2009 West Virginia University Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Faculty in the West Virginia Agricultural and Forestry Experiment Station conduct research in seven program areas including Economic Development and Quality of Life in Rural Communities, Environmental Quality and Stewardship, Fundamental Plant and Animal Systems, Human Nutrition and Health with an Adequate and Safe Food Supply, Global Food Security and Hunger, Production Forestry - Timber Management and Wood Products and Sustainable Energy. We have renamed a former program area titled "Production Agriculture" to be Global Food Security and Hunger to be consistent with the new NIFA program areas. Also note that as of 2009, Wildlife Management has been dropped as a program area with its activities allocated to Environmental Quality and Stewardship. We have added another planned program, as indicated in last year's Accomplishment Report and Plan of Work, titled Sustainable Energy. The remaining three NIFA priority areas, Climate Change, Childhood Obesity and Food Safety will be added next year, as indicated in the Station Plan of Work for 2011 -- 2015.

Needs of West Virginia State citizens dictate that a large portion of our station research agenda is related to economic development in rural communities, improving human nutrition, health and quality of life in rural communities, and protecting and preserving the State's natural resources and environment. Our agenda takes into account the threefold mission of a land grant university and combines basic and applied research, undergraduate and graduate education, and extension and outreach.

While WVU Extension and the WVU Experiment Station are separate entities, we cooperate in many ways: through split appointments, collaborative projects and joint planning. We have collaborative projects with Extension in the areas of plant and soil sciences, forestry and wood products, animal science, rural and community development and design, and nutrition and childhood obesity. We are currently planning collaborative projects in the rural development and childhood obesity areas in response to the program focus areas of NIFA and the recent AFRI RFA.

On example of a successful collaboration between WVU Extension and the WVU Experiment Station is a project titled "Obesity: Assessment, Prevention and Intervention." 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. The principal investigator for this project has a split appointment with Extension and the Experiment Station. As detailed in the narrative for program area 4, this project developed Camp NEW (Nutrition, Education, Wellness) You, an innovative, year-long program that was designed to help obese adolescents and their families develop healthier lifestyle patterns through education and motivation in a group setting. Of 23 campers enrolled in the first cohort, 13 completed all four required sessions. There was a significant decrease in BMI percentile from the first camp to the final follow-up weekend (98.4 to 96.4, $p<0.01$). There were significant improvements in serum insulin levels and insulin sensitivity between the initial values and the first year follow-up. The program has had a statewide impact and has led to changes in educational methods on nutrition. It is also valued by the insurance industry as indicated by continued funding from the major insurance carriers for the next group of children and their families.

Another example of a successful collaboration between WVU Extension and the WVU Experiment Station is the WVU Community Design Team. The program is run jointly by the College and Extension and is designed to conduct community visits and assist communities, for a fee, to help plan for their future. The composition of the team varies for each community selected for a Community Design Team (CDT) visit. A team might include landscape architects, planners, public administrators, engineers, historians, and economic development experts. Team selection is based on both availability of volunteers and the needs expressed by the community as part of their application. The CDT visited three communities in 2009 and has prepared or is preparing reports to assist the communities with their economic development plans.

Economic analyses of several programs which encourage consumption of local goods and the development of local niche markets (pasture finished beef, cool water aquaculture, eco-tourism and recreational activities, organically produced fruits, vegetables, and animal products, Omega-3 enhanced trout, etc.) have shown them to be both profitable and beneficial to local economies. When developed with care, all can also respect local cultures and histories, be protective of natural environments, and contribute to more healthy lifestyles of citizens.

Research efforts to assure the preservation of state natural resources focus on protecting soil and water quality by developing economically effective and environmentally sustainable management practices for agriculture, forestry and other uses of state natural resources. Preventing soil and water contamination with acid drainage from abandoned mines and protecting forest resources from the impacts of diseases and insects are major state concerns, as is the development of optimum methods for restoring disturbed wetlands and remediation of other environmentally compromised areas.

Research involving fundamental, biological systems in plants and animals seeks the basic knowledge needed to address practical problems. Understanding mechanisms which control flower senescence, symbiotic relationships between endophyte fungi and pasture grasses, bacterial response to cold and desiccation stress, genetic control of reproductive processes, adjustment to levels of oxidative stress, pathways of protein metabolism, methods of gene flow in mycorrhizal fungi, etc., all have practical applications which will benefit rural state citizens and society in general.

Due to a variety of factors, West Virginia farmers do not compete well in standard agricultural commodity markets. Station research therefore is focused on the production of higher value products such as those with ornamental or recreational use, with increasing real or perceived product value in specialty, niche or out-of-season markets, with capitalizing on proximity to large, urban markets, etc. Specific examples include research to develop improved management systems for the production of cool water fish (for food and recreation); organic vegetables, fruits and small animal products; pasture raised and finished beef; and out-of-season lamb. Station research also is concerned with developing new methods of disease and insect control which are effective, economically viable and environmentally friendly.

Forest lands in West Virginia represent an enormous resource in the form of hardwood timber, wildlife habitat, and areas for human recreation and restoration. Station research in timber management and wood utilization seeks enhanced profitability of timber production balanced against protection of wildlife habitats and recreational environments. Both are served by research projects which limit negative impacts of insects, disease and invasive species. Timber management research also is strongly influenced by the fact that a majority of state forest lands are in relatively small tracts, owned by many different individuals coexisting with several relatively large lumber producing companies. Research and outreach programs to serve both types of producers are supported.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	38.0	0.0
Actual	0.0	0.0	42.9	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 with expertise in the fields of science addressed in each proposal are selected by the Division Director, Experiment Station Director or designee and asked to judge technical merit, likelihood of achieving stated objectives, and potential impacts for each proposed project. A minimum of three peer scientists (i.e., individuals qualified by their status in the same discipline, or a closely related field of science), are asked to read and provide written comments on the proposed activities. The terms of reference for the reviewers focuses on questions of the quality of the proposed science, technical feasibility of the research, the validity of the scientific approach, and likelihood for completing the stated objectives. Additional comments may be requested on a project's relevance to the station's priorities, the degree of integration with extension (as appropriate), responsiveness to stakeholder needs, and the accuracy of any claims for multi-disciplinary and multi-state collaboration. Reviewers are be asked to present their findings in writing, and records of the reviewers' comments are preserved for the life of the project, or for a period of three years in the event that a project is not initiated. Competitively awarded grants requiring peer review or contract research requiring

grantor approval are exempt from this process.

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.

Much stakeholder input is collected in conjunction with West Virginia University Extension (administratively distinct from the College of Agriculture, Natural Resources and Design) since we share a 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, the West Virginia Farmer's Market Association etc.) We find the new procedure more efficient and to represent a 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 and Natural Resources, etc.) as well as from advisory groups established at the College/Station level (Davis College Visiting Committee and the Experiment Station Advisory Board.

As the focus of the College evolves with time (we recently changed our name from the College of Agriculture, Forestry and Consumer Sciences to the College of Agriculture, Natural Resources and Design to reflect our changing areas of emphasis) we realize that our stakeholder group also changes. We see a need to reach out to both keep in better contact with our traditional stakeholders and to encourage new stakeholders to join with us in evaluating our programs and helping us to plan strategically for the future. We have decided to add a new position at the assistant dean level to take charge of our outreach efforts and to maintain better contact with our diverse stakeholder groups. This new position will start July 1, 2010.

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 and the quality of life of our citizens. As discussed above we are creating a new administrative position at the assistant dean level to help identify and make contact with stakeholder groups.

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 of input 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 come from individual producers.

3. A statement of how the input will be 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. We will be entering a new strategic planning process in 2010 and will be reaching out to traditional and new stakeholder groups to aid our planning process.

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 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	2870872	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	2002363	0
Actual Matching	0	0	5555444	0
Actual All Other	0	0	4562643	0
Total Actual Expended	0	0	12120450	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover	0	0	1353158	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

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			10%	
511	New and Improved Non-Food Products and Processes			10%	
605	Natural Resource and Environmental Economics			25%	
608	Community Resource Planning and Development			25%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			10%	
806	Youth Development			20%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.1	0.0
Actual	0.0	0.0	9.1	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	243630	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	910631	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1120173	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.

