V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Production/Sustainable Forestry

☐ Reporting on this Program

Reason for not reporting

{No Data Entered}

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			65%	
124	Urban Forestry			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
511	New and Improved Non-Food Products and Processes			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	7.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	22453	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	865112	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	499074	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program includes research to develop improved procedures for hardwood timber management and harvest, to increase the efficiency of wood utilization while developing new uses for hardwoods, and, increasingly, to devise new processes to efficiently utilize wood and timber resources in the production of renewable bio-energy and bio-products. Timber management research includes specifically the development of models to predict yields, systems to protect forest resources from insect pests, acid precipitation, fire, disease, and invasive species; harvest management protocols for optimum regeneration and re-growth; methods to use harvest and processing wastes to efficiently produce bio-energy; feedstock and bioproduct logistics; and, programs that respond to research needs and concerns of corporate and private owners and provide economic comparisons among alternative management and harvest methods.

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

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

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

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

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

2. Brief description of the target audience

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

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

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	3

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	1

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

Growth in state timber industry - % change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

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

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

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

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

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Growth in state wood products and furniture industry - % change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

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

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

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

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #3

1. Outcome Measures

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

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

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

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

Key Items of Evaluation

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

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