

# 2010 West Virginia University Research Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 05/04/2011

## I. Report Overview

### 1. Executive Summary

The West Virginia Agriculture 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 (nine of 115 faculty in the Davis College have partial extension 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 formula funds and through competitive funding from NIFA and other sources. In 2010 a concerted effort was made by the directors and associate directors of the Experiment Station and of Extension to coordinate and facilitate joint faculty efforts to go after competitive funding, particularly AFRI funding. The areas of focus for 2010 were rural development, bio-energy and childhood obesity. The effort was successful in securing an integrated five-year AFRI competitive grant in the childhood obesity area. For 2011 we are planning to coordinate efforts in the rural development and organic farming and marketing areas.

Efforts we made to improve communication and better coordinate the programs of the West Virginia Agricultural and Forestry Experiment Station and West Virginia State University. 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. In addition, the Associate Director of the WV Experiment Station attended a portion of the WV State University College of Agriculture's visiting committee meeting. Finally, efforts were initiated in 2010 to give WV State University faculty access to WVU libraries on site and off line resources.

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 eight 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; Sustainable Energy; and, Food Safety. We have reorganized our program areas to better reflect the five priorities of NIFA in our research by making Production/Sustainable Agriculture and Fundamental Plant and Animal Systems appropriate sub areas under Global Food Security and Hunger, by making Environmental Quality and Stewardship a part of Climate Change, and by making Human and Nutrition and Foods a part of Childhood Obesity. We have also added the term sustainable agriculture to the production agriculture and production forestry program areas to better reflect the type of research that is conducted under these areas.

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 Hardwoods 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 who are 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 2010 highlighted in the narrative for each program area.

**Total Actual Amount of professional FTEs/SYs for this State**

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	39.8	0.0
Actual	0.0	0.0	39.3	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 non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey specifically with non-traditional groups

#### **Brief explanation.**

Much stakeholder input is collected in conjunction with West Virginia University Extension (administratively distinct from the College of Agriculture, Natural Resources and Design) since we share a majority of stakeholders. We discontinued special meetings which had as their sole purpose, the gathering of stakeholder input and instead, have more recently relied upon input gathered at meetings with other primary purposes (annual or regular meetings of West Virginia Farm Bureau, West Virginia Forestry Association, West Virginia Grasslands Steering Committee, State Aquaculture Forum, Organic Research Project annual meeting, the West Virginia Farmer's Market Association, etc.) We find the new procedure more efficient and to represent a larger and more diverse segment of our stakeholders. Input also originates from various advisory groups associated with specific interest areas within College Divisions (e.g., Organic Research Project Steering Committee within the Division of Plant and Soil Sciences; Appalachian Hardwood Council; Advisory Board in the Division of Forestry and Natural Resources, etc.) as well as from advisory groups established at the College/Station level (Davis College Visiting Committee).

As the focus of the College evolves with time (we recently changed our name from the College of Agriculture, Forestry and Consumer Sciences to the College of Agriculture, Natural Resources and Design to reflect our changing areas of emphasis) we realize that our stakeholder groups also change. We also felt a need to strengthen our interaction with our existing stakeholder groups. To meet these needs an administrative position for Outreach and Community Affairs was established July 1, 2010 under the Associate Dean and Associate Director of the Agriculture and Forestry Experiment Station to enhance our communication and working relationship with commodity and

industry groups, state agencies and community organizations that represent our College disciplines within the State of West Virginia. The major stimulus for this action is to enhance the College's relationship with our stakeholders and make our programs more relevant to needs of the State. We truly believe that our success as a College will be measured by how well we serve the citizens of West Virginia, then the nation and the world. We value our work with the stakeholders and partnerships within our State and need their input to improve and make more relevant this relationship in the future.

The initial responsibilities identified for this position were:

1. Communicate the position and contact information to the various stakeholder groups offering our assistance and requesting their input.
2. To create an updated data base of stakeholder, community groups and industry partnerships relevant to the College.
3. Evaluate the need for activities to enhance the communication, awareness and image of the College.
  1. Expand our presence and participation to stakeholder groups
  2. Re- create a College Newsletter
  3. Annual open house
  4. Enhance the activities of the College Alumni Association
  5. Research Annual Reports
  6. Re-visit the role of the College Visiting Committee in support of the College

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

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups

**Brief explanation.**

A memo announcing the new position was sent to a partial data base list of stakeholder groups, state agency and industry partners with the position contact information, offering our assistance and asking for their input for improved relations. This position continues to work with extension, state agencies and internally through the divisional directors to develop a more extensive and current data base for commodity and community organizations that encompass a more comprehensive scope for our College programs and activities. This data base is critical for improved communication from the College via all forms of information media. Efforts have been initiated with the communication specialist for the College to assess the need and potential to re-establish a college level newsletter. The College currently has two alumni associations, college and the division of natural resources (forestry). Recommendations have been made to the leadership of the College Alumni Association 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. In addition, consideration should be given to explore concept to merge the two alumni associations into one for the college.

The College has had an increasingly strong representation at numerous commodity and

organizational meetings/programs throughout this year. These meetings included:

West Virginia State Farm Bureau Annual Conference- College through the Collegiate Farm Bureau group had a major involvement in the Young Farmers component of the program agenda.

West Virginia Annual Beef Cattle, Dairy Cattle, Poultry and Small Ruminant Conferences and shows - Faculty presentations as components of these educational programs and are a major participant in the organization and conduct of the shows.

Small Farms Annual Conference- College faculty presentations.

State Conservation Annual Conference- Major efforts to revamp soil testing program at the request of producers to better support the need for nutrient management plans at the farm level. Members of the selection committee to identify applicants for the new executive director for this agency. The College was represented on the State level Committee.

West Virginia State Fair Activities- Displays and recruitment effort.

Regional Appalachian Grazing Conference- Active on the program committee; Faculty organized and presented the entire program for an afternoon session of the program.

West Virginia Agriculture and Forestry Hall of Fame Annual meeting and program.

Agriculture and Forestry Days at the State Legislature- Displays and recruitment effort.

WV Dietetics Association- Faculty representative on the board; faculty presentations at the state-wide meeting.

WV Diabetes Association- Faculty representative on the board; faculty presentations at the State-wide meeting.

State FFA and State 4-H annual contest- Faculty representatives responsible for setting up and conducting these contests.

Small Ruminant Project- Faculty provided extensive service for breeding soundness exams, pregnancy detection, breeding program recommendations and synchronization protocols.

Beef Sire evaluation program- Evaluation and sale of performance tested sires- major activity with ~ 500 producers attending this program activity.

Kiddie Days- Approximately 8,000 pre and kindergarten youth from the region visit the Animal Sciences Farm Unit during one week every April.

Discussion with Monroe County committee to discuss possibility to create a Rural Heritage Center at the WVU Willow Bend farm Unit in Monroe County.

Numerous workshops on food safety, quality control and processing of niche market food products.

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

**1. Methods for collecting Stakeholder Input**

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

**Brief explanation.**

As indicated above, a majority of input is solicited at meetings of various industry groups or at meetings of appointed College and Station advisory groups. A smaller but meaningful number of suggestions come from individual producers. After sending out the memo about the new assistant dean for outreach position the number of incoming emails and phone calls increased tremendously.

In addition to the ongoing service and outreach activities, highly varied requests constantly come to the College. Examples of such request are: to set up a meeting for outreach activities, identify individuals that have the expertise to address a given problem, seeking assistance to set up an business enterprise germane to a discipline within our College, to discuss potential partnership activities or to seek direction for a possible solution to a problem. In addition, many of the request involve academic program issues, graduate and undergraduate applications, potential internship opportunities for family members who are students, employment opportunities and scholarship support opportunities. There has been a particular interest from industry and commodity groups for updated information regarding the search for a new Dean for the College.

**3. A statement of how the input will be considered**

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

**Brief explanation.**

Stakeholder input which relates to College/Station research portfolio is discussed regularly with College advisory groups and with College administrative groups, particularly when work or strategic plans are being prepared and when staffing decisions are pending. We will be entering a new strategic planning process in 2011 and will be reaching out to traditional and new stakeholder groups to aid our planning process.

