteoporosis in post-menopausal women have used ovariectomized and control rats with restricted and unrestricted exercise opportunities. Results showed loss of ovarian function coupled with non-exercise reduced bone mineral density and strength – mainly in the femur – compared to loss of ovarian function alone. However, return to exercise did not improve bone mass or strength, possibly due to the short duration (2 weeks) of return to exercise. Additionally, the greater weight associated with loss of ovarian function did not have a protective effect on bone density.

A continuous growth, feeding and harvesting system was designed for the production of docosahexaenoic acid (DHA) by the marine algae, *C. cohnii*. The algae grew well over a 137 hour trial process with 25% glucose as an energy source. In the final 113 hours, lipid content of the biomass increased from 3.74% to 13.98% with DHA content of the lipid increasing from 15.70% to 36.65%.

A comparison of muscle color and fat content was made between steers finished on pasture and with corn silage. Muscles from pasture finished steers contained greater moisture and less crude fat and were lighter in color, but with more red. Proportions of oleic, arachidic, linolenic, arachidonic, and eicosapentaenoic acids did not differ by diet.

A one week feed withdrawal from rainbow trout increased fillet yield, cooked yield, Kramer shear force, and decreased psychrotrophic bacterial counts.

Electron beam D-values (dose to kill 90% of a target microorganism) were determined for *E. coli* in most representative meat products (dose range 0.22 – 0.64 kGy). D-values for *Salmonella* in tomatoes ranged from 1.06 – 1.50 kGy depending on pH. It also was shown that *E. coli* has a capability to develop a significantly increased resistance to e-beam if repeatedly exposed to sub-lethal doses.

2. Brief description of the target audience

Families, dieticians, consultants, policy makers, researchers, 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	0	0	0
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	1

Patents listed

Patent application - methodology for recovery of protein and lipids from fish processing wastes.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Refereed journal articles

Year	Target	Actual
2007	0	13

Output #2

Output Measure

- Presentations at scientific meetings

Year	Target	Actual
2007	2	3

Output #3

Output Measure

- Workshops and meetings to end-users

Year	Target	Actual
2007	0	0

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Reduction in state incidence of obesity -%
2	Reduction in state incidence of osteoporosis and similar disorders - %
3	General understanding of value of electron beam technology for food safety

Outcome #1**1. Outcome Measures**

Reduction in state incidence of obesity -%

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
703	Nutrition Education and Behavior

Outcome #2**1. Outcome Measures**

Reduction in state incidence of osteoperosis and similar disorders - %

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)****What has been done****Results**

No change

4. Associated Knowledge Areas

KA Code	Knowledge Area
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703	Nutrition Education and Behavior
702	Requirements and Function of Nutrients and Other Food Components

Outcome #3**1. Outcome Measures**

General understanding of value of electron beam technology for food safety

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Consumers with concerns involving food safety especially for foods not amenable to heat treatment such as fresh fruits and vegetables.

What has been done

Electron beam treatment has been tested and found effective in reducing bacterial populations in foods ranging from red meats to leafy vegetables.

Results

Has performed well in attempts to control bacterial populations on foods not amenable to heat treatment.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)**External factors which affected outcomes**

- Economy
- Other (Lack of routine data measurement by state agencies.)

Brief Explanation

Routine measurement of obesity and overweight status is relatively new with exact procedures apparently in the process of being standardized. Annual changes at this point are quite large with 2005-06 changes of +24% and -7% for individuals classed as "obese" and "overweight", respectively. We anticipate this will be a more meaningful measure in the future.

V(I). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

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

Evaluation Results

None beyond evaluation of outcomes.

Key Items of Evaluation

An electronic-beam device for in-home use in controlling bacterial growth on ground meats, leafy vegetables, etc. seems quite feasible.

Program #7

V(A). Planned Program (Summary)

1. Name of the Planned Program

Wildlife 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
135	Aquatic and Terrestrial Wildlife			100%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2007	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual	0.0	0.0	0.6	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	36307	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	61807	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	446155	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish results in refereed research journals and, as appropriate, in popular press. Make presentation at professional meetings and at end-user workshops and meetings

The expansive hardwood forests which cover much of West Virginia provide extensive habitat for a variety of wildlife species which are extremely important to the economy of the state. Research in this planned program is aimed primarily at better understanding habitat requirements for the wildlife important to West Virginia, and to determine the impacts of human activity on wildlife habitat, particularly habitat for fish and birds.

A large majority of the research in this program represents cooperative research between West Virginia State University faculty and scientists with the West Virginia Division of Natural Resources, USGS, US Fish and Wildlife Service, and the Wildlife Management Institute, a group collectively known as the West Virginia Cooperative Fish and Wildlife Unit. Additionally, the majority of the research in this program is supported by non-formula funds.

Projects completed this past year included the development of models to predict "presence/absence" or "abundance" of song bird species based on various landscape characteristics. Models were 52 – 85% accurate and generally more accurate in predicting species presence or absence than predicting species abundance. Related research developed models to map suitable habitat for forest songbirds, particularly in areas undergoing mountaintop removal mining.

Mathematical modeling also was found to be successful in predicting stream characteristics over large areas using minimal data (2.5% and 5.0% sampling) and employing natural interpolation. For example accurate models were developed for stream substrate and depth and potentially for water chemistry, velocity, and fish food sources.

Other research found an apparent relationship between contaminants in the South Branch of the Potomac River and the frequency of intersexes and sperm quality (motility and progressive motility) in small mouth bass.

2. Brief description of the target audience

Wildlife managers, regulators, policy makers, researchers, concerned 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	0	0	0
2007	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2007 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2007	0	2	0

V(F). State Defined Outputs

Output Target

Output #1**Output Measure**

- Refereed scientific manuscripts

Year	Target	Actual
2007	2	15

Output #2**Output Measure**

- End user presentations at meetings and workshops

Year	Target	Actual
2007	2	1

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O No.	OUTCOME NAME
1	Sufficient understanding (to allow development of effective management plans) of habitat and other requirements of additional state bird and fish species
2	Documentation of impacts on wildlife from major, recurring activities associated with farming, logging and mining
3	Increased populations of threatened species, decreased populations of nuisance species - %

Outcome #1**1. Outcome Measures**

Sufficient understanding (to allow development of effective management plans) of habitat and other requirements of additional state bird and fish species

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Much of the general public are significantly concerned about the well-being of our wildlife. In West Virginia, state wildlife contributes significantly to state economic activity.

What has been done

Models have been developed which predict 'presence/absence' and 'relative abundance' of songbird species from various landscape characteristics. Models were 52-85% accurate with greater accuracy in predicting 'presence/absence' than species abundance.

Results

Observation and computer modeling have been used to map suitable habitat for wildlife and to assess the impacts of human activities on wildlife habitat.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #2**1. Outcome Measures**

Documentation of impacts on wildlife from major, recurring activities associated with farming, logging and mining

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	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
135	Aquatic and Terrestrial Wildlife

Outcome #3

1. Outcome Measures

Increased populations of threatened species, decreased populations of nuisance species - %

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	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
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Other (Failure to measure routinely needed data.)

Brief Explanation

Of the outcome measures listed only number of endangered species and number of threatened species are routinely measured. These will be used as a measure of long term success for this program

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

1. Evaluation Studies Planned

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

Evaluation Results

In conjunction with measurement of outcomes.

Key Items of Evaluation