

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---------|---|-----------------|-----------------|----------------|----------------|
| 101 | Appraisal of Soil Resources | | 10% | | 10% |
| 102 | Soil, Plant, Water, Nutrient Relationships | | 10% | | 5% |
| 111 | Conservation and Efficient Use of Water | | 10% | | 0% |
| 124 | Urban Forestry | | 10% | | 0% |
| 131 | Alternative Uses of Land | | 10% | | 5% |
| 201 | Plant Genome, Genetics, and Genetic Mechanisms | | 10% | | 35% |
| 204 | Plant Product Quality and Utility (Preharvest) | | 10% | | 25% |
| 205 | Plant Management Systems | | 10% | | 20% |
| 211 | Insects, Mites, and Other Arthropods Affecting Plants | | 10% | | 0% |
| 212 | Pathogens and Nematodes Affecting Plants | | 5% | | 0% |
| 403 | Waste Disposal, Recycling, and Reuse | | 5% | | 0% |
| | Total | | 100% | | 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 | 1.5 | 0.0 | 0.5 |
| Actual Paid Professional | 0.0 | 1.5 | 0.0 | 1.5 |
| 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 | 79407 | 0 | 13047 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 0 | 132345 | 0 | 111565 |
| 1862 All Other | 1890 All Other | 1862 All Other | 1890 All Other |
| 0 | 0 | 0 | 53955 |

V(D). Planned Program (Activity)

1. Brief description of the Activity

WVSU research scientists continued research efforts in the area of climate change. Mine land reclamation research was redirected to evaluating the use of biochar and other byproducts, and the development of management practices to improve soil productivity, land-use management, and soil environmental services.

Performance studies were conducted using the pilot plant digester and replicate experimental digesters were set up and operating a long-term study of energy thresholds and ecological resilience in the digester microbial communities.

A stakeholder driven project to construct a low-cost high tunnel using the majority of locally available resources began to field test the model to develop a manual. Thirty-one applications were received from eighteen counties. Eleven high tunnels were built in nine counties with the grower and others interested in high tunnel construction. Undertaking multiple builds enabled the staff to eliminate design problems. We found building with the grower not only educated them about high tunnels and their construction but also inspired their colleagues and/or other agriculture professionals that were present. This has spawned construction on additional high tunnels in the state.

WVSU Extension Service has continued to target small-scale producers with education to increase knowledge levels in alternative enterprises that may expand profits for small farm operations in open cropland and forested urban acreage. Home landscape beautification and vegetable gardening are at the center of this heightened resurgence of interest in horticulture.

Commercial growers in the areas of greenhouse and nursery management, cut flower production, and fruit and vegetable production are also seeking marketing and production related advice in order to satisfy growing consumer demands. Some of the projects that are the most often asked about are the identification and/or eradication of plants and pests, the growing cycles of plants, plant maintenance, and alternative gardening techniques

2. Brief description of the target audience

Landowners and small-farm operators, farm and volunteer organizations, WVDEP staff and local government officials, homeowners, various city, county and municipalities, state government, underserved and minority farmers/landowners, WVDA staff; USDA staff and other agricultural and natural resource focused agencies

3. How was eXtension used?

Use of eXtension occurred through participation in two communities of practice (CoP): eOrganic and Consumer Horticulture. "Ask an Expert" questions were answered for one of the CoP.

V(E). Planned Program (Outputs)

1. Standard output measures

| 2012 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---------------|------------------------|--------------------------|-----------------------|-------------------------|
| Actual | 1199 | 4270 | 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

- Train students in anaerobic digester technology and environmental microbiology [Huber]

| | |
|-------------|---------------|
| Year | Actual |
| 2012 | 6 |

Output #2

Output Measure

- Workshops on new varieties and growing techniques for small farmers to adapt to changing environmental conditions

| Year | Actual |
|-------------|---------------|
| 2012 | 4 |

Output #3

Output Measure

- Workshops targeted at alternative agriculture endeavors will be held in targeted counties.