**Brief Explanation of what you learned from your Stakeholders**

The service/outreach agenda of the College continues to address problem issues relevant to the State and appropriate to our disciplines. The service/outreach agenda for the College continues to expand as the faculty numbers and discipline expertise in emerging issues increase. Such increases over the last few years have occurred in 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. With the initiation of a position with specific responsibility in outreach, improvement can be expected in the coordination and follow-through on requests that come to the College. In addition this position could take a lead role to identify specific activities that will enhance the image and visibility of the disciplinary expertise within the College. The potential is very good for this position in outreach to improve our communication and relationships within the university community and the external clientele groups. We are convinced that we can and must improve our involvement and relationships within the State. 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

<b>1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)</b>			
<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	2959970	0

<b>2. Totaled Actual dollars from Planned Programs Inputs</b>				
	<b>Extension</b>		<b>Research</b>	
	<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
<b>Actual Formula</b>	0	0	2741612	0
<b>Actual Matching</b>	0	0	5273895	0
<b>Actual All Other</b>	0	0	2589744	0
<b>Total Actual Expended</b>	0	0	10605251	0



<b>3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous</b>				
<b>Carryover</b>	0	0	1440839	0

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Economic Development and Quality of Life in Rural Communities
2	Climate Change, Environmental Quality and Stewardship
3	Global Food Security and Hunger--Fundamental Plant and Animal Systems
4	Global Food Security and Hunger--Production/Sustainable Agriculture
5	Childhood Obesity, Human Nutrition and Health
6	Production/Sustainable Forestry - Timber Management and Wood Products
7	Sustainable Energy
8	Food Safety

**V(A). Planned Program (Summary)**

**Program # 1**

**1. Name of the Planned Program**

Economic Development and Quality of Life in Rural Communities

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
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%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

<b>Year: 2010</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	6.1	0.0
Actual	0.0	0.0	8.1	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	392830	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	681244	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	327960	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, organic production of vegetables and animal products, and ecotourism. There is also an ongoing study of the effects of socio-economic characteristics including race and ethnic characteristics on participation in recreational activities and another study on the impact of the textile and apparel industry on the economy of the State.

Continued research on the legal barriers to growth in the aquaculture industry in the State resulted in a significant outcome in 2010. Model legislation was developed for WV that would clarify legal and environmental rules governing the State aquaculture industry and reduce barriers to growth of the industry. On April 2, 2010, Governor Joe Manchin signed into the law the West Virginia Aquaculture Development Act, Chapter 19, Article 32. Presented for the first time to the House of Representatives and the Senate of the West Virginia Legislature in February of 2010, this new Act passed both chambers with only two negative votes. This legislation was authored by a Davis College faculty member, pursuant to her participation in USDA funded research grant entitled Assessment and Development of a Legal/Institutional/Educational Framework For the Development of the Aquaculture Industry in West Virginia. This new law mandates the cooperation of major regulatory agencies impacting aquaculture. Since the passage of the law, The Department of Agriculture, Department of Environmental Protect, Division of Natural Resources and other statutorily mandated participants have formed an Aquaculture Advisory Board which has meet on four occasions with the ultimate goal of promulgating a comprehensive set of inter-agency regulations to promote the development of the aquaculture industry in West Virginia.

Our aquaculture project received recognition for its work from the American Farm Bureau. On June 17, 2010, The West Virginia Farm Bureau Magazine was awarded the top award in the nation for "Best

Print News or Feature Series" in the 2010 American Farm Bureau Public Relations Contest. This award was received for a five-part series titled "West Virginia Aquaculture: Fishing for Solutions." This series was produced by the same faculty member who wrote the Aquaculture Development Act as part of her contribution to the aquaculture project.

Other advances were made in the cool-water aquaculture projects. First, an informal survey of the aquaculture industry in the State indicated an increasing interest in aquaponics among current and prospective aquaculture producers. Aquaponics, which combines traditional aquaculture with hydroponics, serves two purposes for producers in that it removes nutrients from the aquacultural waste-water stream that otherwise would become pollutants when released and it produces plant products that can be sold to add to the income of the aquaculture operation. On the research front, a 12 week spring experiment examined growth, production and nutrient removal characteristics of Swiss chard, nasturtium, calendula, kohlrabi, lettuce and strawberry. Kohlrabi was most effective at nutrient removal, followed by Swiss chard and nasturtium. Calendula and strawberry had low removal rates. A summer experiment with the same crops examined growth, production and nutrient removal during summer. Kohlrabi performed the best for total harvestable plant product as well as total biomass. Swiss chard harvestable weight was less than Kohlrabi but still higher than lettuce during the spring/summer experiment. This suggests that the environmental conditions are able to produce a reliable harvestable product of lettuce from spring to fall but there is variability in harvestable weights in other cool-season crops.

Regional economic opportunities need to be based on the natural and human resources present in the region. One study attempted to assess whether the 299 counties (148 are non-metropolitan) in the Northeast (NE) region of the US can successfully build and pursue a growth strategy that depends on the local and neighborhood amenities (natural and built). The results of the impact of amenities on regional economic growth are mixed. Amenities within a county and/or surrounding counties play a significant role in the process of population growth. Historical and cultural amenities like museums, historical sites, zoos, and other attractions, play a positive direct and indirect role in attracting new immigrants. While the direct effect of natural amenities was negative, the indirect effect coming from surrounding counties was positive. This is an important finding with major policy implications. This implies that a county that lacks natural or historical attractions of its own can still benefit from the natural richness of its surrounding counties. Regional cooperation in preservation and management of natural resources and recreational facilities should be one of the main focuses in developing an amenity-led development strategy and then policy makers have to address how these resources are managed and funded. Generally amenities are public goods. If the cost of maintenance and development is left to the county within which they reside, they would tend to be underfunded and underdeveloped. Regional internalization of this positive externality is required to take full advantage of the natural asset in the regional economic growth process.

Another study examined the relationship between income inequality and poverty in Appalachia. The statistical results show an inverse relationship between poverty and income inequality, as also indicated by previous studies. This suggests that a policy geared towards reducing both poverty rate and income inequality at the same time may not be effective in the Appalachian Region. The study supported previous findings that higher per capita income and education reduced poverty. Agriculture, construction and manufacturing industries were found to help reduce poverty. The results also suggest that income inequality in the Appalachian Region may actually contribute to its economic growth and to the poverty reduction in the Region. The percentage of black population in a region was found to hinder policies aimed at poverty reduction and lowering income inequality. Therefore, special government programs providing economic opportunities to the black community in the counties could help in both economic growth and in reducing both poverty and income inequality of the Region. Results also suggest that policies to encourage people to go for higher education and to develop agriculture, construction and manufacturing industries in the region can help reduce income inequality and poverty.

Several different research and outreach activities were conducted on the quality of life in rural

communities. One study titled, "The Causes and Consequences of Tourism and Amenity-based Development on Forest-based Communities and Ecosystems," has contributed to institutional change within the USDA Forest Service and National Park Service in terms of the priority it places on collaborative processes and citizen participation in planning at all levels. This is clearly the case with recent initiatives such as the Sustainable Recreation Initiative, the Planning Rule process followed, and the Collaboration Networking workshops mentioned earlier. Work under this project has also contributed to the further institutionalizing of the "landscape lens" being integrated into Forest Service and Park Service planning at all levels.

Another project involved surveys on information transfer between beef producers and extension agents in West Virginia, satisfaction of contract poultry producers in West Virginia and Virginia and perceptions of West Virginia beef producers on preparedness for an agro-terrorism attack. Study results have created an awareness of the need for biosecurity training for beef producers.

**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 and educators.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	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: 2010

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Actual	0	3	3

**V(F). State Defined Outputs**

## Output Target

### Output #1

#### Output Measure

- Presentations on reserach at professional meetings

Year	Actual
2010	11

### Output #2

#### Output Measure

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

Year	Actual
2010	3

### Output #3

#### Output Measure

- Completed graduate degree programs

Year	Actual
2010	21

### Output #4

#### Output Measure

- Popular press reports.

Year	Actual
2010	4

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Expansion of economic activity in targeted state industries as indicated by annual increases in weighted indices of economic activity involving the production of pasture raised beef and sheep; broilers, turkeys and eggs; trout; organic vegetables; tourism and outdoor recreational activities; ornamental horticulture; timber and wood products etc. - % annual growth
2	Customized designs for enhanced economic development prepared for, and adopted by, state rural communities (#)
3	Enhancing the economic climate for business by removing unnecessary regulatory barriers.
4	Increase information available to farmers in the Appalachian Region about economic opportunities in the aquaculture industry.



**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

Customized designs for enhanced economic development prepared for, and adopted by, state rural communities (#)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	2	2

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Many communities in West Virginia are lagging economically and need assistance in developing plans to enhance their economic development, quality of life, and attractiveness to tourists. Our Community Design Team (CDT) has operated for 12 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 2010 we had a multidisciplinary CDT visit in Rainelle, WV, and Montgomery, WV, and followup visits in four previously visited communities.

**Results**

For Rainelle we developed a basic design for a farmers' market, suggested trails in the hills and pedestrian connections in town, provided economic data, and provided some downtown revitalization ideas including youth concerns about places to play basketball and other activities,

ideas for historic park, a city hall facade and a second park in town. GIS work is being completed to connect Rainelle to the rest of the Greenbrier County area.

For Montgomery tangible results include a class set of mural designs produced by College Landscape Architecture students using historic postcards, selection of a design by the community members, and a completed mural painted by WVU students, college and high school students from the area. Also a class project from a public administration public planning class, documenting suggestions for community planning and change was delivered.

