2012 West Virginia University Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The West Virginia Agricultural and Forestry Experiment Station is part of the Davis College of Agriculture, Natural Resources and Design. While the West Virginia Cooperative Extension Service is a separate administrative unit and not part of the College, research and extension are integrated through joint appointments, through coordination of activities and planning at the deans, directors and associate-directors levels, through integrated research, extension and education projects and programs funded by Hatch, Smith-Lever and McIntire-Stennis capacity funds and through competitive funding from NIFA and other sources. In 2012 we continued to coordinate efforts by the Experiment Station and Extension to encourage joint faculty efforts to go after competitive funding, particularly AFRI funding. The areas of focus for 2012 were nutrition and childhood obesity plus research and extension work on Marcellus shale, an area of growing economic and environmental importance in our region. We have made progress with last year's memorandum of understanding with Penn State and the University of Maryland to share extension and research resources regionally rather than station by station to support our regional tree fruit industry. One plant pathologist was hired by Maryland and Penn State is interviewing for a second position. We are optimistic that this agreement will lead to further regional cooperation in other areas of concern in the future. In fact our three-institution agreement is being used as a model for the Northeast region and was used as an example in a best practices session at the Spring Northeast Experiment Station Director's meeting.

Some progress was made in 2012 to improve communication and better coordinate the programs of the West Virginia Agricultural and Forestry Experiment Station and West Virginia State University. In 2012 we continued to work together on education and outreach programs coordinated with WVU Extension. The Associate Director of the WV Agricultural and Forestry Experiment Station and the Associate Director of Community Resource and Economic Development at WV State University both serve on the Board of Directors of the Northeast Regional Center for Rural Development, which is leading to increased communication in the rural development area. Our new dean and director (as of June 2012) has met with the dean from WV State. We have initiated talks about coordinating our individual accomplishments and POW reports into a single report with WVU Extension. With a new Davis College dean/director, we hope to continue to improve our efforts to work cooperatively with WV State University.

The vision of the Davis College of Agriculture, Natural Resources and Design is to be a leader in learning, discovery, and engagement programs in natural, social and human resources aimed at improving the quality of life for the citizens of West Virginia and beyond. The mission of the Davis College is to enrich the lives of the citizens of West Virginia and beyond. This is accomplished by implementing programs designed to provide excellence in undergraduate and graduate education and research, train future leaders, collaboratively engage critical issues and promote stewardship of natural, renewable and human resources.

The Davis College houses 5 divisions - Animal and Nutritional Sciences, Design and Merchandising, Plant and Soil Sciences, Forestry and Natural Resources and Resource Management - with varied programs of study and multiple degree options. The Greenhouse, Dairy, and Rumen Fermentation Laboratory provide additional opportunities for learning and study, and provide valuable community

service. In addition, the College and Experiment Station utilize our 3,425 acres of farmland and 8,134 acres of forest for teaching, research and outreach activities.

Faculty in the West Virginia Agricultural and Forestry Experiment Station conduct research in seven program areas: Economic Development and Quality of Life in Rural Communities; Climate Change, Environmental Quality and Stewardship; Global Food Security and Hunger: Fundamental Plant and Animal Systems; Global Food Security and Hunger: Production/Sustainable Agriculture; Childhood Obesity, Human Nutrition and Health; Production/Sustainable Forestry: Timber Management and Wood Products; and, Sustainable Energy. We have merged one program, Food Safety, into the Production/Sustainable Agriculture program area.

Needs of State citizens dictate that a large portion of the research projects in these programs is related to economic development in rural communities, improving human nutrition, health and quality of life in rural communities, and protecting and preserving state natural resources and the environment. Four centers and one organizational unit exist within the College to help focus and direct our efforts on economic development, natural resources and the environment. They also contribute to our ability to leverage Hatch and McIntire-Stennis capacity funding by attracting external competitive grants and other external sources of funding. The four centers are the Natural Resource Analysis Center (NRAC), the Environmental Research Center (ERC), the National Geospatial Development Center (NGDC) and the Appalachian Hardwood Center (AHC). The organizational unit is the West Virginia Cooperative Fish and Wildlife Unit.

The Natural Resource Analysis Center (NRAC) was formed in the early 1990s as a multi-disciplinary research and teaching facility in the Davis College of Agriculture, Natural Resources and Design at West Virginia University. Geographic Information Systems and Remote Sensing have been integral parts of the research and teaching programs of the Davis College for many years. The wide range of research and teaching activities at the Center have been designed to complement work within the College, and include environmental planning, environmental and natural resource economics, recreation, wildlife management, forest ecology, and land and water reclamation. Areas of expertise at NRAC include economic development and environmental sustainability, remote sensing, land cover mapping, landscape analyses, watershed-based analysis and applications, and GIS-based planning and decision making. Recent projects have included development of water resource GIS datasets for West Virginia and parcel prioritization methodology development for land conservation.

The goal of the Environmental Research Center (ERC) is to provide a center of excellence at West Virginia University that facilitates the integration of environmental research, outreach/education, and practitioner science. The ERC acts as an unbiased intermediary among groups and as a regional and national leader in integrated environmental and social research and outreach. The Center is housed in the Davis College of Agriculture, Natural Resources and Design, and is a collaborative venture involving faculty and staff from numerous programs and colleges throughout WVU as well as external collaborators from both the public and private sectors. The center's goal is to serve as the nucleus tying together various groups interested in interdisciplinary environmental research and education. As a college center, the ERC focuses on being a key driver behind large multi- and interdisciplinary research, teaching, and outreach efforts focused on environmental topics.

Funded by the Natural Resources Conservation Service (NRCS) and in partnership with West Virginia University, the National Geospatial Development Center (NGDC) was established to develop geospatial technologies that support the business mission of the NRCS. The Center operates collaboratively with university researchers, other NRCS Centers, as well as private and public partners to advance the integration and utilization of geospatial technologies in NRCS. The mission of the National Geospatial Development Center is to enhance NRCS capacity to produce, utilize, and apply soil and natural resources information through the innovative application of geospatial technologies in partnership

with Cooperative Ecosystem Study Units, private industry, and other USDA technology centers.

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. The Appalachian Hardwood Center (AHC) at West Virginia University is a jointly supported center of the WVU Extension Service and the WVU Davis College of Agriculture, Natural Resources and Design. The center was established in 1987 by the West Virginia Legislature to provide technical and research support for the state's growing wood products industry. The AHC is a center of excellence for outreach, extension and technology transfer, professional development, and applied research. The AHC serves sustainable, natural resource-based businesses and communities as well as private forest landowners and natural resource professionals in the Appalachian forest region.

The quantity and variety of wildlife in West Virginia are extremely important to the economy and character of the state. Research in this planned program is designed to better understand habitat requirements for wildlife in West Virginia, and to determine the impacts of human activity on wildlife habitat, particularly habitat for fish and song birds. A large majority of the research in this program represents cooperative research between West Virginia Station faculty and scientists with the West Virginia Division of Natural Resources, USGS, US Fish and Wildlife Service, and the Wildlife Management Institute, a group collectively known as the West Virginia Cooperative Fish and Wildlife Unit. While capacity funding provides infrastructure for this program, the majority of research in wildlife management is supported by external funds, another example of how capacity funds allow us to develop the infrastructure to attract external funding to deal with real-world problems.

This annual report provides an overview of the programs in the WV Agricultural and Forestry Experiment Station with selected accomplishments for 2012 highlighted in the narrative for each program area.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	40.9	0.0
Actual	0.0	0.0	45.0	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 Hatch or McIntire-Stennis 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 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 instead 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 subcommittees).

Strategies indemnified for improvement under the Interim Dean in 2011 have continued. These include a monthly update notes to faculty, staff and alumni; Creation of a spring and fall edition of a College magazine distributed within the College and University and to alumni, visiting committee and external industry and community partners; Re-activation of the College Visiting Committee; Effective representation of the College at major university, alumni, industry and stakeholder functions within the State,etc., State Fair, Farm Bureau, Beef Cattle, Poultry and Forestry commodity organizations. The result has been an enhanced image of the college within the University and among external constituents and improved morale within the College faculty and staff.

The Davis College of Agriculture, Natural Resources and Design continue to value our work with the stakeholders and partnerships within our State and need their continued input to improve and make more relevant these relationships in the future and continue to enhance the well-being and quality of life of citizens in West Virginia in disciplines germane to our College. New facilities such as a new greenhouse completed in 2012 and a designed new Agriculture Sciences building proposed for completion in 2014/15 will enhance the quality of our teaching and research activities and partnership potential with external partners. These new facilities as well as scheduled renovations of existing facilities will certainly improve morale of faculty, staff and students, enhance our image and afford enhanced opportunities for our service, outreach and engagement agenda.

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.

The focus of the Service/Outreach agenda for the College is to continue to enhance our communication and working relationship with our Extension partners, commodity and industry groups, state agencies and community organizations that represent our College disciplines within the State of West Virginia. The impact of these efforts by the College will continue to enhance our relationship with our academic partners and stakeholders and make our programs more relevant to needs of the State and be consistent with Goal 5 of the West Virginia University's 2020 Strategic Plan- "to enhance the well-being and the quality of life of the people of West Virginia. We truly believe that our success as a land grant College/Institution will be measured by how well we serve

the citizens of West Virginia, then the nation and the world. Based on the initial strategies identified in 2010 to improve our Service and Outreach agenda, we have had good success in implementing these strategies and have realized some strong positive impacts for an improved image of the College within the University and our Service and Outreach agenda within the State and region.