| Year | Actual |
|-------------|---------------|
| 2012 | 663 |

Output #4

Output Measure

- WV SU Extension staff will generate media articles and stories related to alternative agriculture.

| Year | Actual |
|-------------|---------------|
| 2012 | 6 |

Output #5

Output Measure

- Urban clientele, municipalities and government organizations will receive information on the Urban Forestry initiative.

| Year | Actual |
|-------------|---------------|
| 2012 | 60 |

Output #6

Output Measure

- Develop novel technique for soil remediation on reclaimed mine lands. [Hass]
Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Evaluate byproduct use, and land management practices, to improve soil productivity and environmental services. [Hass]

| Year | Actual |
|-------------|---------------|
| 2012 | 25 |

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|--------|---|
| 1 | New knowledge concerning how microbial diversity gives rise to methane production and anaerobic digestion [Huber] |
| 2 | Number of small farmers adopting new varieties and growing techniques to adapt to changing environmental conditions [Liedl] |
| 3 | Extension clientele will implement best practices in agriculture and natural resources based on research-based knowledge. |
| 4 | Farmers/growers will utilize best practices with alternative agricultural enterprises to diversify their income portfolio. |
| 5 | Increase awareness of soil remediation technology among mining operators and agencies. [Hass] |
| 6 | Improve value and use of biochar and other byproducts as soil amendments. [Hass] |

Outcome #1

1. Outcome Measures

New knowledge concerning how microbial diversity gives rise to methane production and anaerobic digestion [Huber]

2. Associated Institution Types

- 1890 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)

Agricultural wastes, particularly animal manures, can be a significant source of greenhouse gases (GHG). The principal GHG coming from organic wastes is methane. Anaerobic digestion is an established method for controlling the emission and capture of methane from agricultural and other waste biomass. However, the usefulness of digestion for capturing agricultural GHG depends on the efficiency and stability of digesters which is quite variable. West Virginia poultry farms produce large quantities of wastes that can pollute watersheds and produce GHG. The focus of the WVSU Anaerobic Digestion and Bioenergy Research Program has been studying and optimizing thermophilic digestion. An important issue that discourages the use of this type of digestion is the cost. Future engineering of the process requires understanding the complex interactions among the microorganisms that produce GHG in order to improve stability, and reducing the cost of farm-based digesters.

What has been done

The stability of biogas production in digesters can be affected by the addition of new substrates. The impact of carbohydrate addition on stable poultry litter digesters was tested using five replicate digesters operated during a long-term time series experiment. Glucose pulses were applied to the digesters during continuous feeding with a complex (poultry litter) feedstock. Bacterial diversity (16S rRNA genes) of the replicate digesters was sampled with pyrosequencing. In a second experiment, we set-up and started a new pilot-scale thermophilic plugflow digester. The performance variables for the new digester were monitored, and its capacity to accommodate different hydraulic retention times was tested.

Results

It was found that a modest addition of glucose affected the long-term performance of the digesters. Instability slowly increased during 100 days of operation, including a decline in

methane production. Simulations using the ADM1 model showed that the accumulation of volatile fatty acids was consistent with a change in the kinetic parameters for volatile fatty acid consumption. Unweighted and weighted UniFrac analyses showed that microbial community structure progressively changed as the metabolic instability increased. Therefore, a modest glucose pulse disturbance in these thermophilic bioreactors induced long-term functional instability and structural change, implying a low level of resilience toward this disturbance. A thermophilic plugflow digester was established with poultry litter feedstock. The hydraulic retention time of the digester was advanced up to a 20 day period. The digestion process in the plugflow digester was found to be sensitive to temperature variation.