West Virginia is considered to be a lagging region in terms of economic development and growth, a characteristic shared by many states in the Appalachian Region. While the region has abundant natural resources, particularly coal, forests, water and recreational opportunities, unemployment is typically higher than in the rest of the Nation. Accordingly, the West Virginia Agricultural and Forestry Experiment Station has designated economic development and the quality of life in rural communities as one of our primary program areas. Work in this program area is divided into three categories: contributors to economic growth, developing specific economic opportunities and quality of life.

Research concerning contributors to economic growth involves looking at the factors that characterize regional economies and relating those factors to the levels of economic development and growth that regional economies have experienced over time. One goal of this research is to determine what factors contribute to economic growth and what factors impede growth. Once these factors are identified their contribution to economic growth can be quantified using economic and social science models. The results of such modeling efforts can be used to help formulate policies that encourage the factors that are positively associated with regional economic growth and to circumvent factors that retard growth. Growth factors that are being examined in this research area include the effects of income inequality on regional economic growth; the role of recreational and natural amenities on rural economic growth; the roles of entrepreneurship, socio-economic factors and public policy on economic growth.

Results so far have shown that income inequality is negatively associated with economic growth. Counties in West Virginia that have higher rates of income inequality have slower economic growth rates. Policy makers, therefore, need to consider dealing with income inequality as well as the traditional development policies such as investment in education and government spending as policies and programs that reduce income equality will also help to increase economic growth rates. In another related study, entrepreneurship and entrepreneurial activity (indicated by business startups and number of proprietors) was found to be positively associated with economic growth. The results showed the need for policies that create a positive business environment such as reducing barriers to new businesses, lower personal tax rates, and increased government assistance. Policies that foster entrepreneurship should help close regional gaps in income disparities.

Regional economic opportunities need to be based on the natural and human resources present in the region. A significant part of rural employment growth nationwide has occurred in non-traditional economic activities including those capitalizing on natural resources and climate. A number of possible economic opportunities are currently being investigated in West Virginia, including pasture finished beef, cool water aquaculture, organic production of vegetables and animal products, and ecotourism. There is also an ongoing study of the effects of socio-economic characteristics including race and ethnic characteristics on participation in recreational activities and another study impact of the textile and apparel industry on the economy of the State. We also continue to examine the legal barriers to growth in the aquaculture industry in the State.

Two important results were identified in the cool-water aquaculture projects. First, a consumer acceptance trial was conducted comparing trout with a standard diet supplement of menhaden oil compared with flax seed oil. The flax seed oil was found to increase Omega-3 content in the trout filets. In addition to the health benefits of the increased Omega-3 content, consumers preferred the filets from the trout fed the flax seed supplement. The flax oil supplement is not economically feasible at this time given the price for brook trout for the restaurant trade but may have a niche market potential. Second, researchers examined the use of watercress to remove nitrogen and phosphorus from flowing-water trout aquaculture systems. The watercress was found to reduce both nitrogen and phosphorus levels in the flowing water and to produce watercress as a value-added product for aquaculture operators.

Several different research and outreach activities were conducted on the quality of life in rural communities. This work involved design, implementation and evaluation of recreational activities and interpretation, forest-based recreation, a survey of WV farmer attitudes toward farmland preservation, surveys of ethical practices in youth livestock programs, studies of the value of historic landscapes and cultural artifacts and design of sustainable and affordable rural housing. The survey of farmer attitudes toward farmland preservation was analyzed and the results were disseminated in cooperation with WV Extension. As a result, WV county farmland preservation boards and county commissioners have requested additional information on farmland preservation based on the research results and to better educate local landowners about their options.

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

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	3	
Actual	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations to colleagues and end-users

Year	Target	Actual
2009	8	11

Output #2

Output Measure

- Team consultations with, and reports to assist, community action groups focused on improving local economic development and quality of life.

Year	Target	Actual
2009	3	2

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 as indicated by annual increases in weighted indicies of economic activity involving the production of pasture raised beef and sheep; broilers, turkeys and eggs; trout; organic vegetables; tourism and outdoor recreactional activities; ornamental horticulture; timber and wood products etc. - % annual growth
2	Customized designs for enhanced economic development prepared for, and adopted by, state rural communities (#)
3	Greater understanding of ecology and funcnction of natural and mitigated wetlands.

Outcome #1

1. Outcome Measures

Expansion of economic activity in targeted state industries as indicated by annual increases in weighted indicies of economic activity involving the production of pasture raised beef and sheep; broilers, turkeys and eggs; trout; organic vegetables; tourism and outdoor recreactional activities; ornamental horticulture; timber and wood products etc. - % annual growth

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Regulations involving the State aquaculture industry created barriers for farmers and business people wishing to enter the State aquaculture industry. Regulations in WV were more restrictive than in surrounding states.

What has been done
An investigator on our aquaculture project drafted legislation (the Aquaculture Development Act--HB 236) and had it sponsored and proposed for the 2010 Legislative session. The aquaculture project is a joint effort between the WVU Experiment Station and WVU Extension. Legal research on this issue has been ongoing for four years.

Results
The results in 2009 involved completion of the legal research and writing of the proposed legislation. The outcome occurred in 2010 and will be reported next year (so far it has passed the House and Senate and is waiting for signature by the governor).

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Customized designs for enhanced economic development prepared for, and adopted 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
2009	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many communities in West Virginia are lagging economically and need assistance in developing plans to enhance their economic development, quality of life, and attractiveness to tourists.

What has been done
The WVU Community Design Team, a joint effort between the Experiment Station and WVU Extension, was developed twelve years ago to assist rural communities in planning, design and economic development. The CDT annually visits between one and four communities. An interdisciplinary team is put together for each community depending on the needs expressed in the application report. In 2009 two communities were visited. Two customized reports were prepared for two communities, Glenville and Philippi, WV, to assist them in economic development, enhanced community design, and recreational and cultural opportunities.

Results
The reports were prepared and circulated to the two communities and to State policy makers. In addition, the Community Design Team conducted followup activities with communities visited in earlier years to assess their progress and to receive feedback on the CDT program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
608	Community Resource Planning and Development
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #3

1. Outcome Measures

Greater understanding of ecology and funcnction of natural and mitigated wetlands.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Contamination of soil and water with acid mine drainage from abandoned surface and underground mines is a continuing state concern. Research is being conducted to characterize the nature and scope of these problems and to develop cost effective remediation programs.

What has been done
Relevant research projects include restoring surface mines to productive forestland or grassland and restoring lost aquatic ecosystem functions on reclaimed mine sites. Natural and created wetlands contribute to environmental quality by serving as filters for dissolved and suspended fertilizers and other pollutants as well as providing ecosystem and habitat services.

Results
A study designed to enhance the success of natural and created wetlands continued to collect data on amphibians, birds, vegetation, water quality, invertebrates, litter decomposition rates, and soils in mitigation and natural wetlands. The researchers developed an evaluation tool named the West Virginia Wetland Rapid Assessment Procedure (WVWRAP). The research should result in enhanced wetlands function in the state and an increase in wetland ecosystem integrity. The West Virginia Wetland Rapid Assessment Procedure (WVWRAP) is being used to evaluate wetlands state-wide as part of a comprehensive regulatory wetland monitoring program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Other (Re-evaluation of outcome measures)

Brief Explanation

The expansion of economic activity in targeted state industries (Outcome #1) is being dropped in future plans of work because we no longer feel it is an appropriate measure measure of the performance of this program, "Economic Development and the Quality of Life in Rural Communities." The third outcome measure involving the ecological function of natural and mitigated wetlands will be moved to program area 2, Environmental Quality and Stewardship, in a future POW.

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

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.7	0.0
Actual	0.0	0.0	7.0	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	373367	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	808417	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	651897	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish/present results; contribute to educational and outreach programs.

Research to assist in the preservation of West Virginia's soil, water, forest and wildlife resources is a high priority in the West Virginia Experiment Station. The focus of Station research is on studying, protecting and restoring environmental quality while developing economically effective and environmentally sustainable management practices for agriculture, forestry, mining

and rural communities. Our primary environmental research areas involve minelands restoration, water quality, wetlands, and aquatic and terrestrial wildlife ecology.