Strategies to Enhance our Service/Outreach Agenda

1. Contact and communicate information to the various stakeholder groups offering our assistance and requesting their input to identify their priority needs.
2. To create an updated data base of stakeholder, community groups and industry partnerships relevant to the College.
3. Implement activities to enhance the communication, awareness and image of the College.
   a. Expand our presence and participation to stakeholder groups
   b. Re- create a College Newsletter
   c. Annual open house
   d. Enhance the activities of the College Alumni Association
   e. Research Annual Reports
   f. Re-visit the role of the College Visiting Committee in support of the College

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.

Surveys are distributed at annual meetings for numerous organizations having interest in College program areas (related to agriculture, forestry, landscape architecture, interior design, human nutrition, etc,) to provide input. Division Directors, College faculty and advisory groups are queried regularly and routinely to identify industries, groups or subject matter areas needing representation in the College input stream and for specific individuals to fill these roles.

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.

The Davis College continues to address the future challenges in service and outreach under new leadership effective June 1, 2012. Dr. Daniel Robison became the new Dean of the College and Director of the Experiment Station. In preparation for this transition to the new leadership, a team of faculty from Extension and the College were asked to develop future strategies to improve the effectiveness of the College's outreach and engagement agenda. This team has completed a survey within the academic and extension units of WVU and plans are ongoing to utilize our existing data base and extend this survey to external stakeholders, industry and community partners as the next step in the development of proposed strategies for an enhanced outreach and engagement agenda for the College. The summary of the internal survey would suggest that approximately 75% of the responding faculty feel that they are contributing to the University's outreach and engagement agenda. The definition of outreach, engagement and service as viewed by the faculties is highly variable without any common description across the various disciplines. In addition, when asked to identify the most limiting factor to the enhancement of our service and outreach agenda, there was a common theme; lack of resources and failure of the system to provide any meaningful reward in support of the promotion and tenure system.

The College continues to have two alumni associations, college and the division of natural resources (forestry). The new Dean should be given time to explore and make recommendation for potential changes in the meeting and banquet venues to link with other activities in the college and improve participation and grow this association in support of the college.

Brief Explanation of what you learned from your Stakeholders

Impact of the Outreach Activities: Under the leadership of the new Dean the internal and external image and recognition of the Davis College remain very strong. With the development of strategies for continued improvement of the College outreach and engagement agenda, the College under the new leadership will continue to focus and expand our agenda. The service/outreach agenda of the College will continues to address problem issue relevant to the State and appropriate to our disciplines. The service/outreach agenda for the College will continues to expand as the faculty numbers and discipline expertise in emerging issues increase and the partnerships with academic, industry ,state agencies, community and stakeholder organizations are enhanced. Such increases over the last few years have occurred in community design teams, human nutrition and foods, animal sciences and design. We know that the average citizen or the stakeholder can easily define their perceived need or desired support from the University. However, they have little understanding or concern for the separation of duties defined within the University structure. Thus, their concept of the value of the University/College is reflected in the effectiveness of their relationship with an individual or individuals on the faculty and staff. We are convinced that we have and must continue to improve our involvement and relationships within the State and among our alumni. The College through our faculty can improve our contributions to the educational programming and problem solving for the various groups and organizations and enhance the awareness of the University and the College within the State.

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	3232524	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	2918770	0
Actual Matching	0	0	6361074	0
Actual All Other	0	0	4461168	0
Total Actual Expended	0	0	13741012	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	1911100	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

☑ Reporting on this Program

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%	
134	Outdoor Recreation			15%	
511	New and Improved Non-Food Products and Processes			15%	
604	Marketing and Distribution Practices			15%	
605	Natural Resource and Environmental Economics			10%	
608	Community Resource Planning and Development			20%	
724	Healthy Lifestyle			5%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			5%	
903	Communication, Education, and Information Delivery			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.5	0.0
Actual Paid Professional	0.0	0.0	6.9	0.0
Actual Volunteer	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	419306	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	687734	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	169909	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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, natural gas, 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 two categories: economic development and quality of life.

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, wood utilization, organic production of vegetables and animal products, and ecotourism. Cutbacks in Agricultural Research Service (ARS) budgets and the closing of the ARS facility in Beaver, WV, have led to a reduction in the research resources devoted to the pasture finished beef projects. The elimination of congressionally directed spending has also led to reduced activity in the aquaculture and wood utilization areas. These cutbacks increase the relative importance of federal capacity funding and AFRI competitive funding to the success of our research programs.

In spite of funding cutbacks, advances were made in the aquaculture/aquaponics project. One study sought to determine how strains of rainbow trout differ in their performance under elevated temperature. This is an important consideration as most streams in the Mid-Atlantic reach summer temperatures that result in high levels of trout mortality. It was found that there were significant differences between the Critical Thermal Maxima among 3 trout strains and that the Case Western strain had a higher thermal tolerance than the Kamloop and Wytheville strains. In general, the Case Western strain consumed less, converted less efficiently, and grew less than the other two strains while held above optimal temperature. Another study examined the genetic basis for observed differences in thermal performance between strains based on how expression of Heat Shock Protein (HSP) 70 and HSP90 differ. The results confirm that the Case Western strain has higher thermal tolerance, highlighting the importance of this strain as a candidate to be cultured in aquaculture facilities to mitigate impacts of future climate change. Another study examined aquaculture feeding rates, fish growth and economic efficiency. It was found that feeding to satiation will maximize growth rate and shorten a production cycle, but restricted feeding will result in higher feed efficiency and lower cost/lb of gain.

On the aquaponics front, production data for 12 vegetable crops and 2 ornamental crops showed

greatly decreased production during fall/winter months. Production in spring and summer showed greater increase in production which is most likely dependent on temperature and light during production. Data did indicate that the lettuce cultivar Red Sails performed better in our system then Green Ice and Buttercrunch. Preliminary analysis of the nutrient removal data indicates that when crops are growing quickly an exponential function best describes uptake rates while under slower growing conditions a linear function is appropriate.

Native plants with potential use in the landscape and pharmaceutical industries have been identified from an extensive list of native plants in West Virginia. Information has been disseminated to medical doctors and pharmaceutical firms interested in plant extracts for treatment of specific illnesses. Initial findings have sparked interest by those wanting to develop products for sale in the pharmaceutical industry. Techniques are being explored to enhance concentration of the active ingredient in plants. Several protocols for in vitro propagation and storage were developed. These protocols will help conserve and protect several native plant species.

Another study examined lower back (lumbosacral, LSP) disease in working dogs, such as those used in the military or law enforcement. Eighteen Labrador Retrievers were included in the study, 12 males and 6 females. Groups consisted of 1 companion dog without LSP, 14 companion dogs with LSP, 2 working dogs without LSP, and 1 working dog with LSP. Mean area ratios were lower for all paraspinal muscles in working and companion dogs with LSP, except for the longissimus lumborum. Mean CT densities were lower for all paraspinal muscles in working dogs with LSP, except for the quadratus lumborum. Mean CT densities were lower for longissimus and quadratus lumborum muscles and higher for psoas/iliopsoas and multifidus muscles in companion dogs with LSP. Most of the findings in our study were similar to those reported in human studies. Higher area ratios for longissimus muscles and higher mean densities for psoas/iliopsoas, quadratus lumborum, and multifidus muscles in dogs with LSP were unexpected and may warrant further investigation.

2. Brief description of the target audience

The primary audience for our community and economic development activities is community managers, planners, policy makers, consultants and local development committees or groups. For aquacultural and agricultural product development and marketing, the audience includes producers, processors and distributors. Our work on the quality of life is used by local and State planners and policy makers, State citicens and community groups and educators.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	6	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	6

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	Actual
2012	4

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	14

Output #4

Output Measure

- Popular press reports.

Year	Actual
2012	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of community specific plans developed and adopted in whole or in part to help enhance economic development and quality of life.
2	Number of business plans in the State developed and implemented with assistance from the WVU Agricultural and Forestry Experiment Station.
3	Improve recreational fishing opportunities to help stimulate the recreational fishing industry in the State.

Outcome #1

1. Outcome Measures

Number of community specific plans developed and adopted in whole or in part to help enhance economic development and quality of life.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	4

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. Our Community Design Team (CDT) has operated for 13 years to provide multidisciplinary University teams to help regional communities with economic development, tourism, flood control, transportation planning and design issues. The CDT is a joint venture of the Davis College and WVU Extension

What has been done
In 2012 the WVU Community Design Team visited two new communities, Moundsville and the New Vrindaban, Palace of Gold Community, revisited one (Clay)and completed a project involving Parkersburg.

Results
In Parkersburg the team worked with the Northern WV Brownfields Assistance Center Development Collaborative and obtained a competitive grant to assist the community with Brownfield remediation and development. In a collaboration between Extension and Davis College Programs, the team produced a marketing report for business owners and drafted a historic preservation plan concerning the endangered old county courthouse. A 6-person Landscape Design Team that included faculty and students analyzed potential park plans and overall spatial needs in Moundsville. Historic, business, tourism and neighborhood opportunities were also considered.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #2

1. Outcome Measures

Number of business plans in the State developed and implemented with assistance from the WVU Agricultural and Forestry Experiment Station.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Improve recreational fishing opportunities to help stimulate the recreational fishing industry in the State.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recreational fishing is an important and growing State industry. The industry is limited by two factors: water pollution from abandoned mining operations and limits to cold water fishing opportunities (mainly trout)due to warm water in the summer months.