4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---------|--------------------------------------|
| 403 | Waste Disposal, Recycling, and Reuse |

Outcome #2

1. Outcome Measures

Number of small farmers adopting new varieties and growing techniques to adapt to changing environmental conditions [Liedl]

2. Associated Institution Types

- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

| Year | Actual |
|------|--------|
| 2012 | 40 |

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Season extension tools, such as high tunnels, can significantly increase sustainable food production by extending the season to grow and protect crops from inclement weather and pests. Planting and first harvest are earlier in high tunnels, which also allow plant growth earlier in the spring as well as later into the fall. In this way, high tunnel growers are able to access main and lucrative early- and late-season markets. High tunnels are ideally suited to the climate and topography for small producers in WV. In fact, the production season can almost cover the entire calendar year without the addition of small heaters even in WV. Thus, a producer growing only on the land can produce eight out of the twelve months, but a grower that augments this with a high tunnel can produce almost year round. There has been limited adoption of high tunnels in West Virginia prior to 2009 due to limited exposure to the technology, a lack of design knowledge,

and cost and transportation of materials to rural areas. Most growers while interested were not willing to spend over \$10,000 to purchase a technology they are not familiar with and not sure if it was something that would augment their profits. Thus the idea was born to develop a low-cost eco-friendly high tunnel that could be constructed for under \$1,000 to introduce growers to the technology and opportunities. This would allow them to investigate the use of high tunnel technology and see if it was worth expanding into this area for their farm enterprise. This project from the WV Department of Agriculture Specialty Block Grant Program.

What has been done

Our approach was to construct a low-cost high tunnel using as many locally available resources as possible. Thirty-one people or groups applied for the project from 18 counties in WV. By replicating a high tunnel design that was low-cost with multiple builds we were able to work out most of the 'bugs' to help in developing a manual. The project allowed us to complete construction of eleven high tunnels using our low-cost eco-friendly high tunnel concept. Twelve additional presentations and/or workshops in West Virginia on high tunnels have been completed since 2010.

Results

Eleven high tunnels were built using our low-cost eco-friendly high tunnel concept in nine counties in WV. The farmer/grower recruited others to assist with the building process. We found that this not only educated the grower about high tunnels and their construction but also inspired their colleagues and/or other ag professionals that were present. We have anecdotal evidence that that shows we are already on target to meet our goal of having thirty additional high tunnels constructed: 1) a number of people at our workshops have applied for NRCS EQUIP funding for a high tunnel which did not exist when we started this project, 2) we have growers and groups that have asked for our supply list and assistance to put up their own high tunnel and 3) we have groups already putting up another high tunnel (Williamson Community Garden site).

4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|----------------|---|
| 211 | Insects, Mites, and Other Arthropods Affecting Plants |
| 212 | Pathogens and Nematodes Affecting Plants |

Outcome #3

1. Outcome Measures

Extension clientele will implement best practices in agriculture and natural resources based on research-based knowledge.

2. Associated Institution Types

- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

| Year | Actual |
|------|--------|
| 2012 | 1040 |

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Extension is steeped in the tradition of taking research based knowledge and extending its outreach to the general public. Though this has always been the method of delivery, nationwide Extension marketing teams have been evaluating how this transfer of information has been perceived as well as received, necessitating an overhaul in the mode of delivery and marketing of the name Extension Service. In an effort to ensure that the general public is receiving information on how to implement best practices in agriculture based on research based knowledge, WV SU Extension Service has established workshops designed to better illustrate not only the concept being taught, but to also educate through hands-on, real life scenarios in the field, making Extension more pertinent to one's everyday life.

What has been done

In an effort to educate small farmers, backyard gardeners and the general public on how to implement best practices in agriculture and natural resources based on research-based knowledge, 28 workshops were delivered around the state. Nine Community and Adaptive Gardening Workshops were delivered to educate adults on proper gardening techniques to develop sustainable gardening opportunities for years to come. Five adult based gardening programs have been implemented and sustained in central and southern WV facilitated in conjunction with numerous community organizations. Eleven workshops were conducted on the topic of small fruit production concentrating on brambles, strawberries, blueberries, grapes and tree fruits. Water conservation practices were targeted as a topic with two hydroponic/aeroponic production workshops as well as two separate workshops on the implementation of rain barrels. Four urban forestry workshops were delivered on the topics of small orchard management as well as alternative woodlot management through specialty mushroom cultivation.