Contamination of soil and water with acid mine drainage from abandoned surface and underground mines is a continuing state concern. Research is being conducted to characterize the nature and scope of these problems and to develop cost effective remediation programs. Relevant research projects include restoring surface mines to productive forestland or grassland (including switchgrass as a possible feedstock for biofuels) and restoring lost aquatic ecosystem functions on reclaimed mine sites. The results from the aquatic ecosystem project are being integrated into a state-wide process to maximize stream restoration effectiveness in mined watersheds. The research team made nearly 20 presentations to state agencies, federal agencies, industry partners and conservation stakeholder groups in 2009. Two papers were written to facilitate the discussion of how to maximize stream restoration benefits while minimizing costs.

The final report of a reforestation project summarized their findings regarding the productivity of reclaimed mineland as a function of soil quality, soil amendments, use of hydroseeding and tree species. The researchers measured tree survival in weathered brown sandstone and in unweathered gray sandstone treated with and without bark mulch and with and without hydroseeding. After two years, plots of brown sandstone alone and brown sandstone with hydroseeding had an average pH of 4.7, while gray sandstone and gray sandstone with hydroseeding was pH 7.6. Brown sandstone and gray sandstone with bark mulch and with bark mulch and hydroseeding had an average pH of 7.2. After two growing seasons average survival across brown sandstone alone was 83%, with bark mulch 89%, with hydroseeding 68%, and with bark mulch and hydroseeding 77%, while gray sandstone alone was 88%, with bark mulch 85%, with hydroseeding 44%, and with bark mulch and hydroseeding 88%. Tree survival across treatment combinations for sugar maple was 92%, white pine 88%, northern red oak 86%, and black cherry 85%.

The final report was issued for a study related to management of riparian forested habitats and the population resistance and resilience in brook trout populations in headwater streams. The long-term study of brook trout populations in 25 WV streams was awarded a Research Achievement award from the U. S. Forest Service "2009 Rise to the Future Watershed Award" honoring the project for research productivity.

Natural and created wetlands contribute to environmental quality by serving as filters for dissolved and suspended fertilizers and other pollutants as well as providing ecosystem and habitat services. A study designed to enhance the success of natural and created wetlands continued to collect data on amphibians, birds, vegetation, water quality, invertebrates, litter decomposition rates, and soils in mitigation and natural wetlands. The researchers developed an evaluation tool named the West Virginia Wetland Rapid Assessment Procedure (WVWRAP). The research should result in enhanced wetlands function in the state and an increase in wetland ecosystem integrity. The West Virginia Wetland Rapid Assessment Procedure (WVWRAP) is being used to evaluate wetlands state-wide as part of a comprehensive regulatory wetland monitoring program.

Another research project has been examining ways to reduce the environmental impact of the WV poultry industry through efficient waste management strategies. Off-farm transport of poultry litter and on-farm implementation of best management practices (BMPs) for land application were found to be preferred strategies to address nutrient imbalances. Forest land application of poultry manure had the lowest average cost and more forest land than agricultural land was used for manure application according to survey results. This study also involved a feasibility and economic viability analysis of a bio-based waste to energy system utilizing poultry litter as a fuel and a fixed-bed gasifier as a medium to convert litter into heat and cooling energy. Greenhouse and soil tests were conducted on the biochar byproduct of gasification. As a soil amendment, biochar was determined to be alkaline and to increase plant essential macro and micro nutrients when added to West Virginia soils. No significant effects were observed on the tissue concentrations of lead or cadmium in radish bulbs, radish leaves, or spinach leaves. For the economic analyses, three major types of benefits from installation of a gasifier on a broiler farm were described: production of biochar and possible carbon credits, savings of fossil fuel, and improved health and production of broilers. Three scenarios were examined with economic analyses: base, high energy prices, and optimistic benefits. Under these scenarios, a broiler producer could afford to pay about $190,000, $350,000, or almost $900,000 for the gasifier. One outcome of this study is that manure transfer/nutrient management guidelines for the Agricultural Management Assistance litter transfer program were altered in terms of mileage and payment rates based on findings from this research.

Finally, work was concluded on a project concerning survival of newly emerging bacteria of public health significance in water and wastewater. The study demonstrated that the opportunistic pathogen, Enterobacter sakazakii, is able persist for extended periods of time in aquatic environments. The researchers also determined that commercially available media used to detect this bacterium from food may not be adequate for reliable detection of the organism from water. Through modification of the standard detection medium, combined with other adjustments of the routine isolation procedure, recovery of E. sakazakii has been substantially improved while simultaneously inhibiting non-target antagonists.

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

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	5	
Actual	0	9	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Science-based articles for lay audiences

Year	Target	Actual
2009	5	6

Output #2

Output Measure

- Presentations of research results

Year	Target	Actual
2009	8	17

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Reduce the percentage of West Virginia streams classified as 'impaired'.
2	Reduce percentage of state streams classified as impaired by agricultural and forestry activities.

Outcome #1

1. Outcome Measures

Reduce the percentage of West Virginia streams classified as 'impaired'.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Reduce percentage of state streams classified as impaired by agricultural and forestry activities.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agricultural and managed forest lands can be a source of water pollution in the form of sediment, nutrients and pesticides. Concentrated animal facilities, such as intensive poultry production in the Potomac watershed, can, if not managed properly, lead to nitrogen and phosphorus runoff into streams and rivers.

What has been done
Several research projects have been examining ways to reduce the environmental impact of the WV poultry industry through efficient waste management strategies.

Results
Off-farm transport of poultry litter and on-farm implementation of best management practices (BMPs) for land application were found to be preferred strategies to address nutrient imbalances. Forest land application of poultry manure had the lowest average cost and more forest land than agricultural land was used for manure application according to survey results. One outcome of this study is that manure transfer/nutrient management guidelines for the Agricultural Management Assistance litter transfer program were altered in terms of mileage and payment rates based on findings from this research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

605 Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Data not available)

Brief Explanation

The first outcome measure, "Reduce the percentage of WV streams classified as impaired," is being dropped from future plans of work. It is no longer felt that this outcome measure is sufficiently linked to to the performance to be a good indicator or outcomes. The second outcome measure, "reduce percentage of state streams classified as impaired by agricultural and forest activities," is being retained at least temporarily while we compile data that will allow reporting this outcome. A qualitative outcome was reported under this measure in 2009.

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

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

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: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual	0.0	0.0	5.4	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	593674	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	987809	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	656473	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish / present results.

Research involving fundamental plant and animal systems is designed to increase our understanding of reproductive, nutritional and general physiological systems and processes. On the animal side, practical problems addressed include

embryonic mortality in sheep and cattle, performance limiting amino acids in animal rations, and health and disease resistance in poultry. For plants, the 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.

Considering the animal systems fundamental research first, work was concluded on a project studying the effectiveness of uric acid as an antioxidant and its effects on poultry health and disease. The goal of a current research project was to establish models of oxidative stress in birds and determine the efficacy of manipulating plasma uric acid concentrations to modulate oxidative stress, thereby increasing our understanding of how oxidants exert their specific affects on tissues. The conclusion is that this study has established the importance of uric acid and its regulation on oxidative stress in chickens. Factors that reduce uric acid can be associated with increased oxidative stress while those that increase uric acid reduce oxidative stress. Ultimately this study should contribute to a greater understanding of animal health.

Another study examined the biochemical and molecular aspects of lysine degradation in poultry. The research produced a change in knowledge relative to how quickly and to what extent growing chickens respond metabolically to alterations in dietary lysine. This new information will affect how we design future experiments investigating the metabolism of this essential nutrient.

A study of ovarian influences on embryonic survival in ruminants increased our knowledge on regulation of oocytes and early embryos as well as luteal function during the estrous cycle, specifically in regard to expression of genes and mechanisms of action of factors that are involved in regression of corpora lutea in cattle and sheep. The finding of a novel microRNA in the oocyte and early bovine embryo may be very important to understanding early embryonic loss and lead to an increase in the rate of successful pregnancies in ruminants. The approval by FDA in October 2009 of the Controlled Internal Drug Delivery Device for administration of progesterone for out-of-season breeding in sheep, after 11 years of work that involved faculty and students on this project, is a major success.