What has been done
We have worked with the Department of Natural Resources in the State to restore tree cover in the upper reaches of two watersheds to reduce water temperatures and have also designed culvert systems that do not block trout movement to allow trout to move to cooler spring-fed sections of streams in the summer. We have also been developing new strains of trout that are more heat tolerant than current strains. The results confirm that the Case Western strain has higher thermal tolerance, highlighting the importance of this strain as a candidate to be cultured in aquaculture facilities to mitigate impacts of future climate change. Another study examined aquaculture feeding rates, fish growth and economic efficiency. It was found that feeding to

satiation will maximize growth rate and shorten a production cycle, but restricted feeding will result in higher feed efficiency and lower cost/lb of gain.

Results
The Case Western strains demonstrated heat tolerance make it a favorable candidate for stream stocking programs in the State. The strain may also be useful in the Northern sections of the Northeast as climate change warms previously cold aquatic habitats. We are starting a three year study in conjunction with the State Department of Natural Resources to examine the effectiveness of the stream restoration efforts in restoring native trout species in damaged stream reaches.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Brief Explanation

Cutbacks in Agricultural Research Service (ARS) budgets and the closing of the ARS facility in Beaver, WV, have lead to a reduction in the research resources devoted to the pasture finished beef projects. The elimination of congressionally directed spending has also lead to reduced activity in the aquaculture and wood utilization areas. These cutbacks increase the relative importance of federal capacity funding and AFRI competitive funding to the success of our research programs.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

Key Items of Evaluation

The Community Design Team (CDT) continues to be an effective means of providing university expertise to local communities who wish to improve the regional economy and the quality of life in rural communities. Earlier evaluations of the program led to the realization that a single visit and report was often not sufficient to insure that community goals were met. Consequently, we now schedule follow-up visits with previously visited communities to assess how well they have implemented the plans that were jointly

developed and to assist with a mid course correction to get them back on track. This change has increased the effectiveness of the CDT and has often identified new opportunities for collaboration. In addiiton, while students have always been involved in the visits, we have developed a new Masters in Landscape Architecture program that allows students to conduct research at the community level. This change is too recent to evaluate, but we feel strongly that it will be successful.

We are just starting a three year evaluation of our stream restoration efforts. The evaluation will not only look at the ecological impacts of the restoration projects, but will also examine the economic consequences of the efforts in terms of recreational benefits and costs of implementation.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change, Environmental Quality and Stewardship

☑ Reporting on this Program

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			15%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
112	Watershed Protection and Management			15%	
132	Weather and Climate			15%	
133	Pollution Prevention and Mitigation			15%	
135	Aquatic and Terrestrial Wildlife			20%	
605	Natural Resource and Environmental Economics			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	10.1	0.0
Actual Volunteer	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	454248	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1156043	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1314947	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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 particularly given the extra stresses and uncertainty imposed by a changing climate. 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 and anticipating and adapting to climate change. Our primary environmental research areas involve mine land restoration, soil science, ecosystem resiliency to climate change and other environmental stressors, water quality, wetlands, and aquatic and terrestrial wildlife ecology.

Contamination of soil and water with acid mine drainage from abandoned surface and underground mines and restoration of the landscape from surface mining are important issues in West Virginia. 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 and watersheds. Progress continues in assessing the ecological functions of restored and created wetlands.

One project involved a study of amphibians in 12 mitigated and 12 natural wetlands in order to gauge whether mitigated wetlands are functionally equivalent to natural wetlands. This is an extremely important scientific and policy issue because many wetlands have been drained for development and federal law requires that any new development of wetlands be balanced by equivalent constructed wetlands. Wetlands are extremely important because of their ecological roles providing habitat, buffering rainfall events to reduce flooding and serving as nutrient and pollution sinks. The investigator has determined that, based on the diet composition and use and selection of prey by adult red-spotted newts, created wetlands provide an adequate prey base for generalist amphibian predators. Based on similar abundance of spring peeper and green frog metamorphs in created and natural wetlands, he also provided evidence for the assertion that created wetlands are functional replacements of natural wetlands with respect to wildlife habitat.

Negative impacts to headwater catchments resulting from large scale surface mining are pervasive in West Virginia. The state's mitigation program is critical to ensuring the restoration and maintenance of essential headwater functions such as flood mitigation, provision of clean water, and supplying food, nutrients, and energy to downstream fisheries. A recently completed study quantified the ecological benefits of the current stream mitigation process. This allowed the investigator to identify shortcomings in the current process and recommend changes that will ensure a maximally beneficial process. They are

now working to integrate this information into a spatially explicit modeling system that will allow state agencies, federal agencies, and industry partners to identify priorities for restoration and design strategic stream mitigation plans. Results from this research are being used to develop a state-wide stream mitigation trading and banking program based on functional stream ecosystem values. The results also are being integrated into a state-wide process to maximize stream restoration effectiveness in mined watersheds. The research team made almost 50+ presentations to state agencies, federal agencies, industry partners and conservation stakeholder groups from 2008-2012. Most notably, the team has attracted several additional complementary research projects totaling over $1 million in research grants from state, federal, and industry partners, thus highly leveraging their use of federal capacity funding.

Mountaintop removal mining is a dominant driver of land use/land cover changes in the Appalachian Region of the Eastern United States and is expected to increase in scale in the coming decades. While several studies quantify land use/land cover changes attributed to traditional surface mining and at regional scales, no studies focus specifically on mountaintop removal/valley fill mining practices at the watershed scale. Two studies were conducted to explore the impacts of mountaintop removal mining at the basin scale and the headwater scale. For the basin scale study, no statistically significant trends were detected in any of the time series. However, the headwater scale study, using simple hydrometric data and transfer function rainfall-runoff modeling a clear pattern was detected. The mined catchment has a higher magnitude response to rain events in terms of total specific discharge and peak specific discharge than the forested catchment. More rainfall is being converted to streamflow in the mined catchment and the event response is more rapid in the mined catchment as demonstrated by the time lag between peak precipitation and peak discharge and response time modeling. Analysis of the transfer functions used to describe catchment processes suggests that this more rapid response is being controlled by a rapid draining of a fast responding reservoir.

Several pathogens of man may be transmitted through contaminated drinking water. Primary pathogens such as those causing dysentery, cholera, shigellosis and typhoid fever are of major concern in developing counties where water and wastewater treatment are lacking or minimal. However, more attention has been directed recently to the role of opportunistic pathogens in causing waterborne disease, especially in developed countries despite the use of apparent adequate drinking water treatment. One project is focused on Cronobacter (Enterobacter) sakazakii, a pathogen most frequently associated with contaminated infant formula. Possibly, C. sakazakii may gain access to the powdered infant formula through the use of contaminated water used to reconstitute the liquid formula. Since relatively little is known about the ecology of this pathogen, the investigators are especially interested in the ability of C. sakazakii to respond to natural and artificial stressors the bacterium may encounter (survival in aquatic environments such as ground water, response to disinfection processes, efficiency of laboratory recovery methods, sensitivity to antibiotics following environmental stress, e.g.). Current efforts are centered on an examination of the response of C. sakazakii to a combination of low temperature and nutrient deprivation, a situation that may occur in cold-temperature groundwater environments. An understanding of the physiological response of C. sakazakii to such environmental stresses should be of assistance in the assessment of the ecology and distribution of this opportunistic pathogen in aquatic environments. Although observations are somewhat preliminary in nature at this point, findings will be shared with federal, state, and local agencies involved with the evaluation and regulation of water quality.Public health officials and regulatory agencies involved in policy decisions regarding water quality will be better informed about the significance of C. sakazakii as a potential waterborne pathogen.

At the request of USDA-ERS, a modified version of the Intergovernmental Panel on Climate Change model was used to estimate the change in soil carbon storage when land is removed from the Conservation Reserve Program (CRP) and returned to crop production. The model was not initially written to account for changes from CRP to another land use because land enrolled in the CRP was assumed to remain in the CRP. Therefore, equations needed to be adjusted to account for a change in land use that may generate lower soil carbon accumulation or, in the case of the CRP, losses in the soil carbon that was

increased under the previous land use. The model has now been updated to account for land use changes from CRP to crop rotations that may reduce the amount of stored carbon. The results of this analysis have been provided to USDA-ERS for review. The results of this project will be used to provide an assessment of the costs of crop and land management activities that could be implemented to increase the amount of carbon stored in agricultural soils. This information, combined with estimates of the biophysical potential for agricultural lands to sequester carbon will aid in determining appropriate policy and legislation activities to address issues of global concern.

Another investigator continued research on the conservation genetics of fish and wildlife populations. This year's work examined the genetic effects of lake sturgeon stocking. The results of the study demonstrated that multiple years of stocking is necessary to adequately represent the genetic diversity of the source population. Also, the number of released offspring and family sizes need to be equalized across years in order to maximize the effective population size.

2. Brief description of the target audience

The activities in this area are used to contribute to the body of knowledge in the environmental and natural sciences, and to inform policy makers, planners, regulatory agencies and public interest and citizens groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	15	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	8

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	1

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	15

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Reduce percentage of state streams classified as impaired by agricultural and forestry activities (%).
2	Number of State landowners adopting reclamation and watershed protection practices in consultation with Experiment Station Faculty.

Outcome #1

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	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As reported under goal 1, recreational fishing is an important state industry. In addition, impaired streams reduce water quality to communities that draw their drinking water from streams and can lead to increased flooding. Wetlands are often important contributors to stream health and quality of aquatic ecosystems.