A follow up visit to Glenville, WV, involved a College student developing a design for a pocket-park next to the city hall as a follow-up to the visit there two years ago. Approximately \$400,000 in grant money is being spent on another park in the center of town that was discussed and designed during the original CDT visit. The park will be completed in Spring 2011.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
131	Alternative Uses of Land
134	Outdoor Recreation
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
724	Healthy Lifestyle
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures
903	Communication, Education, and Information Delivery

**Outcome #3**

**1. Outcome Measures**

Enhancing the economic climate for business by removing unnecessary regulatory barriers.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Regulations involving the State aquaculture and other industries create barriers for farmers and business people wishing to enter or expand industries. Regulations in WV are often more restrictive than in surrounding states, reducing the competitiveness of WV businesses.

**What has been done**

Model legislation was developed for WV that would clarify legal and environmental rules governing the State aquaculture industry and reduce barriers to growth of the industry. On April 2, 2010, Governor Joe Manchin signed into the law the West Virginia Aquaculture Development Act, Chapter 19, Article 32. Presented for the first time to the House of Representatives and the Senate of the West Virginia Legislature in February of 2010, this new Act passed both chambers with only two negative votes. The work was the result of a long-term USDA funded project entitled Assessment and Development of a Legal/Institutional/Educational Framework For the Development of the Aquaculture Industry in West Virginia. This new law mandates the cooperation of major regulatory agencies impacting aquaculture.

**Results**

Since the passage of the law, The Department of Agriculture, Department of Environmental Protect, Division of Natural Resources and other statutorily mandated participants have formed an Aquaculture Advisory Board which has meet on four occasions with the ultimate goal of promulgating a comprehensive set of interagency regulations to promote the development of the aquaculture industry in West Virginia.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
131	Alternative Uses of Land
604	Marketing and Distribution Practices
608	Community Resource Planning and Development
903	Communication, Education, and Information Delivery

**Outcome #4**

**1. Outcome Measures**

Increase information available to farmers in the Appalachian Region about economic opportunities in the aquaculture industry.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
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2010 {No Data Entered} 0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

There are many economic opportunities in cool-water aquaculture in the Appalachian Region due to the proximity to markets on the Eastern Seaboard and the relative abundance of clean and cold water.

#### What has been done

Our aquaculture project researchers and extension personnel developed a five-part series on the aquaculture industry, regulations, and opportunities based on the long term project based at West Virginia University.

#### Results

On June 17, 2010, The West Virginia Farm Bureau Magazine was awarded the top award in the nation for "Best Print News or Feature Series" in the 2010 American Farm Bureau Public Relations Contest. This award was received for a five-part series titled "West Virginia Aquaculture: Fishing for Solutions."

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
604	Marketing and Distribution Practices
608	Community Resource Planning and Development
903	Communication, Education, and Information Delivery

### V(H). Planned Program (External Factors)

#### External factors which affected outcomes

- Economy
- Appropriations changes

#### Brief Explanation

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

#### Evaluation Results

#### Key Items of Evaluation

**V(A). Planned Program (Summary)**

**Program # 2**

**1. Name of the Planned Program**

Climate Change, Environmental Quality and Stewardship

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			15%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
112	Watershed Protection and Management			15%	
132	Weather and Climate			10%	
133	Pollution Prevention and Mitigation			15%	
135	Aquatic and Terrestrial Wildlife			25%	
605	Natural Resource and Environmental Economics			10%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.9	0.0
Actual	0.0	0.0	4.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	317266	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	531583	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	370441	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 minelands' restoration, 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 was made in assessing the ecological functions of restored and created wetlands.

One study examined wetland management techniques and the success of amphibian species, an important measure of the health of a wetland ecosystem. This project also has an outreach component that involves working with private landowners to encourage more positive attitudes toward maintaining wetlands on their properties. Another study examined the ability of current wetlands mitigation strategies on reclaimed minelands to restore long-term ecosystem health. The goals of this project are to quantify aquatic ecosystem functions on reclaimed mines and compare them to the functions of native systems and quantify changes in aquatic ecosystem functions on reclaimed mine sites over time. Results from this research are being used to develop a state-wide stream mitigation trading and banking program based on functional stream ecosystem values. Results also are being integrated into a state-wide process to maximize stream restoration effectiveness in mined watersheds. This research team made 25 presentations to state agencies, federal agencies, industry partners and conservation stakeholder groups in 2010. They also published 5 articles in peer-reviewed journals in 2010. Finally, we secured an additional \$500,000 in research funds to leverage our Hatch capacity funds.

Another related project that has been very successful at leveraging Hatch capacity funds by attracting competitive and other external sources of funding involves conducting a suite of studies related to management of riparian forested habitats and the population resistance and resilience in brook trout populations in headwater streams. This work is co-funded by the WV DNR, and two offices of the USDA Forest Service. Significant progress has been made on all study objectives for these allied projects and has resulted in three presentations and three publications.

Soil survey research continued at our National Soil Survey Center Geospatial Research Unit. Major work has been concentrated on two areas: (i) development of preliminary map products derived from gridded versions of the STATSGO and SSURGO databases for the properties as specified by the GlobalSoilMap.net project, and (ii) pilot projects for generating raster continuous soil maps based on terrain attributes. Related research involves improving our understanding of the processes, characteristics, and interpretations of hydromorphic, hydric, and subaqueous soils, and to inventory wetland and soil carbon resources using field indicators of hydric soils, geospatial modeling, and remote sensing.

Finally, a long-term study of the effects of gypsy moth defoliation on forest regeneration and wildlife populations found that although gypsy moths completely destroyed large tracts of forest habitat in this area, isolated patches of quality vegetation structure (refugia) remained and that those areas were used by forest birds. Moreover, the defoliated tracts were subject to immediate understory release and the density of birds associated with that early succession plant type increased substantially, leading to an overall increase in the number of bird species present and individual population densities.

**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.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	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: 2010  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Actual	2	12	14

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentations on research at professional meetings

Year	Actual
2010	8

**Output #2**

**Output Measure**

- Popular press articles on research

<b>Year</b>	<b>Actual</b>
2010	4

**Output #3**

**Output Measure**

- Completed graduate degree programs

<b>Year</b>	<b>Actual</b>
2010	3



**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Reduce the percentage of West Virginia streams classified as 'impaired' (%).
2	Reduce percentage of state streams classified as impaired by agricultural and forestry activities (%).
3	Gain an understanding of the long-term impacts of periodic gypsy moth defoliation.
4	To better understand the ecological services provided by wetlands and to educate landowners about those services.

**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

Gain an understanding of the long-term impacts of periodic gypsy moth defoliation.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Gypsy moth populations increase and decrease in periodic cycles. A better understanding of the long-term environmental consequences of defoliation events at the peaks of the cycles would help policy makers decide whether appropriate management should involve aggressive spraying of insecticides or a more passive approach that allows natural predators and defoliation to limit the population of gypsy moths.

**What has been done**

A long-term study of the effects of gypsy moth defoliation on forest regeneration and wildlife populations found that although gypsy moths completely destroyed large tracts of forest habitat in

this area, isolated patches of quality vegetation structure (refugia) remained and that those areas were used by forest birds. Moreover, the defoliated tracts were subject to immediate understory release and the density of birds associated with that early succession plant type increased substantially, leading to an overall increase in the number of bird species present and individual population densities.

**Results**

The finding that periodic defoliation by gypsy moths can actually have a neutral or even positive impact on certain plant and animal species may lead to reduced use of pesticides in dealing with gypsy moth infestations, leading to reduced environmental and ecological damages from outbreaks.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

**Outcome #4**

**1. Outcome Measures**

To better understand the ecological services provided by wetlands and to educate landowners about those services.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Wetlands provide numerous ecological services, many of which are not fully understood by researchers and landowners. As such, landowners often treat wetlands as a nuisance and drain or fill them, thus damaging the ecological services provided by the wetland.

**What has been done**

One study examined wetland management techniques and the success of amphibian species, an important measure of the health of a wetland ecosystem. Another study examined the ability of current wetlands mitigation strategies on reclaimed minelands to restore long-term ecosystem health. The goals of this project are to quantify aquatic ecosystem functions on reclaimed mines and compare them to the functions of native systems and quantify changes in aquatic ecosystem functions on reclaimed mine sites over time. This project also has an outreach component that involves working with private landowners to encourage more positive attitudes toward maintaining wetlands on their properties.