The research involving ergot alkaloids produced by fungi that are symbiotic with pasture grasses found that modification of the expression of critical ergot pathway genes should alter the ergot alkaloid profile of endophytic fungi in grasses, thus altering the biological properties of the infected grasses. The researcher hypothesizes that decreased expression of easA will result in the accumulation of clavine alkaloids from the early portion of the pathway while reducing the accumulation of lysergic acid derivatives from the later portion of the pathway. Conversely, overexpression of easA is hypothesized to reduce the accumulation of clavine alkaloids and instead divert those early pathway intermediates into lysergic acid derivatives from the later part of the pathway. Since clavine alkaloids and lysergic acid derivatives have been shown to have differential effects on insects versus mammals, shifting the bulk of the pathway product towards one alkaloid class or the other should change the biological properties of the fungus-grass symbiosis and reduce problems associated with ingestion of ergot alkaloids by grazing animals.

Work concluded on the molecular characterization of cold shock proteins (CSP) in Arabidopsis. The researchers performed the first extensive functional characterizations for a cold shock protein gene family in a model plant system. They also completed an extensive evolutionary analysis of plant CSPs which will serve as a foundation for future studies pertaining to plant CSPs. Their biochemical characterization of post-translational modifications of plant CSPs will have significant impact for future studies aimed to decipher the functional role(s) of SUMOylation and phosphorylation of plant CSPs. They also showed for the first time that CSPs are seasonally regulated in an extremely freeze tolerant perennial woody plant (red-osier dogwood). These correlative data suggest that CSPs might be involved in the process of cold acclimation in woody plants.

Work has continued on the development and testing of biological controls for the chestnut blight and other chestnut pathogens and pests. The study has found that the transition from high levels of disease to acceptable levels of biological control appears to require significant time; in this case, more than 20 years. Another component of this research involves field testing transgenic strains of the chestnut to see whether these modified strains can enhance biological control agents. To date, the experimentation has demonstrated that the transgenic strains can function in the forest by increasing the production of hypovirus-infected inoculum. While this condition should allow for better biological control, additional time will be required to confirm their effectiveness.

2. Brief description of the target audience

Primarily researchers; professional practitioners, regulators, some producers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	5	
Actual	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Research presentations

Year	Target	Actual
2009	5	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Identify and map genes affecting flower senescence - # genes
2	Develop ergot alkaloid deficient grasses at or near wild-type vigor
3	Successfully develop and employ strategies using hypovirus as a biological control agent for Chestnut blight
4	Identify ovarian-specific gene expression affecting reproductive success

Outcome #1

1. Outcome Measures

Identify and map genes affecting flower senescence - # genes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	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 #2

1. Outcome Measures

Develop ergot alkaloid deficient grasses at or near wild-type vigor

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Ergot fungi exist symbiotically with pasture grasses. Ergot fungi can be toxic to cattle and other ruminants.

What has been done
The research involving ergot alkaloids produced by fungi that are symbiotic with pasture grasses found that modification of the expression of critical ergot pathway genes should alter the ergot alkaloid profile of endophytic fungi in grasses, thus altering the biological properties of the infected grasses.

Results
The researcher hypothesizes that decreased expression of easA will result in the accumulation of clavine alkaloids from the early portion of the pathway while reducing the accumulation of lysergic acid derivatives from the later portion of the pathway. Conversely, overexpression of easA is hypothesized to reduce the accumulation of clavine alkaloids and instead divert those early pathway intermediates into lysergic acid derivatives from the later part of the pathway. Since clavine alkaloids and lysergic acid derivatives have been shown to have differential effects on insects versus mammals, shifting the bulk of the pathway product towards one alkaloid class or the other should change the biological properties of the fungus-grass symbiosis and reduce problems associated with ingestion of ergot alkaloids by grazing animals.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The American chestnut tree was nearly wiped out by chestnut blight in the early 20th century.

What has been done
Multi-institutional research has been ungoing to develop blight resistant cultivars of the American chestnut and to develop biolgical controls of the blight.

Results
Work has continued on the development and testing of biological controls for the chestnut blight and other chestnut pathogens and pests. The study has found that the transition from high levels of disease to acceptable levels of biological control appears to require significant time; in this case, more than 20 years. Another component of this research involves field testing transgenic strains of the chestnut to see whether these modified strains can enhance biological control agents. To date, the experimentation has demonstrated that the transgenic strains can function in the forest by increasing the production of hypovirus-infected inoculum. While this condition should allow for better biological control, additional time will be required to confirm their effectiveness.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Identify ovarian-specific gene expression affecting reproductive success

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improving the reproductive success of ruminants is important in reducing costs of production of sheep and cattle.

What has been done
A novel microRNA structure was found in the oocyte and early bovine embryo that may be very important in understanding early embryonic loss and lead to an increase in the rate of successful pregnancies in ruminants.

Results
This study increased our knowledge on the regulation of oocytes and early embryos as well as luteal function during the estrous cycle, specifically in regard to expression of genes and mechanisms of action of factors that are involved in regression of corpora lutea in cattle and sheep.

4. Associated Knowledge Areas

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

305 Animal Physiological Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Competing Public priorities

Brief Explanation

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

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

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
501	New and Improved Food Processing Technologies			10%	
502	New and Improved Food Products			10%	
702	Requirements and Function of Nutrients and Other Food Components			20%	
703	Nutrition Education and Behavior			30%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			30%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual	0.0	0.0	2.3	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	98532	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	328520	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	132805	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 citizens have the third highest level of obesity in the Nation (Center for Disease Control, 2008). West Virginia is also above the national averages for incidence of diabetes, high blood pressure, and cardiovascular disease, as well as for osteopenia and osteoporosis. Station research in human nutrition and health 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 bioactive compounds in foods, including krill protein, and is developing omega-3 DHA enhanced diets and educational programs to support their adoption. Please note that our childhood obesity work is reported under this program but will be moved in 2010 to its own program (Childhood Obesity) to reflect the priorities of NIFA.

One important line of research at the WV Experiment Station involves assessing strategies to increase Omega-3 content (including docosahexaenoic acid, or DHA) in foods due to the health benefits of Omega-3 fatty acids. One project is investigating economically feasible ways to produce vegetarian sources of DHA by improving batch methods for growing Crypthecodinium cohnii, a heterotrophic marine alga that can accumulate high levels of DHA. Results showed that C. cohnii growth could be maintained in continuous production; however, biomass, lipid and DHA yields did not exceed values reported by cultivation in batch mode. With more research, this process may be capable of providing a sustainable and commercially viable vegetarian source of DHA. This line of research is consistent with the goals of USDA to promote a healthy and well nourished society.

Other projects involve the digestibility and health effects of different sources of omega-3 fatty acids including krill. One finding was that omega-3 polyunsaturated fatty acids (n-3 PUFAs) in different chemical forms affect digestibility and tissue fatty acid deposition. The preliminary data generated from this project led to a competitive NRI grant that was awarded Jan 2009 to determine the effects of feeding rats n-3 PUFAs from different oil sources on digestibility, tissue deposition, and oxidative stability. Evaluating alternative sources of n-3 PUFA is important because depletion of existing fish stocks and environmental contaminants has raised public concern regarding fish consumption.

A joint project with WVU Extension concerns local food choices, eating patterns and health. In 2009 the team conducted public workshops and created teaching materials related to home food preservation and processing and preparing venison. Extension faculty and staff were trained at these workshops. Five fact sheets on home food preservation were written or updated and distributed at the State Fair and on the website. Home food preservation workshops were featured on local television news programs. Venison workshops were featured on at least two local news programs and the WV Dept. of Natural Resources show "West Virginia Wildlife Minutes." Findings regarding the marketing, sensory attributes and production of Omega-3 enhanced brook trout were presented at the U.S. Trout Farmers Association Fall Conference. WVU Extension's work on home food preservation and venison processing improved the skills of individuals who will answer questions brought by the public and who will conduct workshops and trainings. The final impact should be improved food safety and health. Increased sales of aquaculture products should also improve the health of consumers. The development of a local food system in West Virginia, as promoted by the WV Food Policy Council, could lead to greater access to fresh fruits and vegetables and improved health of West Virginians.