What has been done
We have been working with the State Department of Natural Resources (DNR) to examine ways to improve the upper reaches of streams, both in terms of replanting trees around streams that had been removed in past forestry operations and restoring stream structure to create pools for trout and other species and to slow waterflow in storm events to reduce downstream flooding. Two streams are being restored now, Upper Shavers Fork, part of the Cheat River system and the upper reaches of the Cranberry River. Both formerly had native populations of trout before forestry operaitons and mining damaged the rivers. Another study has examined the effectiveness of constructed wetlands in replacing the ecological services of damaged or converted wetlands.

Results
So far the results of the stream restoration efforts have appeared to be positive. It will take time to evaluate the changes as trees around the streams grow to provide a better canopy to reduce stream temperatures and as species repopulate the habitat. We are undertaking a three year evaluation of the projects from an ecological and economic perspective.

The wetlands study has determined that, based on the diet composition and use and selection of prey by adult red-spotted newts, created wetlands provide an adequate prey base for generalist amphibian predators. Based on similar abundance of spring peeper and green frog metamorphs in created and natural wetlands, it also provided evidence for the assertion that created wetlands

are functional replacements of natural wetlands with respect to wildlife habitat.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Number of State landowners adopting reclamation and watershed protection practices in consultation with Experiment Station Faculty.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

Key Items of Evaluation

A group of researchers, research administrators and program leaders from the Department of Natural Resources met to evaluate our stream restoration efforts, our aquatic ecology efforts and our economic analyses of the benefits of stream restoration. While the agency was happy with each of the individual areas of research we determined that it would be better if the different disciplines worked together rather than separately. That discussion led to the decision to undertake a three year study that simultaneously examined the joint effects of stream restoration on stream ecology and economic benefits and costs.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Fundamental Plant and Animal Systems

☐ Reporting on this Program

Reason for not reporting

{No Data Entered}

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 FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.5	0.0
Actual Paid Professional	0.0	0.0	5.5	0.0
Actual Volunteer	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	849582	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1042054	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	398134	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research involving fundamental plant and animal systems is designed to increase our basic scientific 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 that are symbiotic with pasture grasses.

One study titled, " Biochemical and Genetic Basis for Ergot Alkaloid Diversification," concluded in 2012. The study examined the production of alkaloids by ergot fungi that are symbiotic with grasses. Better understanding of the process for producing the alkaloids and the types of alkaloids produced is important because some of the alkaloids are beneficial to the grass and others are toxic to the ruminants that feed on the grass. Ergot alkaloid producing fungi generate a diverse set of bioactive alkaloids from a single pathway inefficiently converting one pathway intermediate to the next. The result of this pathway inefficiency is the accumulation of some pathway intermediates and spur products to concentration similar to that of the pathway end product. This issue is important in forage grasses that contain ergot alkaloid-producing fungal symbionts, because different ergot alkaloids provide different benefits (of potential agricultural significance) to the producing fungi and the grasses that they colonize. Some ergot alkaloids deter insect feeding and are insecticidal. Several ergot alkaloids are toxic to mammals or deter grazing, adversely affecting animal agriculture. This study has provided new information on the means by which a diverse set of alkaloids is produced from a single pathway. The investigators also demonstrated that altering the expression of an individual gene can increase or decrease levels of ergot alkaloids from different parts of the pathway, potentially altering the anti-insect or antimammalian activities of the fungus. By understanding and manipulating the ergot pathway, it may be possible to alter the profiles of ergot alkaloids in grasses to improve their agronomic and nutritional properties.

Another study titled, "Ovarian Influences on Embryonic Survival in Ruminants," also concluded in 2012. The goal of the project was to identify new genes in bovine fetal ovaries. The project was successful through deep sequencing of bovine oocytes. A predicted bovine ZnF gene was identified. Preliminary analysis of this novel ZnF gene in various bovine somatic and ovarian tissues revealed that its expression is, in fact, restricted to fetal ovaries. Identification of a novel gene in bovine fetal ovaries expands knowledge of the bovine oocyte and provides an opportunity for characterization of this gene and its role in ovarian function. A better understanding of PGF2alpha signaling resulting in CL regression is the key to

discovering new methods of estrous cycle manipulation in the cow, as well as other mammals. The demonstration that AMPK is involved in the response to activation of the prostaglandin F receptor in corpora lutea elucidates one more component of the mechanism of action of PGF2alpha in luteal regression. Further molecular characterization of the newly discovered zinc finger gene and analysis of its expression during follicular development and early embryogenesis will provide new information about the functional roles of this novel (potentially oocyte-specific) ZnF gene in the regulation of folliculogenesis and early embryogenesis in cattle.

Researchers conducting a study titled, "Phylogenetic, ecological, and biogeographical characterization of arbuscular mycorrhizal fungi and their symbioses with plants in diverse habit," continued their work in developing a gene library which now totals 386 sequences that encompass 78 species of arbuscular mycorrhizal fungi (AMF) in 16 genera. The basic research into the phylogeny of AMF is providing new information on relationships between species and genera, as well as defining the phenotypic plasticity that heretofore was interpreted as reflective of species-level differences. Patterns of LSU gene evolution, and the variants discovered in this gene, are providing evidence that concerted evolution, a process important in homogenization of variants (insuring functional ribosomes) is either slowed or inhibited enough that variants persist as ancestral polymorphisms. This work also is showing that selection is a much more potent force than genetic drift in retention of these variants because each fungus has a large effective population size. Our applied research is providing data which commercial producers can use to more effectively manage inoculum production and storage and testing new ways that these fungi can be delivered for application to horticultural crops.

A long-term study titled, "Biological Improvement of Chestnut through Technologies that Add Management of the Species, its Pathogens and Pests," has sought to determine ways to restore the American chestnut, which has been nearly eliminated from the U.S. by the chestnut blight. Outcomes of this project have focused on three field-oriented studies. The first is a long-term experiment designed to initiate biological control of chestnut blight in an American chestnut stand near West Salem, Wisconsin. The 20-year study involves the release of hypoviruses (viruses that reduce the virulence of the chestnut blight fungus) into the resident population of Cryphonectria parasitica, the fungus that causes chestnut blight. Annual evaluations of the disease have demonstrated that biological control is possible especially on trees that have been treated with strains that contain hypoviruses. The highest level of hypovirulent inoculum to perpetuate biological control was in the area of the stand with the longest history of infection and hypovirus introduction. Although some trees in the stand have died, others are recovering from the disease and should survive. 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. As biological control is achieved, seed production should be restored so that the American chestnut component of the stand can be perpetuated. A second series of studies is designed to evaluate whether increased resistance to chestnut blight that has resulted from The American Chestnut Foundation's breeding program can be combined with biological control afforded by utilizing hypoviruses. To accomplish this, American, Chinese, European chestnuts and a variety of Chinese X American backcrosses have been planted in an orchard setting and will be used to test whether the two approaches to disease control can be combined effectively to manage chestnut blight. The third project involves an assessment of hypoviruses in the C. parasitica population in the Great Smoky Mountain National Park in TN and NC. Seven areas of the park have been surveyed and over time 159 isolates of C. parasitica on 139 American chestnut trees were collected. Only one putative hypovirulent isolate was identified. Further testing is necessary to ascertain the biological control effectiveness of the putative hypovirulent isolate.

2. Brief description of the target audience

The target audience for this area is composed of animal and plant scientists, biochemists, professional practitioners, dieticians, regulators and agribusiness firms.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	14	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentation on research at professional meetings

Year	Actual
2012	12

Output #2

Output Measure

- Completed graduate degree programs

Year	Actual

2012 8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

Gain understanding of the mechanisms that govern flower senescence

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Certain types of ergot fungi are symbiotic with grasses. Better understanding of the process for producing the alkaloids and the types of alkaloids produced is important because some of the alkaloids are beneficial to the grass and others are toxic to the ruminants that feed on the grass. It may be possible to engineer grass varities that produce fewer ergot alkaloids but are still vigorous in the environment. Better understanding of the process for producing the alkaloids and the types of alkaloids produced is important because some of the alkaloids are beneficial to the grass in acting as insect repellants and others are toxic to the ruminants that feed on the grass.

What has been done
This study examined the production of alkaloids by ergot fungi that are symbiotic with grasses. It was discovered that ergot alkaloid producing fungi generate a diverse set of bioactive alkaloids from a single pathway inefficiently converting one pathway intermediate to the next. The result of this pathway inefficiency is the accumulation of some pathway intermediates and spur products to concentration similar to that of the pathway end product.

Results
This study has provided new information on the means by which a diverse set of alkaloids is produced from a single pathway. The investigators also demonstrated that altering the expression

of an individual gene can increase or decrease levels of ergot alkaloids from different parts of the pathway, potentially altering the anti-insect or antimammalian activities of the fungus. By understanding and manipulating the ergot pathway, it may be possible to alter the profiles of ergot alkaloids in grasses to improve their agronomic and nutritional properties.

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 - # new strategies employed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The American chestnut was once an important Eastern U.S. tree species, both from an ecological standpoint and an economic standpoint. The American chestnut has been nearly eliminated from the U.S. by the chestnut blight.

What has been done
A long-term study titled, Biological Improvement of Chestnut through Technologies that Add Management of the Species, its Pathogens and Pests, has sought to determine ways to restore the American chestnut.The 20-year study involves the release of hypoviruses (viruses that reduce the virulence of the chestnut blight fungus) into the resident population of Cryphonectria parasitica, the fungus that causes chestnut blight. Annual evaluations of the disease have demonstrated that biological control is possible especially on trees that have been treated with strains that contain hypoviruses. The highest level of hypovirulent inoculum to perpetuate biological control was in the area of the stand with the longest history of infection and hypovirus introduction. Although some trees in the stand have died, others are recovering from the disease and should survive. 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.