**Results**

Results from this research are being used to develop a state-wide stream mitigation trading and banking program based on functional stream ecosystem values. Results also are being integrated into a state-wide process to maximize stream restoration effectiveness in mined watersheds. This research team made 25 presentations to state agencies, federal agencies, industry partners and conservation stakeholder groups in 2010. They also published 5 articles in peer-reviewed journals in 2010. Finally, we secured an additional \$500,000 in research funds to leverage our capacity funds.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy
- Appropriations changes
- Competing Programmatic Challenges

**Brief Explanation**

We are in the process of investing resources in faculty positions in the wildlife ecology, conservation genetics, and climate change areas. While our SY's in this category are lower this year than planned, we hope to rectify that situation in the future by devoting more resources to this program.

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

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)****Program # 3****1. Name of the Planned Program**

Global Food Security and Hunger--Fundamental Plant and Animal Systems

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			25%	
206	Basic Plant Biology			15%	
301	Reproductive Performance of Animals			25%	
302	Nutrient Utilization in Animals			15%	
304	Animal Genome			10%	
305	Animal Physiological Processes			10%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual	0.0	0.0	5.4	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	735928	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	983102	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	305802	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 science understanding of reproductive, nutritional and general physiological systems and processes. On the animal side, practical problems addressed include embryonic mortality in sheep and cattle, performance limiting amino acids in animal rations, and health and disease resistance in poultry. For plants, the program emphasis varies from determining functions of ubiquitin and other polypeptide tags, to understanding basic mechanisms of flower senescence and cold shock adaptation, to combating the impacts of phytophthora and Chestnut blight, to defining and eliminating negative effects on grazing animals of ergot alkaloids produced by fungi symbiotic with pasture grasses.

Considering the animal systems fundamental research first, one project continued culturing primary hepatic cells with various CYP450 and other enzyme inhibitors to begin to assess the relative contribution of different enzyme systems to the catabolism of progesterone. The investigators have clearly demonstrated that providing sufficient nutrition to maintain milk production, while simply altering the feedstuffs utilized to stimulate insulin secretion, leads to a dramatic decrease in the activity of the enzymes responsible for progesterone, an increase in progesterone half life and a decrease in the metabolic clearance rate of progesterone. At the same time this hyperinsulinemic diet does not alter feed intake, milk yield or blood flow to the liver. The data indicate that CYP2C is the primary cytochrome responsible for progesterone catabolism in the lactating dairy cow, followed by CYP3A and aldoketo reductase.

Another study examined ovarian influences on embryonic survival in ruminants. The investigators found that NOBOX (a homeobox gene that is preferentially expressed in bovine oocytes) is an essential maternal factor during bovine early embryogenesis, and that it functions in the regulation of embryonic genome activation, pluripotency gene expression and blastocyst cell allocation. Intracellular calcium homeostasis is crucial in regulating progesterone production and apoptosis. This finding therefore contributes to our understanding of the mechanisms that render the early CL resistant to luteolytic actions of PGF<sub>2</sub>α. The work with the oxytocin receptor inhibitor, atosiban, may shed light on why oxytocin appears to be luteolytic in some situations, but is not a necessary component of the action of prostaglandin F<sub>2</sub> α in regression of the ovine and bovine CL.

On the plant science front, work continued on identifying the triggers of flower senescence. The investigator has developed a new model of flower senescence in which CEBP, a nuclear-encoded chloroplast protein, acts as a repressor of flower senescence. This protein, because of its putative pivotal role in the trigger mechanism of flowers senescence, will in future work be targeted for genetic engineering applications. Understanding flower senescence at the molecular level will help efforts of increasing the economic value and productivity of agricultural crops through genetic engineering. Specifically, manipulating flower longevity will lead to higher crop productivity by increasing the window of opportunity for flowers to be pollinated. This in turn has the potential of increasing crop yields. In contrast inducing full or partial flower senescence may lead to more efficient breeding efforts by alleviating the need to emasculate flowers. In addition decreased flower longevity may result in a decrease of invasiveness of crop and ornamental plant species.

A long-term regional research project that had its inception at WVU, "Biological Improvement of Chestnut through Technologies that Address Management of the Species, its Pathogens, and Pests," achieved an important milestone in 2010--it was awarded both the Northeast regional award for multi-state research and the national award of excellence from the Association of Land Grant Universities. "The APLU award is indeed a significant one as it recognizes the collaborative accomplishments of researchers from 14 land-grant institutions, the federal government and a non-profit organization," said William MacDonald, professor of plant and soil sciences in the Davis College. "The scientific challenges inherent in restoring the America chestnut can only be accomplished when scientists collectively combine their knowledge and

talents."

Outcomes of this project have focused on four field-oriented studies. The first is a long-term experiment designed to initiate biological control of chestnut blight at an American chestnut stand near West Salem, Wisconsin. The study has been in place for 20 years and involves the release of hypoviruses (viruses that reduce the virulence of the chestnut blight fungus) by introducing them into the resident population of *Cryphonectria parasitica*. Hypovirus spread has been assessed annually by analyzing *C. parasitica* isolates that arise from cankers. Hypoviruses are recovered most readily from cankers on trees that receive hypovirulent inoculum and less effectively to trees that did not receive treatment inoculum. In June 2010, a study examined the spread of hypoviruses to American chestnut trees outside the permanent study plots. Samples were removed from 345 cankers on 225 trees. To date, hypovirulent isolates have been recovered from 79% of the trees in the area with the longest treatment history, and from 5-11% of the trees distant from the original treatment area. Although some trees in the stand have died, others now are in remission from the disease and should survive. As biological control is achieved, seed production should be restored so that the American chestnut component of the stand can be perpetuated.

A second research topic has involved field testing transgenic (genetically modified) strains of *Cryphonectria parasitica* to assess whether they can enhance the biological control potential of hypoviruses. The advantage the modified strains bring is their ability to transmit hypoviruses at high levels to asexual spores and also to sexual spores that result when fungal mating occurs. The experimentation has demonstrated that the transgenic strains can function in the forest by increasing the production of hypovirus-infected inoculum. Each year, significantly more cankers have been detected that have become hypovirus infected and greater numbers of sexual spores were detected that are hypovirus infected. Additional time will be required to confirm the effectiveness of using the transgenic strains.

A third study 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. Current efforts are to maintain optimal growth conditions for the planting that contain American, Chinese, European chestnuts and a variety of Chinese X American backcrosses. These trees eventually will be used to test whether the two approaches to disease control can be combined effectively to manage chestnut blight. A fourth study involved a survey of a population of *C. parasitica* isolates from American chestnut trees in the Great Smokey Mountain National Park. This study examined the diversity of the fungal population and any associated hypoviruses. Seventy-one cankers on sixty-one trees were sampled in 2010 and tests have shown that there is a great amount of diversity among the *C. parasitica* isolates. No hypoviruses have been detected.

The research involving ergot alkaloids produced by fungi that are symbiotic with pasture grasses continued in 2010. It is hypothesized that modification of the expression of ergot pathway genes should alter the ergot alkaloid profile of endophytic fungi in grasses and the corresponding biological properties of grasses that contain these endophytes. Since clavine alkaloids and lysergic acid derivatives have been shown to have differential effects on insects versus mammals, shifting the bulk of the pathway product towards one alkaloid class or the other should change the biological properties of the fungus-grass symbiosis. Understanding the functions of ergot alkaloid biosynthesis genes will allow for alteration of the pathway and thus the profile of ergot alkaloids that accumulate in agriculturally important fungi.

## **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.

### **V(E). Planned Program (Outputs)**



**1. Standard output measures**

2010	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: 2010

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Actual	0	15	15

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentation on research at professional meetings

Year	Actual
2010	8

**Output #2**

**Output Measure**

- Completed graduate degree programs

Year	Actual
2010	3

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Identify and map genes affecting flower senescence - # new genes
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**

Identify and map genes affecting flower senescence - # new genes

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	1	1

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Understanding flower senescence at the molecular level will help efforts of increasing the economic value and productivity of agricultural crops through genetic engineering.

#### **What has been done**

The investigator has developed a new model of flower senescence in which CEBP, a nuclear-encoded chloroplast protein, acts as a repressor of flower senescence.

#### **Results**

This protein, because of its putative pivotal role in the trigger mechanism of flowers senescence, will in future work be targeted for genetic engineering applications. Specifically, manipulating flower longevity will lead to higher crop productivity by increasing the window of opportunity for flowers to be pollinated. This in turn has the potential of increasing crop yields.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**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	Quantitative Target	Actual
2010	0	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

The American chestnut was among the most valuable trees in eastern North American forests, spanning from southern Ontario to northern Florida. Chestnut blight, a disease caused by the fungus *Cryphonectria parasitica*, eliminated the American chestnut as a canopy species.

**What has been done**

WVU researchers and leaders helped organize a long-term regional research project, "Biological Improvement of Chestnut through Technologies that Address Management of the Species, its Pathogens, and Pests," that involves researchers from 14 land-grant institutions, the federal government and a non-profit organization.