We have several projects that are concerned with childhood obesity. Next year these projects will be reported under a new program area, "Childhood Obesity." This year we continue to report those activities under the program area "Human Nutrition and Health with an Adequate, Safe Food Supply." Projects within this program examine different ways to combat childhood obesity including exercise and recreation, prevention and intervention, and obesity assessment. Diabetes, because of its high prevalence in WV and because of its linkage to obesity and diet, is also a significant focus of this program area.

Another program that is joint with WVU Extension developed Camp NEW (Nutrition, Education, Wellness) You, an innovative, year-long program that was designed to help obese adolescents and their families develop healthier lifestyle patterns through education and motivation in a group setting. The program consisted of a two-week summer residency program with a variety of educational sessions for children and their parents; developmentally appropriate activities; groups counseling; enrichment activities; and a structured, 12-month follow-up intervention designed to provide continued support for families as they make the targeted behavior changes a part of their lifestyles. There were six formal nutrition lessons during the two weeks. These were planned and delivered by Dietetic Interns from the Human Nutrition and Foods graduate program at WVU. They included lessons on label reading, portion sizes, the Idaho Plate Method, and nutrient content. The campers reported to the Foods Lab for a morning snack and a short nutrition lesson related to the snack. The snacks that were provided were planned to be nutrient dense and easy so that the children could make them at home. They completed computer-based, interactive nutrition lessons. During the middle weekend of camp, the interns lead the campers in a grocery store tour and shopping trip for food to prepare a healthy dinner for their parents. The children planned the dinner and chose the recipes with guidance from the interns and camp counselors. The camp counselors monitored the cafeteria selections of the children in their group and modeled healthy behaviors while the children were in their care. Children and their parents participated in three follow-up weekends at different locations.

Of 23 campers enrolled in the first cohort, 13 completed all four required sessions. There was a significant decrease in BMI

percentile from the first camp to the final follow-up weekend (98.4 to 96.4, p<0.01). There were significant improvements in serum insulin levels and insulin sensitivity between the initial values and the first year follow-up. These are positive trends that show a decrease in risk of type 2 diabetes mellitus after a year-long intervention. There were no significant changes in blood pressure, cholesterol levels, or triglycerides. Tests of overall knowledge and physical activity knowledge showed a significant increase from the initial assessment to the first follow-up period but then dropped back to baseline at one year. Tests of nutritional knowledge showed a similar pattern, but the increase from baseline did not reach statistical significance. These results prompted a change in educational methods to provide more consistency in the messages across the educational periods for the new cohort of campers. The program has had a statewide impact. Funding from the major insurance carriers has continued for the next group of children and their families. Marshall University has joined with WVU to offer the program on their campus beginning in the summer of 2010.

2. Brief description of the target audience

Families, dietitians, consultants, policy makers, researchers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	2	
Actual	0	3	3

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations at scientific meetings

Year	Target	Actual
2009	3	5

Output #2

Output Measure

- Workshops and meetings to end-users

Year	Target	Actual
2009	1	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Annual reduction in state incidence of overweight and obesity and obesity related health problems (diabetes, cardiovascular disease, hypertension, etc.)-%
2	Reduction in state incidence of osteoperosis and similar or related disorders - %
3	Develop intervention and education strategies to help children and their parents choose nutritious foods.
4	Develop education and extension programs to help reduce childhood obesity.

Outcome #1

1. Outcome Measures

Annual reduction in state incidence of overweight and obesity and obesity related health problems (diabetes, cardiovascular disease, hypertension, etc.)-%

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Reduction in state incidence of osteoperosis and similar or related disorders - %

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Develop intervention and education strategies to help children and their parents choose nutritious foods.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
West Virginia citizens have the third highest level of obesity in the Nation (Center for Disease Control, 2008). West Virginia is also above the national averages for incidence of diabetes, high blood pressure, and cardiovascular disease, as well as for osteopenia and osteoporosis.

What has been done
A joint project between the WVU Experiment Station and WVU Extension concerns local food choices, eating patterns and health. In 2009 the team conducted public workshops and created teaching materials related to home food preservation and processing and preparing venison.

Results
Five fact sheets on home food preservation were written or updated and distributed at the State Fair and on the website. Home food preservation workshops were featured on local television news programs. Venison workshops were featured on at least two local news programs and the WV Dept. of Natural Resources show "West Virginia Wildlife Minutes."

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. Outcome Measures

Develop education and extension programs to help reduce childhood obesity.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a major health issue in the U.S. and in West Virginia. Intervention strategies that target children before they become obese have been found to be more effective than treating obesity after its onset.

What has been done
A program was developed jointly with WVU Extension called Camp NEW (Nutrition, Education, Wellness) You, an innovative, year-long program designed to help adolescents and their families develop healthier lifestyle patterns through education and motivation in a group setting. The program consisted of a two-week summer residency program with a variety of educational sessions for children and their parents; developmentally appropriate activities; group counseling; enrichment activities; and a structured, 12-month follow-up intervention designed to provide continued support for families as they make the targeted behavior changes a part of their lifestyles.

Results
Of 23 campers enrolled in the first cohort, 13 completed all four required sessions. There was a significant decrease in BMI percentile from the first camp to the final follow-up weekend (98.4 to 96.4, $p<0.01$). There were significant improvements in serum insulin levels and insulin sensitivity between the initial values and the first year follow-up. These are positive trends that show a decrease in risk of type 2 diabetes mellitus after a year-long intervention. There were no significant changes in blood pressure, cholesterol levels, or triglycerides. Tests of overall knowledge and physical activity knowledge showed a significant increase from the initial assessment to the first follow-up period but then dropped back to baseline at one year. Tests of nutritional knowledge showed a similar pattern, but the increase from baseline did not reach statistical significance. These results prompted a change in educational methods to provide more consistency in the messages across the educational periods for the new cohort of campers. The program has had a statewide impact. Funding from the major insurance carriers has continued for the next group of children and their families. Marshall University has joined with WVU to offer the program on their campus beginning in the summer of 2010.

4. Associated Knowledge Areas

KA Code	Knowledge Area

703 Nutrition Education and Behavior

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Other (Re-evaluation of outcome measures for this program)

Brief Explanation

We are seriously re-evaluating the appropriateness of the current outcome measures for this program. That reevaluation began last year but was interrupted by the untimely passing of our Associate Experiment Station Director, Dr. William Vinson. It is anticipated that these outcome measures will be replaced with measures of knowledge and action outcomes in the next Plan of Work.

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}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Global Food Security and Hunger

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			15%	
202	Plant Genetic Resources			5%	
205	Plant Management Systems			15%	
211	Insects, Mites, and Other Arthropods Affecting Plants			10%	
212	Pathogens and Nematodes Affecting Plants			10%	
301	Reproductive Performance of Animals			15%	
302	Nutrient Utilization in Animals			10%	
303	Genetic Improvement of Animals			5%	
304	Animal Genome			5%	
307	Animal Management Systems			10%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.5	0.0
Actual	0.0	0.0	10.4	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	605341	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1525456	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1132805	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

This program was formerly called Production Agriculture. For 2009 and the future we have merged it into the new NIFA priority area "Global Food Security and Hunger." We feel the new program area provides a good fit because all the plant- and animal related projects in the production agriculture area are focused on increasing the productivity of agriculture thereby contributing both to food security and alleviating world hunger.

West Virginia agriculture is dominated by high intensity poultry production and low intensity pasture-fed ruminant production. Much of the land in West Virginia is characterized by steep slopes and high rates of erosion that are suitable to pasture but not to intensive row-crop production. Most intensive crop production, including some fruits and vegetables, is limited to those regions of the state that have relatively flat terrain and favorable soil characteristics. To be competitive, West Virginia producers typically must become competitive either by increasing the value of what they produce or by reducing transportation and production costs by relying on locally-marketed products, by taking advantage of the State's proximity to major urban markets or by developing niche products. Some examples of successful enterprises include encouraging markets and consumer acceptance of pasture-raised and pasture-finished beef; cool water aquaculture; focusing on higher priced products such as those with ornamental or recreational use; increasing real or perceived product value in specialty or out-of-season markets such as lamb and organic products; and by diversifying product offerings.