Results
As biological control is achieved, seed production should be restored so that the American chestnut component of the stand can be perpetuated.

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 - # new genes identified

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Better understanding of ovarian specific gene expression may help to increase reproductive success in ruminants and other animals.

What has been done
The project was successful through deep sequencing of bovine oocytes. A predicted bovine ZnF gene was identified. Preliminary analysis of this novel ZnF gene in various bovine somatic and ovarian tissues revealed that its expression is, in fact, restricted to fetal ovaries.

Results
Identification of a novel gene in bovine fetal ovaries expands knowledge of the bovine oocyte and provides an opportunity for characterization of this gene and its role in ovarian function. A better understanding of PGF2alpha signaling resulting in CL regression is the key to discovering new methods of estrous cycle manipulation in the cow, as well as other mammals.

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

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

Key Items of Evaluation

Basic research is difficult to evaluate on a short term basis, so this program will be evaluated internally and externally on a 5-year basis, with the date of the first review to be determined at our Spring 2013 visiting committee meeting.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Global Food Security and Hunger--Production/Sustainable Agriculture

☑ Reporting on this Program

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.5	0.0
Actual Paid Professional	0.0	0.0	11.2	0.0
Actual Volunteer	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	954598	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2085085	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1626189	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program area involves applied research in plant and animal production systems. Projects are focused on increasing the productivity and sustainability 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 with a declining amount of acreage in tree-fruit 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. A number of projects at the Davis College involve long-term organic farming research involving plant systems, animal systems, integrated plant and animal systems and non-chemical control of parasites in sheep.

In our organic farming research this year a field trial compared yield response and pest damage from the Brown Marmorated Stink Bug (BMSB) to applied compost in tomato, green beans, and zuccini. Four replicate plots of each combination were planted with rows of each cultivar. Plots were amended prior to planting with 0 and 10 tons of dairy manure compost (0.64 % N, 0.58 % P, 0.72 % K,) per acre. Drip irrigation was applied as needed. Green bean cultivars Royal Burgundy, Provider, and Rocdor showed relatively little injury to Brown Marmorated Stink Bug (BMSB) due to very low pest populations. Yields of Provider were significantly greater than the other cultivars; however, compost had no significant effect on yield. Tomato cultivars WV 63, Great White, Washington Red, Black Prince, Black Cherry, and White Cherry all showed injury to BMSB. Although symptoms were most pronounced on darker cultivars, neither cultivar nor compost treatment had a significant effect on the percentage of BMSB-injured fruit. Yields were highest for Golden Nugget and Washington Cherry early in the season, but WV 63 and Great White were highest in the later part of the season. Yields were higher in plots with compost than in plots without, but there was a tendency for the low input plots to have higher yields very late in the growing season, suggesting that compost promotes early yielding. No significant pest pressure was observed. Yields of

Dundoo, Magda, Raven, and Zephyr squash did not differ among compost treatments, although Magda and Zephyr produced the highest yields and tended to be higher with compost than without.

A project titled, "Management of the Brown Marmorated Stink Bug," examined pesticide, biological control, and combined strategies to manage the BMSB. In particular, the spined soldier bug is a predator of the BMSB, but its effectiveness was hypothesized to be reduced by use of pesticides. A bioassay of insecticide effects on spined soldier bugs was conducted. Three organic insecticides and three non-organic insecticides were selected for insecticide bioassays: Pyganic, Azera, and insecticidal soap for organic insecticides and Lannate, Vydate, and Asana for non-organic pesticides. Nymphs and adult spined soldier bugs were be used for the bioassay. An insecticide was directly applied to spined solider bugs and their mortality was recorded after 1, 2, 3, 4, and 5 days after application. The same bioassay was conducted for each of three spined solider bug stages with each of three different rates of pesticides (i.e., control, low, medium, and high concentration based on pesticide labels). The investigator found that all the pesticides tested caused some degree of mortality to spined solider bugs. Lannate and insecticidal soap showed 100% mortality of all the stages of spined solider bugs. Also, high concentration of other pesticides caused >60% mortality of spined soldier bugs; especially, 100% mortality was caused by high concentrations of Asana and Vydate, indicating a highly negative impact of pesticides. However, spined soldier bugs (specifically fifth instars) showed relatively higher level of resistance to organic pesticides (Pyganic and Azera) and non-organic pesticides (medium and low concentrations of Vydate, and Asana). Therefore, these insecticides have a potential for integrated BMSB management using pesticides and spined soldier bugs together.

Progress continued to be made in 2012 on an important integrated project concerned with enabling out-of-season lamb production and promoting the sheep industry in the region. Use of the CIDR insert and ram introduction in out-of-season breeding is increasing in flocks in the region. Considerable activity in the project this year involved talks and demonstrations on farms and in symposia. Venues included the meeting of the American Sheep Industry Association in mesa AZ on January 26, 2012, the Clarence Elmore Farm in Greenbrier County, WV, in June and August, and the NCERA National Sheep Symposium in Spencer, Iowa, on July 27, 2012. Project Leader Scott Bowdridge presented a national webinar on new approaches to parasite control in December 2012. It was demonstrated that there may be monetary advantages for marketing spring bred, fall-born ewe lambs. Ewes from the winter extended light trial were sold at the West Virginia Ram Lamb Performance Test Sale in July, 2012. Prices averaged $341 for ewe lambs pregnant to first service from spring breeding, $350 for those pregnant to second service, and $315 for non-pregnant ewe lambs to be bred in August or September. The higher sale price minus added expenses resulted in a net gain of $56.65 over sale for slaughter.

Another sheep project titled, "Sustainable Small Ruminant Production in the Southeastern U.S," examined the impacts of protein supplementation on parasitism in organic farming systems. The data suggest that protein supplementation in an organic sheep production system may mitigate the effects of parasitism on post-weaning growth. Protein supplementation may also provide a means by which organic sheep producers may better manage gastrointestinal parasitism as anthelmintics are not allowable for use on organic farms. In 2012 over 100 producers attended events to disseminate the results of these studies.

In the pasture-based beef (PPB) systems, sequential winter grazing (November and December) of permanent grassland, orchard grass and tall fescue was repeated. Grazing grassland most susceptible to quality deterioration (permanent grassland) before tall fescue (less susceptible to winter damage) improved live weight gain of steers. Winter grazing and feeding haylage on pasture increased quality and quantity of subsequent forage in spring and summer. Care must be taken to avoid bare spots in spring due to uneaten or poorly distributed haylage. The experiment is being repeated in 2012-2013. The investigators also examined the wider, ecosystem-level impacts of pasture-based beef (PBB) systems. Specifically, they conducted analyses to determine how PBB systems fit into societal goals of improved environmental quality and energy independence alongside the goal of food production that could be more

profitable for producers, healthier for consumers, and more sustainable for communities. Outcomes include providing information and tools to assist producers, the industry and policy makers make better decisions that can result in enhanced profitability, better risk management, and enhanced industry sustainability. In addition to research-related publications and presentations, a major outreach effort this year was a field day program at the WVU Experiment Station Reedsville farm during the summer. Attendees included producers, members of the community, natural resource professionals, extension agents, and researchers. The field day focused on grassland agriculture with an emphasis on integrated pasture-livestock systems, and included workshops as well as visits to field sites.

Major water quality problems exist in the multi-state Chesapeake Bay Watershed. Among the many suspected contributors to those water quality problems are agricultural operations in the watershed. Contributing factors to water quality problems can include runoff from dairy operations in Southern Pennsylvania and phosphorus runoff from confined poultry operations in West Virginia. WVU has a unique research relationship with a large turkey integrator (currently the 10th largest turkey producer in the nation). Recent work has demonstrated that phosphate in feeds may be reduced in diets to a degree that live performance and yield are not affected while potential environmental stressors associated with land application of litter are significantly reduced. These data are crucial to alleviate concerns associated with the perception of production agriculture's negative effect on the Chesapeake Bay watershed. The research collaboration has also investigated amino acid density, feed form, and beta glucan inclusion, all in hopes of improving breast yield, the most economically important muscle meat yielded by large tom turkey production.

Several studies are underway that look at non-pharmaceutical methods of reducing gastrointestinal nematode infections in sheep. One compared the immunity of St. Croix and Suffolk Cross lambs infected with and then cured of nematode infection with a control group of lambs that did not have prior infection. As a result of the prior infection St. Croix lambs never developed a measureable fecal egg count over a period of 7 weeks whereas the previously infected Suffolk cross lambs ended the study with an average fecal egg count of 3,000 eggs/gram. The impact of this study is that the results will allow us to further substantiate claims that St. Croix hair sheep have a pronounced ability to reduce fecal egg count. These reductions are in large part to due to enhanced immune responses. This experiment also allowed us to validate our model system of generating native sheep and testing immune responses. Over 100 sheep producers have attended events where our results were presented.

2. Brief description of the target audience

The target audience for this program area includes producers, processors, distributors, extension specialists, agricultural consultants, regulators, policy makers and other researchers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	16	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentation on research at professional meetings

Year	Actual
2012	14

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	8

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual

2012 9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Growth in state sales of beef - % increase
2	Growth in state aquaculture industry - annual % increase in gross revenue
3	Growth in state broiler, egg and turkey sales- annual % increase
4	Increase in sheep producer income due to lengthening the season to promote out-of-season lamb sales.