**Results**

To date, hypovirulent isolates have been recovered from 79% of the trees in the area with the longest treatment history, and from 5-11% of the trees distant from the original treatment area. Although some trees in the stand have died, others now are in remission from the disease and should survive. As biological control is achieved, seed production should be restored so that the

American chestnut component of the stand can be perpetuated. In 2010 the project received both the Northeast regional award for multi-state research and the national award of excellence from the Association of Land Grant Universities.

#### 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	Quantitative Target	Actual
2010	1	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 investigators found that NOBOX (a homeobox gene that is preferentially expressed in bovine oocytes) is an essential maternal factor during bovine early embryogenesis, and that it functions in the regulation of embryonic genome activation, pluripotency gene expression and blastocyst cell allocation.

###### **Results**

The results of this study represent an advance in knowledge about ovarian function that may lead to the development of management practices and treatments to increase reproductive success in ruminants.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
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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 and Data Collection)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 4**

**1. Name of the Planned Program**

Global Food Security and Hunger--Production/Sustainable Agriculture

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
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%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.5	0.0
Actual	0.0	0.0	7.4	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	625673	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1210704	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	762808	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

This program was formerly called Production Agriculture. For 2010 and the future we have made it a sub-topic of the NIFA priority area "Global Food Security and Hunger: Production/Sustainable Agriculture." We feel the new program title provides a description of our work in this area fit because all the plant- and animal related projects in this area 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.

Progress continued to be made in an important integrated project concerned with enabling out-of-season lamb production and promoting the sheep industry in the region. The project has stabilized sheep numbers in West Virginia over the last 12 year period and contributed efficacy data that allowed US approval of the CIDR-G for market as an aid in out-of-season breeding in the US. It has provided data on late embryonic and fetal mortality in the ewe and begun to provide such data in the goat. These data will enable the ultimate development of management approaches to reduce or limit these losses. The project website has been updated in 2010 and continues to provide a significant resource for cooperating and other producers. The outreach/extension component of the project held the annual small ruminant short course in Randolph County in conjunction with the WV Shepherd's Federation. The program emphasized parasite control and management methods. Attendance approached 50 individuals. The project held and sponsored 3 shearing schools in 2010 in an attempt to facilitate the urgent need for more shearers within the region. The project conducted breeding soundness examination on over 50 rams for producers in advance of the breeding season. Focus on estrous synchronization out-of-season and pregnancy testing continues and was demonstrated at the annual performance tested sale as well as in numerous ewe flocks



and over 600 head of sheep and. Studies of late embryonic and fetal mortality in goats in conjunction with Lincoln University is being done in 5 goat herds in three states this year to add to data collected in 4 herds in 2009-2010.

In the pasture-based beef systems project higher fall pasture allowance for heifers resulted in higher body weight, which was maintained throughout the winter and following spring, indicating that input in the form of conserved forages can be reduced during the winter. Reducing the use and dependence on conserved forages can reduce cost of rearing replacement heifers and at the same time make the final product conform better to the label "Pasture Raised Beef". It is concluded that any kind of grassland may be used for winter grazing until it runs out or is covered with snow. Tall fescue is most suited and keeps its quality for a longer period. Maintaining animals all winter on the grassland reduces productivity of first cut hay and increases productivity of second cut hay, and also increases pasture herbage mass. Most grassland in WV is similar to the permanent grassland (PAS) and cannot readily be harvested for conservation. It can be used for winter grazing.

An experiment with mixed grazing (sheep and cattle) from May to July was initiated to manage botanical composition (increase legume and decrease weed percentage) on winter stocked grassland. Two steers/ac or 1 steer and 6 yearling lambs/ac can be carried on permanent grassland from May to July. A combination of techniques including stochastic analysis, econometric and optimization modeling, and financial engineering were used to assist producers, the industry and policy makers make better decisions. Results include identification of the production and market conditions under which pasture-based beef (PBB) could be more profitable, as well as specific risk-management strategies, information that can be beneficial to both existing producers and potential adopters of PBB technologies. Types of consumers were identified who exhibit a distinct preference and an associated higher willingness-to-pay for pasture-based beef, information that can be used in the development of marketing strategies.

A study in its fourth year on the benefits of alternative feed additives used to increase production and/or efficiency of production of lactating dairy cows concluded that no significant benefit exists with regard to feeding specific feed supplements, at least not under the limitations of the studies carried out under this project. The project provided needed scientific data to an area which is dominated by anecdotal and unpublished evidence.

A continuing project on the effect of diet formulation and manufacture technique on pellet production, nutrient and exogenous enzyme retention and broiler performance has concluded that diet formulation and manufacturing technique are, in fact, linked and must be considered when attempting to optimize pellet quality. To maximize broiler performance, the diet formulation and manufacturing technique must be considered. It is likely that increased mixer-added fat (MAF) improved exogenous enzyme retention and nutrient utilization by broilers. Subject to current fat prices, increasing MAF may reduce the total cost of broiler production, particularly when reduction of electrical energy usage is considered. Males had improved feed conversion and were larger than females, and those in the group with an equal male/female ratio were intermediate. Whole pellets in the diet improved FCR compared with ground pellets. Broilers fed high-quality pellets exhibited the greatest carcass weight.

The Davis College has developed its capacity to do conduct geospatial analysis at several levels: spatial statistics, geographic information systems and remote sensing. One facet of this program involves targeted pest management strategies. A new platform of unmanned aerial vehicle (UAV) was developed for the project by the collaboration with aerospace engineers at the Department of Aerospace and Mechanical Engineering at West Virginia University. The investigators have developed a miniaturized autopilot system (3 oz. total weight) which operates an Unmanned Aerial Vehicle (UAV) without a pilot or controller. Such UAV technology can be used for landscape-scale pest detection in a large geographic area, providing economical and effective landscape-scale pest detection. Other pest-related efforts involved measuring the spatial response of natural pest enemies (spined soldier bugs and lady beetles) to

a pheromone attractant (positive for the soldier bugs not effective for the lady beetles) and an effort to organize at the regional level to combat the marmorated stink bug.

A number of projects at the Davis College involve long-term organic farming research involving plant systems, animal systems and integrated plant and animal systems. One study examined the impact of composting organically grown potatoes and watermelon on pest and disease resistance. Organic growers struggle to maintain high levels of soil fertility, and are prohibited from using synthetic pesticides. Hence, use of tolerant cultivars and soil amendments create complex management interactions that greatly influence final yields and disease incidence. These results indicate that Keuka Gold is more tolerant of diseases than All Blue, but responses vary with the levels of fertility. Watermelon yields were not affected by compost levels, but disease response to compost in some tomato cultivars was observed. Brandywine tomato had relatively low levels of disease in compost amended plots, but had the highest levels of any cultivar in plots without compost. These results help organic growers identify optimum management alternatives for their particular cropping systems. These results confirm similar observations in field trials in organic farming systems research.

Information about the sustainability of winter grazing systems is required to assess the suitability of this production system in West Virginia environments. This project was started in March 2007 and includes a major field research component. Data collected reflect the spatial and temporal variation of soil properties in WV pasture soils, and its relationship with forage and pasture productivity and system sustainability. The project evaluation at this time indicates a relationship between soil properties and pasture development and yield. Spatial relationships between soil properties, forage productivity, and landscape attributes can be used to manage site-specific grazing. During the study period, biomass accumulation at lower landscape positions was more subject to weather extremes. Soil strength at 0 to 2 cm was related to biomass production in the high and medium, but not low, elevation zones. Temporal stability in biomass production was related to elevation. The data produced supports the hypothesis that soils in the Appalachian region have certain physical characteristics (e.g. Gilpin series) that might favor winter grazing and sustained pasture production. The risk of soil degradation is significantly less due to the presence of soil skeleton.

**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.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2010</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	0	14	14

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentation on research at professional meetings

<b>Year</b>	<b>Actual</b>
2010	7

**Output #2**

**Output Measure**

- Popular press articles on research

<b>Year</b>	<b>Actual</b>
2010	4

**Output #3**

**Output Measure**

- Completed graduate degree programs

<b>Year</b>	<b>Actual</b>
2010	9

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Growth in state production of beef and lamb - % increase
2	Growth in state aquaculture industry - annual % increase
3	Growth in state number of farms marketing organically produced vegetables - annual % increase
4	Growth in state broiler, egg and turkey industries - annual % increase

**Outcome #1**

**1. Outcome Measures**

Growth in state production of beef and lamb - % increase

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	2	0

**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. Production of lambs out of the traditional season would give producers an economic advantage due to higher market prices for out-of-season lambs.

**What has been done**

We have a long-term integrated pasture 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.