Considerable progress was made this year in an effort to enable out-of-season lamb production. The FDA in October 2009 approved the use of CIDR-G for marketing in the USA as an aid in induction and synchronization of estrus in anestrous ewes. This will enable producers throughout the country to breed more ewes out of season, spreading the marketing period and increasing income from lamb and from products of dairy sheep. One of the WVU project leaders was able to present data from the project on efficacy of this method at the Great Lakes Dairy Sheep Symposium in November, at which time the approval was announced.

In the pasture-based beef systems project field trials indicate that animal performance from stockpiled forage and conserved feed was highest when the grassland was tall fescue or orchard grass and the conserved feed was haylage. Lowest was on naturalized grassland with haylage. A decision support tool for beef producers was also developed and launched to aid producers in improving profitability and analyzing risk. Producers can specify up to four marketing options for their calves, including sale as live animals at weaning, sale as live animals after grain and forage backgrounding, sale as harvested beef after grain and forage finishing, and sale as harvested beef after forage-only finishing. Profitability for animals sold as harvested beef is calculated on both a carcass weight and a saleable product basis.

This year a study of dietary manipulation of progesterone catabolism demonstrated that the rate at which progesterone is catabolized can be influenced by alterations in hormone concentrations without a negative impact on energy balance or milk yield. Prior to the current project an extensive body of data supported the notion that the high rate of progesterone catabolism observed in the dairy cow simply reflected the high rate of blood flow to the liver, as a result of her very high dry matter intake, and that reducing that catabolism to improve peripheral progesterone concentrations would require a reduction in feed intake. Such a reduction would dramatically reduce milk production and therefore is commercially irrelevant. By clearly establishing that by modulating insulin secretion with diet can impact the rate of progesterone decay we have opened the possibility that the very low fertility and pregnancy retention observed in dairy cows could be mitigated without the need for a reduction in milk production.

Work concluded on a project designed to monitor and control stink bugs for apple and peach producers. The researchers tested different sized pyramid traps and different construction materials for the traps in order to determine the most cost effective trap design. There was no significant difference in trap capture due to ear tag size, indicating that changing the jar top design prevented most of the escape. In the apple orchard, captures of adult brown and green stink bugs, nymphs, and total stink bugs did not differ significantly among trap sizes and deployment methods. Dusky stink bugs, which were fewest in number, were captured less frequently in suspended traps with the smaller size pyramid. In the peach orchard, there were no significant differences in capture among trap treatments for adult dusky and green stink bugs, and nymphs. Captures of brown stink bugs and total stink bugs were significantly lower in the smallest trap, but only when suspended. Cost of materials per trap (excluding shipping, lure and ear tag) was estimated at $10.00 for a 0.6 m pyramid - 3.8 L jar, $6.50 for a 0.3 m pyramid - 3.8 L jar, and $5.75 for a 0.3 m pyramid - 1.9 L jar. Reducing the pyramid and jar size in half reduced trap costs by 43%, without sacrificing trap capture efficiency.

A long-term organic farming project also concluded in 2009. Low-input organic farming systems using green manure and cover crops were compared to high-input systems that include 10 T/acre dairy manure compost amendments from off-farm

sources. Systems were assessed in a market garden vegetable trial and a field crop/livestock trial at the WVU Horticultural Research Farm which has been certified organic since 2003. The field crop trial included with- and without-livestock (sheep) treatments, arranged in a factorial randomized block design with the two compost (high vs low-input) treatments. Soil and plant samples were analyzed and pests were monitored and controlled uniformly on all treatments following organic standards. Small-plot trials evaluated compost rates, pest management, and variety evaluations to optimize yields and reduce insect and disease problems. Yields of potato, pumpkin, spinach and tomato were greater from plots with compost than from plots without. Root rot of spinach was significantly lower in plots with compost. Sheep produced healthy lambs which gained equally well on plots with or without compost, but compost allowed a higher stocking rate, producing more total gain per acre. Compost application resulted in significantly higher soil organic matter content, as well as higher levels of phosphorus, potassium, calcium and magnesium, than in low-input plots. Organic poultry production practices demonstrated successful broiler production without the need for synthetic methionine supplements when poultry were given access to pasture.

Maintaining and improving soil fertility, managing pests, and producing increased yields require knowledge-intensive practices on organic farms. This project demonstrated that improved production practices result in improved yields while enhancing soil quality and reducing adverse environmental impacts. Economic analyses of profitability will reduce costs and financial risks of conventional growers seeking to enter the organic market. Improved pest management practices will reduce losses to diseases, insects and weeds, leading to improved yields and more reliable production. The ability to produce poultry without synthetic methionine or lambs without synthetic antihelminthics are limiting factors in organic livestock production, and the methods developed in this project should significantly enhance grower success and profitability.

Another project concluded that was focused on evaluating and updating a computer-based tool for predicting and controlling fire blight, a disease that affects apple and pear producers. The program, called Maryblyt, was evaluated, slightly modified, and rewritten for the Windows operating system. The rewritten program has been disseminated using 1) email update to colleagues, growers, agents, and consultants (list culled from a world-wide list of fire blight professionals); 2) presentations at professional meetings; 3) presentations at grower meetings; 4) written publication in Plant Health Progress; and 5) a web page for delivering the program to potential users.

Finally, a project concluded that had been underway for 10 years involving alternative (organic) methods for controlling nematodes. Use of chemical nematicides has been restricted, requiring alternative nematode management practices. Use of crop rotation and organic amendments could reduce nematode populations. The studies conducted in this project have demonstrated that two organic farming systems have suppressed plant-parasitic nematodes, although the mechanisms remain undetermined. A better understanding of nematode behavior and nematode population dynamics is needed to improve soil management. The impact of organic management practices on crop production represents an approach that can identify improved nematode management for both conventional and organic producers. While biological control agents, such as predatory nematodes, trapping fungi or the bacterium Pasteuria penetrans, are common in agricultural soils, limited success has been achieved in using these agents. More needs to be learned about their biology in order to obtain consistent control of plant-parasitic nematodes common in agriculture.

Next year the food safety projects will be reported under a separate Food Safety Program Area. This year, because the program is relatively small, it will be reported under Global Food Security and Hunger. The primary activities in this program area involve food safety issues in pre-slaughter management of processed fish fillets in cold-water aquaculture operations and developing procedures for testing for and eradicating newly emerging water borne bacteria that may enter the food supply.

The water-borne bacteria study concluded that their findings should provide valuable information on the possible public health significance of pathogenic E. sakazakii in aquatic and food environments. The identification of key substrates required to detect stressed E. sakazakii suggests the possibility of further modifying currently available growth media to enhance the sensitivity and selectivity of the detection procedure. With a better understanding of the ecology and etiology of this opportunistic pathogen, public health officials should be able to make informed decisions concerning the protection of drinking water supplies and food safety.

2. Brief description of the target audience

Producers, extension specialists, consultants, regulators, policy makers and other researchers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	6	
Actual	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations

Year	Target	Actual
2009	9	8

Output #2

Output Measure

- Popular articles

Year	Target	Actual
2009	3	4

Output #3

Output Measure

- Producer presentations, workshops, etc.

Year	Target	Actual
2009	3	3

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 (index; cummulative %
2	Increase in state aquaculture industry - cummulative %
3	Increase state number of farms marketing organically produced vegetables - cummulative %
4	Growth in state broiler, egg and turkey industries - cummulative %

Outcome #1

1. Outcome Measures

Growth in state production of beef and lamb (index; cummulative %

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	4	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Production of lambs out of the traditional season would give producers an economic advantage due to higher market prices for out-of-season lambs.

What has been done
WVU has been studying means of inducing estrus out of season to extend the production season for lambs.

Results
Considerable progress was made this year in an effort to enable out-of-season lamb production. The FDA in October 2009 approved the use of CIDR-G for marketing in the USA as an aid in induction and synchronization of estrus in anestrous ewes. This will enable producers throughout the country to breed more ewes out of season, spreading the marketing period and increasing income from lamb and from products of dairy sheep. One of the WVU project leaders was able to present data from the project on efficacy of this method at the Great Lakes Dairy Sheep Symposium in November, at which time the approval was announced.

In terms of the quantitative target, the number of cattle and calves and sheep fell by approximately 10 percent in 2009 due to economic market conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Increase in state aquaculture industry - cummulative %

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cold water aquaculture represents an economic opportunity for farmers in West Virginia and the region.