Outcome #1

1. Outcome Measures

Growth in state sales of beef - % increase

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	19

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Beef cattle and sheep production are important sectors of the WV agricultural economy, given the relative abundance of high quality pasture land and the relative shortage of prime farmland for intensive agricultural product production.

What has been done
We have a long-term integrated pasture-based beef program that has examined ways to increase the production quantity and quality of pasture grass and to enhance the market opportunities for pasture raised beef.

Results
In the pasture-based beef (PPB) systems, sequential winter grazing (November and December) of permanent grassland, orchard grass and tall fescue was repeated. Grazing grassland most susceptible to quality deterioration (permanent grassland) before tall fescue (less susceptible to winter damage) improved live weight gain of steers. Winter grazing and feeding haylage on pasture increased quality and quantity of subsequent forage in spring and summer. The experiment is being repeated in 2012-2013.

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

Growth in state aquaculture industry - annual % increase in gross revenue

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The State aquaculture industry takes advantage of one of West Virginias best resources, cold fresh water. The aquaculture industry produces trout for stream stocking for recreational fishing and trout for restaurants and direct sale to consumers.

What has been done
We have been engaged in a long term project that combines research, demonstration projects and extension and outreach to try and support the aquacultural industry.

Results
Slow but steady growth in the state aquaculture industry.

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

Growth in state broiler, egg and turkey sales- annual % increase

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The poultry industry in WV (broilers, eggs and Turkeys) is the single largest agricultural industry in the State. There is considerable pressure on this industry due to increasing costs of production, regional competition and pressures to reduce phosphorus pollution in the Potomac Watershed.

What has been done
West Virginia University's Davis College has one of the most productive feed manufacture and animal nutrition research programs in the United States as evidenced by WVU's number of industry collaborations and publications, and by invitations to speak at national and international professional conferences. Current work in poultry feed pellet quality focuses on designing the feed in such a way that there is less breakage and waste when it is consumed. . WVU has a unique research relationship with a large turkey integrator (currently the 10th largest turkey producer in the nation).

Results
Recent work has demonstrated that phosphate in feeds may be reduced in diets to a degree that live performance and yield are not affected while potential environmental stressors associated with land application of litter are significantly reduced. These data are crucial to alleviate concerns associated with the perception of production agriculture?s negative effect on the Chesapeake Bay watershed. The research collaboration has also investigated amino acid density, feed form, and beta glucan inclusion, all in hopes of improving breast yield, the most economically important muscle meat yielded by large tom turkey production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

211	Insects, Mites, and Other Arthropods Affecting Plants
307	Animal Management Systems

Outcome #4

1. Outcome Measures

Increase in sheep producer income due to lengthening the season to promote out-of-season lamb sales.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The sheep industry is a growing industry in the Appalachian region. If producers can extend the production season for lambs they would be able to receive higher prices and therefore higher incomes from their production.

What has been done
Progress continued to be made in 2012 on an important integrated project concerned with enabling out-of-season lamb production and promoting the sheep industry in the region. Use of the CIDR insert and ram introduction in out-of-season breeding is increasing in flocks in the region. Considerable activity in the project this year involved talks and demonstrations on farms and in symposia.

Results
It was demonstrated that there may be monetary advantages for marketing spring bred, fall-born ewe lambs. Ewes from the winter extended light trial were sold at the West Virginia Ram Lamb Performance Test Sale in July, 2012. Prices averaged $341 for ewe lambs pregnant to first service from spring breeding, $350 for those pregnant to second service, and $315 for non-pregnant ewe lambs to be bred in August or September. The higher sale price minus added expenses resulted in a net gain of $56.65 over sale for slaughter.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities

Brief Explanation

Cutbacks in Agricultural Research Service (ARS) budgets and the closing of the ARS facility in Beaver, WV, has lead to a reduction in the research resources devoted to the pasture finished beef projects and small ruminants. The elimination of congressionally directed spending has also led to reduced activity in the aquaculture and wood utilization areas. These cutbacks increase the relative importance of federal capacity funding and AFRI competitive funding to the success of our research programs.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting. This year we conducted an internal review of our horticulture program and an internal and external industry level review of our poultry program. Both areas are very important to the agricultural economy of the State. The results of these reviews are presented in the next section.

Key Items of Evaluation

We have decided to move toward strengthening our horticulture and and poultry research programs given the importance of these areas to the economy of the state and region. In the horticulture area we have taken steps to increase our research capacity through construction of a new state of the art greenhouse complex that started operation in 2012. We are also planning to strengthen the research capacity of the horticulture program by designing enhanced growth chamber and plant tissue culture laboratories in our new research building. Construction of the new building will start in 2013 and is scheduled to be completed in 2015.

In the poultry area, we worked with industry and the State to look at ways to strengthen our applied research program. Currently we have two poultry research facilities, one at our Reyman Memorial Farm which is in the eastern part of the state and one on our animal sciences farm near the campus. We are planning to build another poultry research facility on the animal sciences farm using state, university and industry resources. The timetable for this construciton has not yet been determined.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Childhood Obesity, Human Nutrition and Health

☑ Reporting on this Program

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			15%	
502	New and Improved Food Products			15%	
702	Requirements and Function of Nutrients and Other Food Components			20%	
703	Nutrition Education and Behavior			30%	
724	Healthy Lifestyle			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.5	0.0
Actual Paid Professional	0.0	0.0	2.3	0.0
Actual Volunteer	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	199357	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	405257	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	266470	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

West Virginia citizens have the third highest level of obesity in the Nation (32.4%, Center for Disease Control, 2011). 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.

A number of projects continued to look at the effects of omega-3 DHA enhanced diets on various aspects of human health, either directly or through animal models. One study using rats as a model investigated whether different sources of Omega-3 polyunsaturated fatty acids (PUFA) from different oil sources affects lung fatty acid composition, eicosanoid metabolism, and oxidative stability. The n-3 PUFA, alpha-linolenic acid (ALA, 18:3n-3) was only detectable in the lungs of rats fed ALA-rich fish oil. The study results have implications for individuals consuming n-3 PUFA supplements to promote health and for the development of recommendations regarding lung health. Another study looked the relative efficacy of different sources of Omega-3 PUFA's on serum cholesterol and triglycerides using mice as models. The investigator determined that fish oil was more effective at reducing serum triglycerides than the other sources but all source had at least some effect on serum cholesterol levels. The omega-3 fatty acids, DHA and EPA were incorporated into tissue lipids but DHA was incorporated at a greater amount in mice fed fish oil. Liver mRNA abundance has not been changed significantly for most genes tested. In the cultured adipocytes we determined that exposing cells to fatty acids from coconut oil made the cells more sensitive to conjugated linoleic acid-induced lipolysis than exposing them to the fatty acid from soy oil, consistent with previous results in mice.

Another study looked at the consumer acceptance of an Omega-3 fortified food product. Surimi, a lean source of fish protein, is consumed worldwide in various forms. Considerable increases in U.S. consumption of surimi products was observed in the 1980s but tapered off in recent decades. Consumer demand for foods enriched with omega-3 fatty acids including DHA and EPA has increased due to potential health benefits. Therefore, a nutritionally-enhanced surimi frank fortified with flaxseed or salmon oil was developed. Sensory evaluation, consumer acceptance and shelf-life studies were conducted. Flaxseed or salmon oil was added at 2 g/100g sample, franks without added oil served as a control. Product composition, quality indicators over a 21-d storage period and sensory evaluations were measured. The control had less total lipid than the oil-fortified franks ($P<0.05$). The oil-fortified franks were darker than the control ($P<0.001$) and color values did not change over time ($P>0.05$). Salmon oil franks had greater MDA concentrations ($P<0.001$); however, MDA did not change over time regardless of frank type ($P>0.05$). There were differences in textural properties between frank types ($P<0.05$), with the flaxseed franks being softer and less gummy, cohesive and chewy than the control franks. Participants evaluated product attributes (visual appeal, color, aroma, texture, flavor, and acceptability) on a hedonic scale; there were no differences ($P>0.05$) between franks. Fifty four panelists reported consuming sausage on a weekly to monthly basis and most (50/79) indicated interest in purchasing this type product. Results indicate that surimi franks were accepted by young adult consumers, which may indicate market potential of these types of products.The value-added food products developed from surimi enable the seafood and aquaculture industries to diversify its product offerings with highly nutritious food products.

2. Brief description of the target audience

The target audience for this program area includes dieticians, nutritionists, policy makers, researchers, extension specialists, 4-H and other youth program developers, community leaders and State citizens.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	6	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at scientific meetings

Year	Actual
2012	7

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	1

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Annual reduction in state incidence of obesity -% reduction
2	Participants in nutition workshops will increase their knowledge of the relation between nutrition and health (% of participants reporting a gain in knowledge).
3	Participants in nutrition workshops will gain an understanding of how to make healthy food choices (% reporting a gain in understanding).
4	Development of food products containing enhanced amounts of omega-3 polyunsaturated fats (PUFA) that are acceptable to consumers.

Outcome #1

1. Outcome Measures

Annual reduction in state incidence of obesity -% reduction

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	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 (32.4%, Center for Disease Control, 2011, a drop 0f .1 percent). 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
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). Ninety six young adults have been enlisted into a study involving nutrition and chronic illness and three family fun nights were held to recruit families and young children to study the effectiveness of use of incentives in public programs to reduce obesity.

Results
These projects are in the data collection and analysis phases, results will be reported in forthcoming reports.