Results

The Community and Adaptive Gardening efforts have impacted a total of 483 adults directly while indirectly impacting more than 4000 through programs developed and information conveyed based on education received through our outreach efforts. Attendance at the workshop series alone represented 14 organizations across the state seeking education on program development, management and sustainability. Of the participants, 85% were looking to implement new garden programs this past year. Grant funding for these programmatic efforts during this timeframe totaled \$22,128. Eleven Small Fruits Workshops were delivered covering production methods for brambles, strawberries, blueberries, grapes and tree fruits. These workshops were attended by 410 participants ranging from backyard gardeners, amateur wine makers as well as small farm operators. During these workshops, approximately 85% of the participants have indicated an increase in knowledge of small fruit production techniques. Approximately 60% of the participants indicated that they would be including small fruits in their operation during that growing season. A poster titled Small Fruit Demonstration Gardens: Educating the Public about Growing Their Own Small Fruits was also presented at the 2012 AEA/ARD Land-Grant Conference in Memphis, TN, on June 24-28, 2012 in regards to the Small Fruit Program. The Hydroponic/Aeroponic Workshops were delivered to 33 people in conjunction with the FFA Program at a local High School. Water conservation and rain barrel workshops were also presented to an additional 54

participants. Four urban forestry workshops were delivered to 60 individuals on the topics of small orchard management as well as alternative woodlot management through specialty mushroom cultivation. During these workshops, approximately 80% of the participants have indicated an increase in knowledge of mushroom production and/or the health benefits of mushroom production. Multiple participants have shown an interest in marketing their mushrooms at a local farmers market, which will begin to open up a local niche market in the area.

4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---------|---|
| 111 | Conservation and Efficient Use of Water |
| 124 | Urban Forestry |
| 131 | Alternative Uses of Land |

Outcome #4

1. Outcome Measures

Farmers/growers will utilize best practices with alternative agricultural enterprises to diversify their income portfolio.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

| Year | Actual |
|------|--------|
| 2012 | 663 |

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Traditional agriculture production in West Virginia has been steadily decreasing due to high overhead operational costs, lack of suitable cropland, increased restrictions by the EPA on concentrated animal feeding operations as well as an aging labor force. When it comes to farming in West Virginia, even the largest farms are small when compared to statistics nationwide. Reports from the WVU Small Farm Center indicate that the residents report spending \$7.2 billion on food each year, but our farmers only capture 19 cents of every dollar spent in the state. With this trend, alternative agricultural practices targeting small farm and backyard gardeners have become a focus of the WVSU Extension Service. Through development of educational workshops illustrating how to best cultivate, manage and market a specialized crop, farmer's looking to optimize their farmland have been educated on how to make the most out of their small acreage.

What has been done

In an effort to educate small farmer's and backyard gardener how to cultivate, manage and market a specialized crop through alternative agricultural practices, 24 workshops were delivered around the state. Eleven workshops were conducted on the topic of small fruit production concentrating on brambles, strawberries, blueberries, grapes and tree fruits. Two workshops on seasonal crops extension through the use of cold frames were delivered educating the general public on ways to increase productivity and be the first and last to the market with fresh, quality produce. Water conservation practices were targeted as a topic with two hydroponic/aeroponic production workshops as well as two separate workshops on the implementation of rain barrels. Four urban forestry workshops were delivered on the topics of small orchard management as well as alternative woodlot management through specialty mushroom cultivation. Two workshops focusing on weed identification and alternative weed eradication methods were held as well as results the of a cut flower production project presented as a potential value added product for established farm enterprises.