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

**Results**

In the pasture-based beef systems project higher fall pasture allowance for heifers resulted in higher body weight, which was maintained throughout the winter and following spring, indicating that input in the form of conserved forages can be reduced during the winter. Reducing the use and dependence on conserved forages can reduce cost of rearing replacement heifers and at the same time make the final product conform better to the label "Pasture Raised Beef". It is concluded that any kind of grassland may be used for winter grazing until it runs out or is covered with snow. Tall fescue is most suited and keeps its quality for a longer period. Maintaining animals all winter on the grassland reduces productivity of first cut hay and increases productivity of second cut hay, and also increases pasture herbage mass. Most grassland in WV is similar to the permanent grassland (PAS) and cannot readily be harvested for conservation. It can be used for winter grazing.

Cattle sales were again down about 10 percent in 2010. Sheep sales, while up in 2009, fell by 17 percent. The declines are due to increased costs of production, depletion of the breeding stock due to unusually high prices, and in the case of sheep, increased predation from coyotes.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
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

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	100

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Cold water aquaculture, particularly trout production for sale as a meat product, represents an economic opportunity for farmers in West Virginia and the region. The region has an abundance of fresh cold water and is close to Eastern Seaboard markets.

###### **What has been done**

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

###### **Results**

Production figures were not available for 2010 at the time of this report, but in 2009, trout sales doubled in value over 2008. This represents significant growth in the industry and growing

importance of the industry to the agricultural sector of the WV economy. There is some doubt about the accuracy of data on the aquaculture industry, given that it is a growing industry and all producers may not have been counted in the past.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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 number of farms marketing organically produced vegetables - annual % increase

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	1	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

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

**What has been done**

A number of projects at the Davis College involve long-term organic farming research involving plant systems, animal systems and integrated plant and animal systems.

**Results**

One study examined the impact of composting organically grown potatoes and watermelon on pest and disease resistance. Organic growers struggle to maintain high levels of soil fertility, and are prohibited from using synthetic pesticides. Hence, use of tolerant cultivars and soil amendments create complex management interactions that greatly influence final yields and disease incidence. These results indicate that Keuka Gold is more tolerant of diseases than All Blue, but responses vary with the levels of fertility. Watermelon yields were not affected by

compost levels, but disease response to compost in some tomato cultivars was observed. Brandywine tomato had relatively low levels of disease in compost amended plots, but had the highest levels of any cultivar in plots without compost. These results help organic growers identify optimum management alternatives for their particular cropping systems. These results confirm similar observations in field trials in organic farming systems research.

Data on growth in the organic farming industry in WV were not available for 2010 and this state-defined outcome will be dropped from future reports.

#### 4. Associated Knowledge Areas

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

#### Outcome #4

##### 1. Outcome Measures

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

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	0

##### 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**

A continuing project on the effect of diet formulation and manufacture technique on pellet production, nutrient and exogenous enzyme retention and broiler performance. Other studies have examined ways to reduce the phosphorus content of poultry litter through diet modification



and to better utilize the litter as a fertilizer to reduce phosphorus pollution of water.

### **Results**

The study has concluded that diet formulation and manufacturing technique are, in fact, linked and must be considered when attempting to optimize pellet quality. To maximize broiler performance, the diet formulation and manufacturing technique must be considered. It is likely that increased mixer-added fat (MAF) improved exogenous enzyme retention and nutrient utilization by broilers. Subject to current fat prices, increasing MAF may reduce the total cost of broiler production, particularly when reduction of electrical energy usage is considered. Males had improved feed conversion and were larger than females, and those in the group with an equal male/female ratio were intermediate. Whole pellets in the diet improved FCR compared with ground pellets. Broilers fed high-quality pellets exhibited the greatest carcass weight.

Data are not available for 2010, but for 2009 the combined production of broilers, eggs and turkeys was down 10 percent from 2008.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
133	Pollution Prevention and Mitigation
302	Nutrient Utilization in Animals
307	Animal Management Systems

### **V(H). Planned Program (External Factors)**

#### **External factors which affected outcomes**

- Economy
- Appropriations changes
- Competing Public priorities

#### **Brief Explanation**

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

#### **Evaluation Results**

{No Data Entered}

#### **Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 5**

**1. Name of the Planned Program**

Childhood Obesity, Human Nutrition and Health

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
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%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.5	0.0
Actual	0.0	0.0	3.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	244653	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	469071	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	79736	0

**V(D). Planned Program (Activity)**

## 1. Brief description of the Activity

West Virginia citizens have the fifth highest level of obesity in the Nation (Center for Disease Control, 2009). West Virginia is also above the national averages for incidence of diabetes, high blood pressure, and cardiovascular disease, as well as for osteopenia and osteoporosis. Station research in human nutrition and health is focused on determining the current and potential impacts of diet, nutritional education and dietary intervention on obesity and obesity related conditions (diabetes, elevated cholesterol and plasma lipids, heart attack, stroke and some cancers). The program also is testing the efficacy and safety of bioactive compounds in foods, including krill protein, and is developing omega-3 DHA enhanced diets and educational programs to support their adoption. Please note that our childhood obesity work was formerly reported under a separate program but has been merged with the closely related research area Human Nutrition and Health to reflect advice on the Plan of Work from NIFA. A food safety project that was formerly reported under this program has also been moved to a new program titled Food Safety, again to reflect the priorities of NIFA.

Bone loss (osteoporosis) may be lessened if bone health is improved by optimizing nutrition intervention. The n-3 polyunsaturated fatty acids (PUFAs) have been suggested to improve bone health. However, n-3 PUFA sources differ in the types of fatty acids, ratio, and structural form. Therefore, a research project was undertaken to determine the effect of n-3 PUFAs from different sources on bone mineral, microarchitecture, and strength and potential mechanisms of affect. Laboratory rats were randomly assigned to a high fat 12% (weight) diet consisting of either corn oil (CO) control or to n-3 PUFA rich flaxseed (FO), krill (KO), menhaden (MO), salmon (SO), or tuna (TO). After 8 weeks of feeding bone mineral content was greater in rats fed TO or SO ( $P<0.001$ ) than CO-fed rats. Bone mineral density in TO-fed rats was higher ( $P=0.006$ ) compared to CO-fed rats. Rats fed TO or SO had a lower ( $P<0.005$ ) TBARS than CO, KO, and MO, indicating that rats fed TO or SO had lower lipid peroxidation. Rats fed FO or MO had improved bone microarchitecture compared to rats fed CO or SO. Serum osteocalcin was higher ( $P=0.03$ ) in rats fed FO compared to rats fed TO or SO. Based on the study results, sources of n-3 PUFAs influenced bone differently. Rats fed FO or MO, rich in alpha-linolenic acid, promoted bone microarchitecture. Rats fed TO and SO, rich in docosahexaenoic acid, increased bone mineralization. There was no effect on bone strength. Both bone mineralization and microarchitecture are required for bone strength. The study results suggest that rather than focusing on a single source of n-3 PUFAs, perhaps a variety of sources of n-3 PUFAs should be consumed in order to improve bone health during growth.

A related study looked at the relative effectiveness of DHA derived from algal versus fish-based PUFAs. In the first study it was determined that DHA from algal oil is not as efficiently incorporated into tissue lipids as DHA from fish oil; nearly 2X as much dietary DHA from algal oil was required. Furthermore, even at equal tissue DHA concentrations, algal oil is less effective at reducing body fat and serum lipids than fish oil. Greater than 4X as much tissue DHA was needed to result in similar serum triglyceride and cholesterol levels as fish oil-fed mice. In the second study they confirmed that coconut oil-fed mice are more sensitive to dietary conjugated linoleic acid, as they are leaner and have enhanced lipolysis.

An integrated research/extension project on local food choices, eating patterns and population health piloted a survey in three WV counties with questions related to importance of price, freshness, organic production and variety of choices to consumers. Based on responses from 219 farmers market customers, the investigators will revise some of the survey questions and expand the project to 10 West Virginia counties in 2011. WVU Extension faculty members initiated a project to help consumers choose more fruits and vegetables. Eleven vegetables that are grown in WV were highlighted. For each vegetable, a faculty member developed a fact sheet and one or more recipes. These were professionally printed and distributed to 10 counties to be handed out at farmers markets. Extension agents gave cooking demonstrations and sponsored fun, educational activities for children at farmers markets to encourage

greater attendance. WVU Extension faculty members conducted a Survey of Home Canning Practices in West Virginia to determine whether people who can foods at home were knowledgeable about and used the recommended safe food preservation practices. More than 1000 surveys were completed and data entered into a database that is being analyzed at this time.

Two studies are developing baseline obesity and nutrition data that will be used to study in the first case the impacts of community environmental factors on the risk of childhood obesity and in the second case the relationship between university student health practices and the risks of excessive weight gain and metabolic syndrome.