4. Associated Knowledge Areas

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

Outcome #2

1. **Outcome Measures**

Participants in nutition workshops will increase their knowledge of the relation between nutrition and health (% of participants reporting a gain in knowledge).

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Participants in nutrition workshops will gain an understanding of how to make healthy food choices (% reporting a gain in understanding).

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Development of food products containing enhanced amounts of omega-3 polyunsaturated fats (PUFA) that are acceptable to consumers.

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Omega-3 PUFA's are claimed to have positive effects on humans by reducing triglicerides and cholesterol. Research is needed on the relationship between different sources of omega-3 PUFA's and health and applied research is needed to develop consumer acceptable products that contain omega-3 PUFA's.

What has been done
One study using rats as a model investigated whether different sources of Omega-3 polyunsaturated fatty acids (PUFA) from different oil sources affects lung fatty acid composition,

eicosanoid metabolism, and oxidative stability.

Another study looked the relative efficacy of different sources of Omega-3 PUFA?s on serum cholesterol and triglycerides using mice as models.

Another study looked at the consumer acceptance of an Omega-3 fortified food product. Surimi, a lean source of fish protein, is consumed worldwide in various forms. Therefore, a nutritionally-enhanced surimi frank fortified with flaxseed or salmon oil was developed.

Results
The n-3 PUFA, alpha-linolenic acid (ALA, 18:3n-3) was only detectable in the lungs of rats fed ALA-rich fish oil.

The investigator determined that fish oil was more effective at reducing serum triglycerides than the other sources but all source had at least some effect on serum cholesterol levels.
Results indicate that surimi franks were accepted by young adult consumers, which may indicate market potential of these types of products.The value-added food products developed from surimi enable the seafood and aquaculture industries to diversify its product offerings with highly nutritious food products. Patent applications are being considered.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
702	Requirements and Function of Nutrients and Other Food Components
724	Healthy Lifestyle

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)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

We have conducted an internal review of our nutrition and obesity programs. We have concluded that work in this area is hampered by the separation of extension from the experiment station, as they are in separate units. While we do work together on funded integrated projects, our programs could be better integrated. Second, because of planned investments in faculty, our nutrition, healthy food design and obesity research programs are growing in the areas of nutritional biochemistry, clinical/outreach work with the public, and social science analysis of eating and exercise habits.

Key Items of Evaluation

In terms of the first issue, the lack of a permanent dean/director in the experiment station and an interim director in extension has somewhat delayed new cooperative efforts. We now have a permanent dean/director in the experiment station and hopefully will soon have a permanent director of extension. In any case, we will be working together to better coordinate our nutrition and obesity efforts. We also relocated one food technology specialist from the extension building to the agricultural sciences building to encourage joint research and extension in the food technology area.

We have decided to also invest in our infrastructure for our new planned research building (construction to begin 2013, completion in 2015). The new building will include enhanced laboratories in the nutritional biochemistry area, a new sensory kitchen/lab for taste testing new nutritionally-enhanced products, and a health/obesity intervention clinic to work in a research and outreach capacity with the public.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Production/Sustainable Forestry

☐ Reporting on this Program

Reason for not reporting

{No Data Entered}

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			65%	
124	Urban Forestry			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
511	New and Improved Non-Food Products and Processes			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	7.5	0.0
Actual Volunteer	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	22453	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	865112	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	499074	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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; feedstock and bioproduct logistics; and, programs that respond to research needs and concerns of corporate and private owners and provide economic comparisons among alternative management and harvest methods.

A continuing study is looking at market potential and alternative-uses for under-utilized Appalachian hardwoods. A questionnaire was developed to assist in increasing the demand of Appalachian hardwoods by better understanding of consumer perceptions of Appalachian hardwoods. The questionnaires allowed researchers to quantify the perceptions that foreign national and American citizens have in relation to commercially important and also under-utilized Appalachian hardwoods. The results of the study have potential to improve the markets for Appalachian hardwoods as the research provided detailed quantified information that both primary and secondary manufacturers can use to change product mixes and to provide different value-added features and alternative species when manufacturing final wood product goods. The project also focused on hickory species as they currently have a low stumpage price and are relatively abundant. The results of the evaluation indicated that there were differences in purchasing decisions based on gender, age, levels of experience and expertise with wood products. For foreign national respondents, results showed that walnut, red oak and hickory were the most preferred wooden species. Foreign national respondents found that hickory wood with a "spice" finish was non-distinguishable with red oak with a honey spray wood stain. This indicates some potential for hickory when red oak is desirable in some foreign countries (e.g., China) given certain finishing practices are used. Darker color wood samples (walnut and hickory) were perceived more expensive. On the other hand, lighter color wood samples (yellow-poplar, hard maple, and soft maple) were perceived more calm and sustainable. The most preferred hardwood products made from hickory included: doors, kitchen cabinets and wardrobe cabinets. Technical ads were more effective in promoting the durability of hickory than emotional ads. Color was the most influential factor among the American respondents in their wood purchasing decisions, as compared to the international community where functionality and safety was the highest concern. American respondents tend to rely more on technical information when purchasing wood products. The results of the study showed that there are potential new markets for relatively low-valued hickory.

A research project on Beech Bark Disease continued with USDA-Forest Service collaborators. This work is intended to discover ecological factors that contribute to the incidence and severity of beech bark disease. Beech bark disease (BBD) is a complex of causal agents, primarily the beech scale insect, Cryptococcus fagisuga, and various canker- causing Neonectria fungi. Resistance to scale infestation by American beech is heritable; however, a variety of environmental factors may induce ecological resistance, a temporary condition allowing susceptible individuals to remain disease-free. This project intends to identify factors lending to ecological resistance, focusing on biotic and abiotic factors and their relation to BBD incidence and severity. Sample plots have been established in stands with a several-decade history of BBD and a component of disease-free beech. Data collected describe species composition, canopies, topography, coarse woody debris, litter layers and soils. Beech scale infestation and Neonectria infection are qualitatively estimated using a five-category system ranging from no infestation/infection to heavy infestation/infection. The rating systems developed for this project represent a significant improvement over previous methods used for evaluating their populations. Quantitative assessments of these organisms are lacking and the development of image-based reference materials will improve the efficacy of field survey. About 1-2% of American beech are reported to be genetically resistant to BBD, but this survey indicates that beech with no trace signs of BBD appear at frequencies of 15% or more, supporting the hypothesis that factors other than genetics are influencing disease incidence and severity.

A study titled, "Efficient utilization of biomass for Biopolymers in central Appalachia," made progress on two fronts. The first involved synthesis of copper nanoparticles on cellulose-based materials for potential packaging applications. A simple method to produce a cellulose base material with antimicrobial properties was developed by introducing copper nanoparticles on carboxymethyl cellulose (CMC) using sodium borohydride as a copper reducing agent. The antimicrobial properties of the hybrid material were effectively evaluated against the non-pathogenic surrogate of foodborne pathogen Escherichia coli. The second involved the combination of torrefaction and densification processes for underutilized renewable biomass composed by red oak (Quercus rubra) and yellow-poplar (Liriodendron tulipifera L.) for improving their further utilization in thermochemical conversion processes to produce biofuels.

A project titled, "Managing Central Appalachian Forests for Timber, Carbon Credits and Renewable Energy under Risk and Uncertainty," studied the landowners' attitude towards sustainable management and their willingness to accept WTA for payments from selling carbon offset credits in the Central Appalachian Area. Based on the data obtained the investigator found that current participation in sustainable management through carbon offset positively correlate to the economic status of private landowners and property size. In addition, such participation is spatially clustered, implying a neighborhood effect. Landowner's WTA is largely affected by the forest condition and property tax. These findings will be of importance to the policy making of natural resources utilization, conservation, and climate change because the majority of the central Appalachian Forests is in private ownership with a positive view of timber harvesting when the price is favorable but these forests hold great potential for mitigating effects of climate change and providing carbon-neutral biomass feedstock. Understanding the attitude and WTA of private landowners is critical to projecting forest cover change and timber and biomass supply in the study area and recommending meaningful sustainable management guidelines.

A project studying the restoration of hardwood forests that had been damaged by invasive species concluded in 2012. The study sought to illuminate effective treatments to control invasive plants. The primary exotic plant of interest was oriental bittersweet (Celastrus orbiculatus). The investigators learned that oriental bittersweet can be controlled using various methods. As we have gained expertise with the control of this invasive species, the findings have been used by the Natural Resources Conservation Service to guide their forestry cost-share practice guidelines. An information sheet describing control methods for treating bittersweet was used by the WV Natural Resources Conservation Service as a reference to their invasive species control practices.

2. Brief description of the target audience

The target audience for this program includes professional foresters, the forest-product industry, small and large woodlot owners, extension specialists, consultants, regulators and policy makers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	3

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	1

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Growth in state timber industry - % change
2	Growth in state wood products and furniture industry - % change
3	Program and workshop participants will gain information that will improve their forest operation management skills (% of participants who report a gain in knowledge).

Outcome #1

1. Outcome Measures

Growth in state timber industry - % change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The WV State forest industry is larger than the agricultural sector in terms of its contribution to the State economy. The health of the forest sector is thus crucial to the health of the State economy. It is a renewable resource based industry and is thus sustainable if managed properly. One way of expanding the industry is to find markets for underutilized hardwood species such as hickory.