Results

Eleven Small Fruits Workshops were delivered covering production methods for brambles, strawberries, blueberries, grapes and tree fruits. These workshops were attended by 410 participants ranging from backyard gardeners, amateur wine makers as well as small farm operators. During these workshops, approximately 85% of the participants have indicated an increase in knowledge of small fruit production techniques. Approximately 60% of the participants indicated that they would be including small fruits in their operation during that growing season. A poster titled Small Fruit Demonstration Gardens: Educating the Public about Growing Their Own Small Fruits was also presented at the 2012 AEA/ARD Land-Grant Conference in Memphis, TN, on June 24-28, 2012 in regards to the Small Fruit Program. Two Cold Frame Workshops were attended by 20 people and 75% of the participants surveyed illustrated that they had increased knowledge of season extension and felt comfortable constructing a cold frame. The Hydroponic/Aeroponic Workshops were delivered to 33 people in conjunction with the FFA Program at a local High School. Water conservation and rain barrel workshops were also presented to an additional 54 participants. Four urban forestry workshops were delivered to 60 individuals on the topics of small orchard management as well as alternative woodlot management through specialty mushroom cultivation. During these workshops, approximately 80% of the participants have indicated an increase in knowledge of mushroom production and/or the health benefits of mushroom production. Multiple participants have shown an interest in marketing their mushrooms at a local farmers market, which will begin to open up a local niche market in the area. Two Alternative Weed Management classes were offered to the general public with 12 participants as well as a Cut Flower Production seminar at the 2012 International Master Gardener Conference in Charleston, WV which drew interest from 74 conference attendees. This same topic was also presented during the poster session at the 2012 AEA/ARD Land-Grant Conference in Memphis, TN, on June 24-28, 2012.

4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|----------------|--|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 111 | Conservation and Efficient Use of Water |
| 124 | Urban Forestry |
| 131 | Alternative Uses of Land |

Outcome #5

1. Outcome Measures

Increase awareness of soil remediation technology among mining operators and agencies. [Hass]

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Improve value and use of biochar and other byproducts as soil amendments. [Hass]

2. Associated Institution Types

- 1890 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)

Appalachian regional soils are highly acidic and infertile. Mineral exploration, such as coal mining, and the earth-moving operations associated with such land uses further exacerbate the already fragile fertility of these soils. Using organic byproducts, biochar (byproduct of thermo-conversion of cellulosic biomass), and other byproducts have the potential to ameliorate soil properties and environmental services. Improving land management practices of disturbed lands can increase soil fertility and productivity, contributing to local agronomic output, food security, and economy.

What has been done

Development of storm-water soil rating was completed and a workshop conducted to present and disseminate the developed rating tool to relevant audience (the rating tool is currently available for public use through NRCS website). A long-term full-factorial field experiment evaluating anaerobically digested chicken litter as soil amendments is continued and monitored. Biochar from different feedstock and pyrolysis conditions was produced, analyzed, and tested as soil amendment in lab and greenhouse studies.

Results

Some 23 people attended the storm water rating workshop on WVSU campus in June 1st, 2012. Biochar research: properties varied with feedstock and pyrolysis temperature. Increase in biochar ash content increase biochar liming potential and nutrient content. Chicken litter biochar improve regional acid soil fertility by increasing soil pH, nutrient availability, and organic matter content. Two peer reviewed publications (2) were published in Journal of Environmental Quality, and in Journal of Soil and Water Conservation

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Limited field and greenhouse space has impacted the ability of the projects to achieve the intended outcomes. Additional field sites are being identified through contacts with farmers and other agencies.

The office for one scientist was moved and renovated which delayed the project

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Two major initiatives were started: a review of physical facilities to conduct greenhouse and field work, and realignment of extension personnel to better coordinate with research efforts. A new 5-year facilities plan was developed to provide more greenhouse and headhouse space to support both research and extension programming efforts. Also, new laboratory and office space was leased at the WV Regional Technology Park to accommodate more research efforts.

Key Items of Evaluation

Two major initiatives were started: a review of physical facilities to conduct greenhouse and field work, and realignment of extension personnel to better coordinate with research efforts. A new 5-year facilities plan was developed to provide more greenhouse and headhouse space to support both research and extension programming efforts. Also, new laboratory and office space was leased at the WV Regional Technology Park to accommodate more research efforts.