**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.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	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: 2010  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Actual	0	3	3

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentations on research at scientific meetings

<b>Year</b>	<b>Actual</b>
2010	2

**Output #2**

**Output Measure**

- Popular press articles on research

<b>Year</b>	<b>Actual</b>
2010	2

**Output #3**

**Output Measure**

- Completed graduate degree programs

<b>Year</b>	<b>Actual</b>
2010	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Annual reduction in state incidence of overweight and obesity and obesity related health problems (diabetes, cardiovascular disease, hypertension, etc.)-% reduction
2	Reduction in state incidence of osteoporosis and similar or related disorders - % reduction
3	Increase consumer awareness about the local availability of healthy food choices

**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

Increase consumer awareness about the local availability of healthy food choices

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Consumers will not seek out locally grown healthy food choices unless they are aware of price and availability.

**What has been done**

An integrated research/extension project on local food choices, eating patterns and population health piloted a survey in three WV counties with questions related to importance of price, freshness, organic production and variety of choices to consumers. WVU Extension faculty members initiated a project to help consumers choose more fruits and vegetables. Eleven vegetables that are grown in WV were highlighted. For each vegetable, a faculty member

developed a fact sheet and one or more recipes. These were professionally printed and distributed to 10 counties to be handed out at farmers markets. Extension agents gave cooking demonstrations and sponsored fun, educational activities for children at farmers markets to encourage greater attendance.

**Results**

Based on responses from 219 farmers market customers, the investigators will revise some of the survey questions and expand the project to 10 West Virginia counties in 2011. WVU Extension faculty members conducted a Survey of Home Canning Practices in West Virginia to determine whether people who can foods at home were knowledgeable about and used the recommended safe food preservation practices. More than 1000 surveys were completed and data entered into a database that is being analyzed at this time.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
703	Nutrition Education and Behavior
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 and Data Collection)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}



**V(A). Planned Program (Summary)**

**Program # 6**

**1. Name of the Planned Program**

Production/Sustainable Forestry - Timber Management and Wood Products

**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%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.5	0.0
Actual	0.0	0.0	7.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	51902	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	868450	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	622937	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.

One study is looking at market potential and alternative-uses for under-utilized Appalachian Hardwoods. Preliminary investigation was conducted on the current market for hickory, which was identified as an under-utilized species that could be used to produce furniture, panel products, and flooring. Potential market demand, strengths and weaknesses, and opportunities and threats for hickory and hickory-based products were identified. This qualitative information is being used to develop a larger survey that will be sent to regional and international users and potential users of Appalachian Hardwood Species. The survey, in development, is expected to provide the quantitative data needed to determine the current market demand, perceived strengths and weaknesses, opportunities and threats, and potential new uses for the most under-utilized Appalachian Hardwood Species. The results of the marketing research and identification of alternative products is expected to also assist in the later development of non-destructive evaluation systems by identifying key parameters (i.e., characteristics) of importance when selecting hardwood raw materials for use in secondary (value-added) manufacturing.

A research project on Beech Bark Disease has been initiated 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 scale and *Neonectria* 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. Numerous organisms have been found to be associated with diseased beech. Their involvement in the establishment or development of the disease will be evaluated as they are identified. This information can be useful to develop management guidelines that can be used to improve the health of stands with an American beech component.

We have used our capacity funds and the Special Grant for Wood Utilization Research (WUR) to initiate eight projects focused on new products and techniques that make better use of upland hardwoods and residues in the Appalachian region. These projects are regional in terms of their potential impact and, although the research is directed from West Virginia University, the projects have involved industry representatives from across the region as cooperators. Research and extension activities through the Wood Utilization Research Program will help regional forest product manufacturers develop the extraction, production, manufacturing, and marketing breakthroughs needed to keep the Appalachian wood products industry globally competitive into the future. This Special Grant has enabled WVU researchers to leverage funding from other sources and enhance their intellectual capacity. Specific highlights of the efforts include: (1) Hybrid Structural Wood Composites Engineered from Underutilized Hardwood Species Combined with Reformulated Waste Materials, (2) Wood Residue Properties Assessment, Deploymerization, and Fermentation to Ethanol, (3) Sawmill Assistance through Technical Outreach and Automated Yield Tracking Development, (4) Rapid Characterization of Physical and Chemical Properties and Chemical Properties of Some West Virginia Hardwoods Using Near-Infrared Spectroscopy, (5) Biodegradable Nanocomposites from Wood Cellulose Residues, (6) Determination of Specific Energy Consumption in Sawmills: Facilitation of Benchmarking, (7) Identification of Enzymes for Biofuel Conversion from the Microbial Community of the Termite Hindgut, (8) An Evaluation of the Domestic and Global Competitiveness of the West Virginia Forest Products Industry: Problems and Strategies.

Upon completion of these eight components the results will provide useful tools and information to the wood products industry in order to promote Appalachian Hardwood utilization and global competitiveness. The following are the impacts of current finished sections: (1) well-defined technologies for manufacturing hybrid composite products were developed. Because of their highly engineered, consistent mechanical properties, low cost furnish resources and designed physical properties, these products will represent a real alternative to the existing structural wood composites. (2) Successful implementation of the wood residue fermentation to ethanol would impact the biochemical industry of West Virginia. Ethanol production from available cellulosic biomass in West Virginia would boost the local economy, generate new income, increase tax revenue, and create new jobs by a factor of 20. (3) The tracking system developed could be used to aid sawmill cooperators in analyzing their log grades and lumber yields and help automate the tracking of log yields. (4) New technologies may reduce cost and speed up processing of lignocellulosic biomass in biorefineries. (5) Cellulosic nanofibers and/or nanocrystals from wood residues and cellulosic particles presented a commercial potential of creating high-value products from wood residues. (6) The energy consumption research in sawmills provides a benchmark for sawmill owners in terms of energy intensity to produce various species of lumber under varying conditions. The research will produce models that the owners can use to evaluate the energy impact of their production decisions. (7) The discovery of genes that could subsequently be harnessed for the production of biofuels from lignocellulosic feedstocks. This has the potential to accelerate bioenergy development efforts in West Virginia and elsewhere, thereby enhancing rural economies and increasing U.S. energy independence. (8) The long-term impact of the evaluation of the forest products industry would include enhanced ability of the industry to compete globally.

Invasive species represent a significant threat to the Appalachian Hardwoods Industry. Three field-based workshops were held that directly addressed invasive plant species in the woodlands of West Virginia. Roughly 70 participants attended these workshops. At least one of the participants of a field workshop in Putnam County has treated from 50-100 stems of the invasive tree-of-heaven on his property. This was a direct result of the lesson he had learned at the workshop.

**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.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	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: 2010

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2010</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	0	15	15

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentations on research at professional meetings

<b>Year</b>	<b>Actual</b>
2010	12

**Output #2**

**Output Measure**

- Popular press articles on research

<b>Year</b>	<b>Actual</b>
2010	3

**Output #3**

**Output Measure**

- Completed graduate degree programs

<b>Year</b>	<b>Actual</b>
2010	13

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Growth in state timber industry - % change employee compensation
2	Ability to more accurately predict yields of OSB, Paralam and additional wood species from measures on standing timber - new prediction models developed
3	Growth in state wood products and furniture industry - % change in employee compensation
4	Increase awareness of invasive species issues among State private forest land owners.

## **Outcome #1**

### **1. Outcome Measures**

Growth in state timber industry - % change employee compensation

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	1	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.

#### **What has been done**

We have used our capacity funds and the Special Grant for Wood Utilization Research (WUR) to initiate eight projects focused on new products and techniques that make better use of upland hardwoods and residues in the Appalachian region. These projects are regional in terms of their potential impact and, although the research is directed from West Virginia University, the projects have involved industry representatives from across the region as cooperators. Research and extension activities through the Wood Utilization Research Program will help regional forest product manufacturers develop the extraction, production, manufacturing, and marketing breakthroughs needed to keep the Appalachian wood products industry globally competitive into the future.

#### **Results**

Upon completion of these eight components the results will provide useful tools and information to the wood products industry in order to promote Appalachian Hardwood utilization and global competitiveness. The following are the impacts of current finished sections: (1) well-defined technologies for manufacturing hybrid composite products were developed. Because of their highly engineered, consistent mechanical properties, low cost furnish resources and designed physical properties, these products will represent a real alternative to the existing structural wood composites. (2) Successful implementation of the wood residue fermentation to ethanol would impact the biochemical industry of West Virginia. Ethanol production from available cellulosic biomass in West Virginia would boost the local economy, generate new income, increase tax revenue, and create new jobs by a factor of 20. (3) The tracking system developed could be used

to aid sawmill cooperators in analyzing their log grades and lumber yields and help automate the tracking of log yields. (4) New technologies may reduce cost and speed up processing of lignocellulosic biomass in biorefineries. (5) Cellulosic nanofibers and/or nanocrystals from wood residues and cellulosic particles presented a commercial potential of creating high-value products from wood residues. (6) The energy consumption research in sawmills provides a benchmark for sawmill owners in terms of energy intensity to produce various species of lumber under varying conditions. The research will produce models that the owners can use to evaluate the energy impact of their production decisions. (7) The discovery of genes that could subsequently be harnessed for the production of biofuels from lignocellulosic feedstocks. This has the potential to accelerate bioenergy development efforts in West Virginia and elsewhere, thereby enhancing rural economies and increasing U.S. energy independence. (8) The long-term impact of the evaluation of the forest products industry would include enhanced ability of the industry to compete globally.