What has been done
A continuing study is looking at market potential and alternative-uses for under-utilized Appalachian hardwoods. A questionnaire was developed to assist in increasing the demand of Appalachian hardwoods by better understanding of consumer perceptions of Appalachian hardwoods. The questionnaires allowed researchers to quantify the perceptions that foreign national and American citizens have in relation to commercially important and also under-utilized Appalachian hardwoods.

Results
The results of the evaluation indicated that there were differences in purchasing decisions based on gender, age, levels of experience and expertise with wood products. For foreign national respondents, results showed that walnut, red oak and hickory were the most preferred wooden species. Foreign national respondents found that hickory wood with a "spice" finish was non-distinguishable with red oak with a honey spray wood stain. This indicates some potential for hickory when red oak is desirable in some foreign countries (e.g., China) given certain finishing practices are used. On the other hand, lighter color wood samples (yellow-poplar, hard maple, and soft maple) were perceived more calm and sustainable. The most preferred hardwood products made from hickory included: doors, kitchen cabinets and wardrobe cabinets.

Technical ads were more effective in promoting the durability of hickory than emotional ads. Color was the most influential factor among the American respondents in their wood purchasing

decisions, as compared to the international community where functionality and safety was the highest concern. American respondents tend to rely more on technical information when purchasing wood products. The results of the study showed that there are potential new markets for relatively low-valued hickory.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Growth in state wood products and furniture industry - % change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
West Virginia is a major producer of hardwoods, mainly from private forestland. One way to increase employment and income in the forest industry is to develop new value-added products made from forest products and by products.

What has been done
A study titled, Efficient utilization of biomass for Biopolymers in central Appalachia, made progress on two fronts. The first involved synthesis of copper nanoparticles on cellulose-based materials for potential packaging applications. The second involved the combination of torrefaction and densification processes for underutilized renewable biomass composed of red oak (Quercus rubra) and yellow-poplar (Liriodendron tulipifera L.) for improving their further utilization in thermochemical conversion processes to produce biofuels.

Results
A simple method to produce a cellulose base material with antimicrobial properties was developed by introducing copper nanoparticles on carboxymethyl cellulose (CMC) using sodium

borohydride as a copper reducing agent. The antimicrobial properties of the hybrid material were effectively evaluated against the non-pathogenic surrogate of foodborne pathogen Escherichia coli. This finding could be important in developing packaging materials for food products that have antimicrobial properties.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #3

1. Outcome Measures

Program and workshop participants will gain information that will improve their forest operation management skills (% of participants who report a gain in knowledge).

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

The Forestry/Natural Resources Program is evaluated annually by a board of advisors composed of university researchers, industry representatives and representatives of relevant government agencies. Last year the most important recommendation was that we need to upgrade our laboratories.

Key Items of Evaluation

We are currently evaluating two plans for upgrading our laboratories in the forestry and natural sciences areas. One is to upgrade current labs the other is to design a wing for the newly planned agricultural sciences building to house the forestry and natural resources

programs. We are currently working up cost estimates and funding strategies for the two options.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Sustainable Energy

☑ Reporting on this Program

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			10%	
403	Waste Disposal, Recycling, and Reuse			20%	
511	New and Improved Non-Food Products and Processes			40%	
605	Natural Resource and Environmental Economics			15%	
610	Domestic Policy Analysis			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.5	0.0
Actual Paid Professional	0.0	0.0	1.4	0.0
Actual Volunteer	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	19226	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	119789	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	186445	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program focuses on biofuel and bioenergy production. We have increased activity and funding of this area as indicated in 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, nondestructive methods for characterizing the physical and chemical properties of lingo-cellulosic biomass, and syngas production from co-firing coal and biomass. The feedstocks examined so far include algae, switchgrass and mixed grasses, and residual woody biomass from forestry operations.

A continuing project focuses on production of biofuels and bioproducts from biomass. Work in 2012 was to complete the set-up of a bench-scale gasification system. A gasification system from All Power Labs has been set-up with instrumentation and required modifications to perform experiments for this project. The gasifier system was run four times on wood pellets for at least two hours. The gas produced was used to fuel a natural gas engine, which powered the generator to produce electricity. The electricity was used to light a set of four floodlights. In the middle and toward the end of the run, the gas samples were taken for gas composition analysis. Temperatures were also recorded inside the gasifier at two locations: one at the top of the reduction zone and another at the bottom of the reduction zone. These preliminary tests demonstrated that the gasification system is working as expected. In addition, the thermo-chemical decomposition behavior for bark, sapwood and heartwood and the individual wood-polymers (cellulose, hemicellulose and lignin) of typical hardwood were examined. The activation energy was calculated for various fractional conversion values using the isoconversion method. The results showed that char yields of lignin, cellulose and xylan were 41.43%, 4.45% and 1.89%, respectively, at the end of pyrolysis.

A related project sought to improve biofuel production processes and thermochemical conversion processes. Coal and hardwood pellet mixtures were evaluated to produce syngas using a downdraft gasifer. Results showed that coal agglomeration adversely affected the gasification process with mixtures containing 80% or more coal. Use of 20% coal and 80% biomass in a down-draft gasfier helps to increase carbon conversion efficiency without any significant decrease in the hydrogen concentration of the syngas.

2. Brief description of the target audience

The target audience for this program area includes the bio-fuels and materials industries, the electricity generating industry, researchers, regulators, policy makers, and foresters.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	2

Output #2

Output Measure

- Energy policy papers

Year	Actual
2012	0

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual

2012 1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Work with the electrical generation industry to increase the percentage of renewable sources of biomass co-fired with coal (% increase per year)
2	Develop new processes for converting lignocellulose to usable sources of energy (number of new processes).
3	Percentage of participants in workshops held in the State on sustainable energy production and use who gain an understanding of the issue (% who report gains in knowledge).

Outcome #1

1. Outcome Measures

Work with the electrical generation industry to increase the percentage of renewable sources of biomass co-fired with coal (% increase per year)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The economy of WV is heavily dependent on the coal and natural gas industries, both exhaustible fossil fuels. There is a need to diversify both the State economy and our portfolio of energy sources. Increasing the amount of renewable energy production will help diversify the State economy, reduce our dependence as a country on imports of fossil fuels, and lead to a more sustainable energy supply. One way to do this is combining coal with renewable sources of biomass to produce energy products.

What has been done
One project sought to improve biofuel production processes and thermochemical conversion processes. Coal and hardwood pellet mixtures were evaluated to produce syngas using a downdraft gasifer.

Results
Results showed that coal agglomeration adversely affected the gasification process with mixtures containing 80% or more coal. Use of 20% coal and 80% biomass in a down-draft gasfier helps to increase carbon conversion efficiency without any significant decrease in the hydrogen concentration of the syngas. This is one potential method to increase the proportion of renewable sources of energy relative to fossil sources.

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

Develop new processes for converting lignocellulose to usable sources of energy (number of new processes).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Lignocellulose is widely available from residue and byproducts from the forestry and other industries. Unfortunately lignocellulose is more expensive to convert to energy than cellulose, but cellulose-based energy often competes with the production of food products such as corn and sugars. There is a need to develop new technologies that can derive energy from lignocellulose in an economically feasible way.

What has been done
A continuing project focuses on production of biofuels and bioproducts from biomass. Work in 2012 was to complete the set-up of a bench-scale gasification system. The gasifier system was run four times on wood pellets for at least two hours. The gas produced was used to fuel a natural gas engine, which powered the generator to produce electricity. The electricity was used to light a set of four floodlights. In the middle and toward the end of the run, the gas samples were taken for gas composition analysis.In addition, the thermo-chemical decomposition behavior for bark, sapwood and heartwood and the individual wood-polymers (cellulose, hemicellulose and lignin) of typical hardwood were examined. The activation energy was calculated for various fractional conversion values using the isoconversion method. The results showed that char yields of lignin, cellulose and xylan were 41.43%, 4.45% and 1.89%, respectively, at the end of pyrolysis.

Results
The activation energy was calculated for various fractional conversion values using the isoconversion method. The results showed that char yields of lignin, cellulose and xylan were 41.43%, 4.45% and 1.89%, respectively, at the end of pyrolysis.

4. Associated Knowledge Areas

KA Code	Knowledge Area

511 New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Percentage of participants in workshops held in the State on sustainable energy production and use who gain an understanding of the issue (% who report gains in knowledge).

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

The Sustainable Energy Program is relatively new and is still growing. We have plans to add faculty resources and upgrade the laboratories.

Key Items of Evaluation

As discussed under the Sustainable Forestry goal area, we are considering two options for enhancing the laboratory resources of hte Sustainable Energy Program--upgrading current facilities or adding a wing to the new agriucltural sciences building to house program.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Food Safety

☐ Reporting on this Program

Reason for not reporting

This goal area have been merged with the sustainable agriculture goal area.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

The primary activities in this program area involve food safety issues in management of processed fish and fish fillets from cold-water aquaculture operations and developing procedures for testing and for eradicating newly emerging water-borne bacteria that may enter the food supply. Research findings will be communicated to the public, the food processing industry and policy makers in conjunction with the

outreach efforts of WVU Extension.

2. Brief description of the target audience

The target audience for this program area includes the food processing industry, the aquacultural producers and marketers, food processors, regulators and policy makers.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations at Professional Meetings

Year	Actual
2012	0

Output #2

Output Measure

- Articles for the general public

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants attending food safety workshops will gain information that improves their ability to manage food safety issues (% reporting gain in knowledge).

Outcome #1

1. Outcome Measures

Participants attending food safety workshops will gain information that improves their ability to manage food safety issues (% reporting gain in knowledge).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Government Regulations

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}