What has been done
Research and extension projects to help develop species, small scale aquaculture systems and help farmers learn about opportunities. We have also assisted the State in developing regulations for the aquaculture industry that reduce the regulatory burden on small farmers.

Results
Greater than target level growth in the industry for the last five years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems

Outcome #3

1. Outcome Measures

Increase state number of farms marketing organically produced vegetables - cummulative %

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	3	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Organic farming represents a potential economic opportunity for WV farmers. It is crucial that organic farming decisions be based on sound science and proven methods.

What has been done
The WVU experiment has a long history of agronomic and animal research in organic farming, including a certified organic research farm.

Results
A long-term organic farming project concluded in 2009. Low-input organic farming systems using green manure and cover crops were compared to high-input systems that include 10 T/acre dairy manure compost amendments from off-farm sources. Systems were assessed in a market garden vegetable trial and a field crop/livestock trial at the WVU Horticultural Research Farm which has been certified organic since 2003. The field crop trial included with- and without-livestock (sheep) treatments, arranged in a factorial randomized block design with the two compost (high vs low-input) treatments. Soil and plant samples were analyzed and pests were monitored and controlled uniformly on all treatments following organic standards. Small-plot trials evaluated compost rates, pest management, and variety evaluations to optimize yields and reduce insect and disease problems. Yields of potato, pumpkin, spinach and tomato were greater from plots with compost than from plots without. Root rot of spinach was significantly lower in plots with compost. Sheep produced healthy lambs which gained equally well on plots with or without compost, but compost allowed a higher stocking rate, producing more total gain per acre. Compost application resulted in significantly higher soil organic matter content, as well as higher levels of phosphorus, potassium, calcium and magnesium, than in low-input plots. Organic poultry production practices demonstrated successful broiler production without the need for synthetic methionine supplements when poultry were given access to pasture.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
307	Animal Management Systems

Outcome #4

1. Outcome Measures

Growth in state broiler, egg and turkey industries - cummulative %

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	12	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results
Output in the broiler industry fell by 3 percent in 2009 while production of turkeys increased by about 3 percent.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
301	Reproductive Performance of Animals
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities

Brief Explanation

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

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

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			80%	
511	New and Improved Non-Food Products and Processes			20%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.5	0.0
Actual	0.0	0.0	7.3	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	72185	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	860748	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	603106	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 improved procedures for hardwood timber management and harvest, to increase the efficiency of wood utilization while developing new uses for hardwoods, and, increasingly, to devise new 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, systems to protect forest resources from insect pests, acid precipitation, fire, disease, and invasive species; harvest management protocols for optimum regeneration and re-growth; methods to use harvest and processing wastes to efficiently produce bio-energy; programs that respond to research needs and

concerns of corporate and private owners and provide economic comparisons among alternative management and harvest methods.

One project on the economic management of Eastern hardwood forests conducted and analyzed a two-part survey on forest owner participation in West Virginia's Managed Timberland Tax Program. The first analysis examined differences between Managed Timberland Program participants and non-participants. The majority of participants were professional with higher incomes. Lands enrolled tended to be of larger size, be located farther from the landowner's place of residence, and were more likely to have been purchased rather than inherited or acquired as a gift. Results suggest that low enrollment may be attributable to lack of knowledge, poor administration, and failure to target landowner beliefs. Landowners currently enrolled are satisfied with the program. The second analysis employed logistic regression to examine factors that affect the landowner decision to enroll in Managed Timberland. The independent variables examined were landowner characteristics (age, income, education), property characteristics (years owned, method of acquisition, distance, tract size, county), and management characteristics (knowledge, potential benefits). Results showed that landowner, property, and management characteristics were influential factors in the decision to enroll in the Managed Timberland Program. Understanding the underlying factors influencing forest management decisions of this diverse group of forest landowners could form the basis for developing, modifying and targeting policy instruments to motivate NIPF landowners in forest management. Information gathered from the tax survey will provide policy-makers tools to evaluate the forestry tax program of West Virginia. Currently, participation rate in the program is very low. Since the survey was conducted, we have received several calls from landowners expressing their interest to the program. Thus, this study has been very helpful in bringing information to the landowners about government programs that can assist them in managing their forest lands.

Another project is focused on developing an optimal sawing system for small-scale sawmills. Maximizing the profits gained from the conversion of hardwood logs into hardwood lumber is a primary concern for sawmill owners. Recently there has been an increase in the competition for hardwood logs in order to meet increasing demands for timber products. It is also critical to use timber resources efficiently because of the trends of increased log costs and limited availability. The development of optimal sawing system can provide the most efficient method of optimizing the grade and yield of hardwood lumber, which is a start to solving these problems. The research has resulted in the implementation of a procedure for the localization and reconstruction of internal defects in hardwood logs from obtained scanning information. Based on lumber grades and obtained internal defects, optimal sawing algorithms including heuristics and dynamic programming were designed and implemented for log primary break down. The researchers have developed a software system with user-friendly interfaces to implement the algorithms in a 3-D visual simulation environment. The detailed information about all the lumber including lumber dimension, surface measure area, volume, value, and grade will be displayed in the designated area of the screen. Examining actual small sawmill lumber production, the results indicated that a significant gain in lumber value can be achieved by using this optimization system. The program is expected to be uploaded to a website and accessible to the general public for ease of use and convenience.

On the public service front, we continued with coordination efforts for the third Wildland Fire Training and Education Program held at West Virginia University and sponsored by the Mid-Atlantic Fire Compact for service foresters from seven states in the Northeast. Enrollment in the program grew this year to nearly 200 students attending 12 courses focused on wildfire control and management. Another public service project used the NexFlix model (without monthly charges) to distribute DVD's on forest management and then conducted a survey to assess the success of their distribution technique. In general, the response was favorable with a number of the respondents adopting some of the best practices recommended on the DVD's.

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

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	5	
Actual	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations

Year	Target	Actual
2009	5	6

Output #2

Output Measure

- Producer workshops & technical assistance

Year	Target	Actual
2009	4	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Growth in state timber industry - cummulative % change employee compensation
2	Ability to more accurately predict yields of OSB, Paralam and additional wood species from measures on standing timber - new prediction models developed
3	Growth in state wood products and furniture industry - cummulative % change in employee compensation
4	Provide training and education in wildland forest fire management.

Outcome #1

1. Outcome Measures

Growth in state timber industry - cummulative % change employee compensation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The forest industry in WV contains a large number of small, privately owned forests. In order to increase the economic return and output of the forest industry in WV it is necessary to have landowners actively manage their forest lands. The WV Managed Timberland Tax Program is designed to give land owners to develop management plans for their forests. Unfortunately, participation rates are low.

What has been done
One project on the economic management of Eastern hardwood forests conducted and analyzed a two-part survey on forest owner participation in West Virginia's Managed Timberland Tax Program. The first analysis examined differences between Managed Timberland Program participants and non-participants. The second analysis employed logistic regression to examine factors that affect the landowner decision to enroll in Managed Timberland.

Results
Results suggest that low enrollment may be attributable to lack of knowledge, poor administration, and failure to target landowner beliefs. Landowners currently enrolled are satisfied with the program. Results also showed that landowner, property, and management characteristics were influential factors in the decision to enroll in the Managed Timberland Program. Understanding the underlying factors influencing forest management decisions of this diverse group of forest landowners could form the basis for developing, modifying and targeting policy instruments to motivate NIPF landowners in forest management. Information gathered from the tax survey will provide policy-makers tools to evaluate the forestry tax program of West Virginia. Currently, participation rate in the program is very low. Since the survey was conducted, we have received several calls from landowners expressing their interest to the program. Thus, this study has been very helpful in bringing information to the landowners about government programs that can assist them in managing their forest lands.

The quantitative target for this outcome is not being reported this year due to lack of data.

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 prediction models developed

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Growth in state wood products and furniture industry - cummulative % change in employee compensation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	6	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The WV State forest products industry is an important part of the State economy. Much of the WV industry is composed of small bisinesses and sawmills. As such, the industry needs technical assistance to remain competitive. Maximizing the profits gained from the conversion of hardwood logs into hardwood lumber is a primary concern for sawmill owners. Recently there has been an increase in the competition for hardwood logs in order to meet increasing demands for timber products. It is also critical to use timber resources efficiently because of the trends of increased log costs and limited availability

What has been done
An optimal sawing system for small sawmills has been developed. The system determines the most efficient method of optimizing the grade and yield of hardwood lumber.