Data on compensation in the forest industry were not available for 2010.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	1	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. Growth of this sector is dependent on finding new commercial uses for underutilized hardwood species and forest industry residuals.

#### What has been done

One study is looking at market potential and alternative uses for under-utilized Appalachian Hardwoods. Preliminary investigation was conducted on the current market for hickory, which was identified as an under-utilized species that could be used to produce furniture, panel products, and flooring. Potential market demand, strengths and weaknesses, and opportunities and threats for hickory and hickory-based products were identified. This qualitative information is being used to develop a larger survey that will be sent to regional and international users and potential users of Appalachian Hardwood Species. The survey, in development, is expected to provide the quantitative data needed to determine the current market demand, perceived strengths and weaknesses, opportunities and threats, and potential new uses for the most under-utilized Appalachian Hardwood Species.

#### Results

The survey, in development, is expected to provide the quantitative data needed to determine the current market demand, perceived strengths and weaknesses, opportunities and threats, and potential new uses for the most under-utilized Appalachian Hardwood Species. The results of the marketing research and identification of alternative products is expected to also assist in the later development of non-destructive evaluation systems by identifying key parameters (i.e., characteristics) of importance when selecting hardwood raw materials for use in secondary (value-added) manufacturing.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

#### Outcome #4

##### 1. Outcome Measures

Increase awareness of invasive species issues among State private forest land owners.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure



### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Invasive species represent a significant threat to the Appalachian Hardwoods Industry.

#### What has been done

Three field-based workshops were held that directly addressed invasive plant species in the woodlands of West Virginia. Roughly 70 participants attended these workshops.

#### Results

At least one of the participants of a field workshop in Putnam County has treated from 50-100 stems of the invasive tree-of-heaven on his property. This was a direct result of the lesson he had learned at the workshop.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

### 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 and Data Collection)

#### Evaluation Results

{No Data Entered}

#### Key Items of Evaluation

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 7**

**1. Name of the Planned Program**

Sustainable Energy

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			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%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.3	0.0
Actual	0.0	0.0	1.3	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	72852	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	90600	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	26905	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. Much of our work in the biofuels/biomaterials areas is just getting underway as we have recently added scientists in this area. As such, there are few outputs to report at this time. Outputs and program reporting will increase in the near future.

Physical and chemical properties of two common West Virginian hardwoods, Yellow-Poplar and Northern Red Oak, which can serve as potential feed stocks for the emerging biorefinery industry were characterized using two rapid non-destructive spectroscopic methods, near infrared (NIR) and fluorescence spectroscopy respectively. Results of these studies demonstrate that with the exception of holocellulose and ash contents, fluorescence spectrometer can be used to predict some chemical and physical properties of these potential biorefinery feed stocks. Similar NIR spectra-based prediction models of the same properties and populations demonstrate that the predictive models of each property was slightly superior over fluorescence spectra-based models even though both can be used for the same purpose. Fluorescence spectra-based prediction models of estimated holocellulose content and ash content of Northern red oak were poorly predicted statistically.

**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.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2010</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	0	4	4

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Presentations on research at professional meetings

<b>Year</b>	<b>Actual</b>
2010	4

**Output #2**

**Output Measure**

- Energy policy papers

<b>Year</b>	<b>Actual</b>
2010	0

**Output #3**

**Output Measure**

- Completed graduate degree programs

<b>Year</b>	<b>Actual</b>
2010	1

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Increased percentage of state energy consumption from renewable fuels.

## **Outcome #1**

### **1. Outcome Measures**

Increased percentage of state energy consumption from renewable fuels.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	0	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.

#### **What has been done**

Several new research projects are underway 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.

#### **Results**

Much of our work in the biofuels/biomaterials areas is just getting underway as we have recently added scientists in this area. As such, there are few outputs to report at this time. Outputs and program reporting will increase in the near future.

### **4. Associated Knowledge Areas**

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

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy
- Appropriations changes

**Brief Explanation**

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

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 8**

**1. Name of the Planned Program**

Food Safety

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			40%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			60%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	0.0	0.0	2.2	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	300508	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	439141	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	93155	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**



While food safety is a component of many of the projects listed under Global Food Security and Hunger, we will report projects whose primary concern is food safety in this new NIFA mandated program. The primary activities in this program area involve food safety issues in management of processed fish and fish fillets in cold-water aquaculture operations and developing procedures for testing for and eradicating newly emerging water-borne bacteria that may enter the food supply.

Physiological processes in the rainbow trout affect 1) in the short term, changes in muscle food quality associated with variation in postmortem metabolism and 2) in the long term, changes in composition and texture associated with metabolism that supports a dominant process such as vitellogenesis. The effect of rigor state (pre-rigor, deep-rigor, and post-rigor), when fish are filleted, on raw and cooked fillet quality was evaluated. Pre-rigor fillets exhibited the highest pH ( $P < 0.05$ ), lowest cook loss ( $P < 0.05$ ), and the greatest cooked dimensional changes ( $P < 0.05$ ) of the three rigor states. These findings indicate that spawning induced changes should be considered when developing preharvest management strategies to optimize quality of fillets from fertile rainbow trout. Additional work is needed to 1) define the relationship between production parameters and fillet quality and 2) categorize and characterize trout fillet texture.

Another project assessed antibiotic resistance analysis (ARA) and rep-PCR fingerprint patterns of 600 *Escherichia coli* strains obtained from poultry and sheep raised using both organic and conventional production methods. There were significant differences in the ARA and rep-PCR fingerprints of *E. coli* under organic versus conventional production methods. *E. coli* persisted in the soil of the WVU Organic Farm rotational grazing areas for poultry. Compared with organic chickens, more conventional chicken isolates were resistant to ampicillin and cephalothin. All chickens harbored isolates that were resistant to rifampin, streptomycin and neomycin. Conventional and organic sheep isolates were primarily resistant to rifampin, as were isolates from baseline soil samples. We also examined 1200 *E. coli* isolates from pasture-raised beef cattle and their persistence in pasture soils impacted by animal waste. There were strain differences related to animal source, with greater commonality within groups than between groups.

Organic methods of livestock production should reduce the potential for human acquisition of antibiotic resistant bacteria. We compared patterns of antibiotic resistance in fecal bacterial isolates obtained from organic and conventionally raised chickens and sheep, and from pasture-raised beef cattle. We also compared rep-PCR fingerprints obtained from these isolates. The long term goal is to develop ARA and rep-PCR based methods for microbial source tracking in soils and watersheds of northern WV. The presence of distinct *E. coli* strains among organically and conventionally reared chickens, from various experimental systems at the WVU farms in Morgantown, WV confirmed that distinct strains are obtained based on the production practice employed; which in turn affects populations and persistence of specific *E. coli* strains in soil and water. Diverse *E. coli* isolates from pasture-raised, winter-stocked beef cattle and the persistence of select strains in pasture soils also was observed.

## **2. Brief description of the target audience**

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

### **V(E). Planned Program (Outputs)**

#### **1. Standard output measures**

2010	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: 2010  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Actual	0	5	5

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Publications

Year	Actual
2010	5

**Output #2**

**Output Measure**

- Professional Presentations

Year	Actual
2010	2

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Reduce exposure of consumers to antibiotic resistant bacteria.

**Outcome #1**

**1. Outcome Measures**

Reduce exposure of consumers to antibiotic resistant bacteria.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Use of antibiotics in animal production may lead to development of antibiotic resistant strains of bacteria. Organic methods of livestock production should reduce the potential for human acquisition of antibiotic resistant bacteria.

**What has been done**

One study compared patterns of antibiotic resistance in fecal bacterial isolates obtained from organic and conventionally raised chickens and sheep, and from pasture-raised beef cattle. We also compared rep-PCR fingerprints obtained from these isolates.

**Results**

The long term goal is to develop ARA and rep-PCR based methods for microbial source tracking in soils and watersheds of northern WV. The presence of distinct E. coli strains among organically and conventionally reared chickens, from various experimental systems at the WVU farms in Morgantown, WV confirmed that distinct strains are obtained based on the production practice employed; which in turn affects populations and persistence of specific E. coli strains in soil and water. Diverse E. coli isolates from pasture-raised, winter-stocked beef cattle and the persistence of select strains in pasture soils also was observed.

**4. Associated Knowledge Areas**

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

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy
- Appropriations changes
- Competing Programmatic Challenges

**Brief Explanation**

While food safety is part of many of our projects under Global Food Security and Hunger, it is expected that this area will remain a relatively small part of our research portfolio, given limited resources and competing programmatic challenges.

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

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}