Results
The research has resulted in the implementation of a procedure for the localization and reconstruction of internal defects in hardwood logs from obtained scanning information. Based on lumber grades and obtained internal defects, optimal sawing algorithms including heuristics and dynamic programming were designed and implemented for log primary break down. The researchers have developed a software system with user-friendly interfaces to implement the algorithms in a 3-D visual simulation environment. The detailed information about all the lumber including lumber dimension, surface measure area, volume, value, and grade will be displayed in the designated area of the screen. Examining actual small sawmill lumber production, the results indicated that a significant gain in lumber value can be achieved by using this optimization system. The program is expected to be uploaded to a website and accessible to the general public for ease of use and convenience.

The quantitative outcome result is not reported this year due to lack of data.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #4

1. Outcome Measures

Provide training and education in wildland forest fire management.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wildfires are a significant threat to forest lands and forest landowners in WV, particularly during drought years.

What has been done
On the public service front, we continued with coordination efforts for the third Wildland Fire Training and Education Program held at West Virginia University and sponsored by the Mid-Atlantic Fire Compact for service foresters from seven states in the Northeast.

Results
Enrollment in the program grew this year to nearly 200 students attending 12 courses focused on wildfire control and management.

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
- Competing Public priorities
- Other (Re-evaluation of outcome measures)

Brief Explanation

We are seriously re-evaluating the appropriateness of the current outcome measures for this program. That reevaluation began last year but was interrupted by the untimely passing of our Associate Experiment Station Director, Dr. William Vinson. It is anticipated that these outcome measures will be replaced with measures of knowledge and action outcomes in the next Plan of Work cycle.

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

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Sustainable Energy

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			15%	
403	Waste Disposal, Recycling, and Reuse			25%	
511	New and Improved Non-Food Products and Processes			20%	
605	Natural Resource and Environmental Economics			20%	
610	Domestic Policy Analysis			20%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual	0.0	0.0	0.0	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	15634	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	133863	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	265384	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct research; publish/present results; contribute to educational and outreach programs.

This new program focuses on biofuel and bioenergy production. We have begun to increase activity and funding of this area as indicated on the Plan of Work. The program so far is focused on examining different biomass feedstocks for the production of biofuels (ethanol, biodiesel, syngas) and biomaterials. The feedstocks examined so far include algae, switchgrass and mixed

grasses, and residual woody biomass from forestry operations. One project is focused on producing bio-products from modified lignin biomass. So far the project has been able to produce cellulose nanocrystals using recycled wood pulp.

Switchgrass (Panicum virgatum L.) has been suggested as a possible biofuel feedstock crop because of its ability to produce large amounts of biomass over a wide range of growing conditions and its ability to sequester atmospheric carbon into stable soil organic carbon. Appalachia has the potential to become a center of biofuel production with its large expanses of reclaimed mine lands that are central to the U.S. energy market. Switchgrass production on surface mine land offers the unique opportunity to increase the land resources devoted to energy crops without decreasing the land resources devoted to food and livestock feed production. Switchgrass has been shown to be a prolific accumulator of soil organic carbon (SOC) in many agricultural soils throughout the United States. However, minesoils, with their less than optimum growing conditions may limit switchgrass' ability to sequester carbon underground. Minesoils frequently have soil chemical and physical characteristics that may limit plant growth. One research project is designed to identify the best varieties of switchgrass for mined lands in northern Appalachia, their planting and management requirements, yields, biofuel feedstock potential, capacity for carbon capture and sequestration and other revenue streams. Three mine sites in West Virginia were selected to establish switchgrass and monitor yield. Three varieties of switchgrass were randomly assigned and planted into 0.4 ha plots, which were replicated three times for a total of nine plots at each site. Planting was conducted in May of 2008. The varieties of Carthage, Cave-in-Rock and Shawnee were chosen for their favorable growing characteristics and adaptation to West Virginia's climate. Another reclaimed mine site in southwestern Pennsylvania was selected to study carbon sequestration of different aged switchgrass stands. Data for SOC, total C and several other chemical and physical factors including, pH, electrical conductivity, bulk density and nutrient concentration will be presented. Results show that Cave-in-Rock produced the highest yields of the three varieties and the site with better minesoil quality (Hampshire Hill) produced the greatest yields.

A set of projects is being undertaken under the general heading of "Wood Utilization Based Research into Biofuels in the Appalachian Region." One project involves effects of ultrasonication of wood in combination with thermo-chemical treatment for bio-fuel production. Two different experiments were done to achieve the set objective of this study - Alkali treatment of wood - the effects of ultrasonication of wood in combination with thermo-chemical treatment for bio-fuel production. Another considers utilization of wood residues in West Virginia to fabricate high-value and environmentally-friendly nanocomposites. Another is examining the microbial community in the termite gut. The work will result in the discovery of genes that could subsequently be harnessed for the production of biofuels from lignocellulosic feedstocks. This has the potential to accelerate bioenergy development efforts in West Virginia and elsewhere, thereby enhancing rural economies and increasing U.S. energy independence. These projects involve industry representatives from across the state as cooperators. Research and extension activities through the Wood Utilization Research Program will help West Virginia forest product manufacturers develop the extraction, production, manufacturing, and marketing breakthroughs needed to keep the Appalachian wood products industry globally competitive into the future.

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

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	3	
Actual	0	2	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations at meetings and workshops for endusers

Year	Target	Actual
2009	3	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased understanding of habitat and other requirements for the well being of state bird and fish species sufficient to support development of effective management plans.
2	Decreasew in the number of endangered and threatened species in West Virginia
3	Increase the percentage of state energy consumption from renewable fuels.

Outcome #1

1. Outcome Measures

Increased understanding of habitat and other requirements for the well being of state bird and fish species sufficient to support development of effective management plans.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Brook trout are a native species in WV and in addition to serving an important ecosystem role trout fishing is an important part of the State recreation and tourism industry. The brook trout population is negatively affected by acid-mine drainage and other forms of water polution.

What has been done
The final report was issued for a study related to management of riparian forested habitats and the population resistance and resilience in brook trout populations in headwater streams.

Results
The long-term study of brook trout populations in 25 WV streams was awarded a Research Achievement award from the U. S. Forest Service "2009 Rise to the Future Watershed Award" honoring the project for research productivity.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Decreasew in the number of endangered and threatened species in West Virginia

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase the percentage of state energy consumption from renewable fuels.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a national and State need and federal mandate to develop and utilize renewable sources of energy, such as bio-based fuels, to reduce our dependence on imported fossil fuels and to reduce greenhouse gas emissions. Agriculture and forestry are important sources of feedstocks for biofuels. In addition, some of those potential feedstocks, such as poultry litter, are present in excess amounts in certain parts of the State and contribute to water pollution problems.

What has been done
A research project designed to reduce the environmental impact of poultry litter, conducted jointly betweeen the WVU Experiment Station and WVU Extension, has developed ways to utilize poultry litter as a feedstock for producing energy.

Results
A feasibility and economic viability analysis was conducted for a bio-based waste to energy system utilizing poultry litter as a fuel and a fixed-bed gasifier as a medium to convert litter into heat and cooling energy. Greenhouse and soil tests were conducted on the biochar byproduct of gasification. As a soil amendment, biochar was determined to be alkaline and to increase plant essential macro and micro nutrients when added to West Virginia soils. No significant effects were observed on the tissue concentrations of lead or cadmium in radish bulbs, radish leaves, or spinach leaves. For the economic analyses, three major types of benefits from installation of a gasifier on a broiler farm were described: production of biochar and possible carbon credits, savings of fossil fuel, and improved health and production of broilers. Three scenarios were examined with economic analyses: base, high energy prices, and optimistic benefits. Under these scenarios, a broiler producer could afford to pay about $190,000, $350,000, or almost $900,000 for the gasifier.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Other (Listed outcomes are from a program that has been merged into area 2, "Environmental Quality and Stewardship." They will be moved in a future POW.)

Brief Explanation

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

1. Evaluation Studies Planned

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

Evaluation Results

Key Items of Evaluation