

# 2011 West Virginia State University Research Plan of Work

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## I. Plan Overview

### 1. Brief Summary about Plan Of Work

West Virginia State University (WVSU) was officially reinstated as an 1890 Land-Grant institution in 2001. The University began reactivation of its research programs in March of 2000 when the Department of Land-Grant Programs was established. The Department was charged with the mission of administering land-grant related research and extension programs for the University. In 2003 the Department was elevated to the Division of Agricultural, Consumer, Environmental, and Outreach Programs (ACEOP), to accommodate for the rapid growth of the unit, and to better serve the university's constituents. This unit underwent another organizational restructuring, in 2006, when it was renamed the Gus R. Douglass Land-Grant Institute, in honor of WV Department of Agriculture Commissioner Gus. Douglass. Despite this organizational evolution, the mission of the Institute continues to be one of delivering educational and life-long learning opportunities by conducting research, teaching and outreach services to improve the well-being of West Virginia citizens (particularly those underserved). Federal support continues to be a key success factor for the Institute. Formula funding for FY 2008 was slightly over \$1M for research. In 2006, the WV State Legislature appropriated funds to meet 90% of the required match, securing a line item within the institution's budget to meet the match in years to come. The rest of the match is complemented through industry or private collaborative opportunities. As additional state appropriations and other resources are attained, the University continues to strengthen and extend its research capacity and research programs. West Virginia State University, through its Gus R. Douglass Institute's Agricultural and Environmental Research Station (WVSU AERS), has established (since 2000) Land-Grant related research programs that are highly responsive to the needs of the University, the State and the Country's stakeholders. These research programs are based and congruent with the United States Department of Agriculture's prescribed 5 national priorities (goals). Agricultural research at the University is also coordinated between the two Land-Grant Universities in the State to avoid duplication and maximize funding benefits to our stakeholders. This year, WVSU AERS has restructured its Five Year Plan of Work in terms of its main research areas to simplify and facilitate its programming and reporting procedures. All current and new research subprograms (and associated projects) were allocated in one of the three main research categories. The research program categories were changed from 5 to 3 main programs. These Programs include: (1) Sustainable Environment and Renewable Resources, (2) Competitive and Sustainable Agricultural Systems, and (3) Food Systems, Nutrition, and Wellness. The University has a diverse group of scientists with expertise in various fields, including, agricultural genetics, environmental microbiology and chemistry, bioengineering, soil science, horticulture, and aquaculture. The research programs address several challenges to agricultural, environmental and energy industries. Well-established programs within the University are agricultural waste management and microbiology, and plant genomics. New areas of focus include alternative energy and alternative agriculture. On-campus facilities include several analytical laboratories, an aquaculture facility, greenhouses, a pilot scale anaerobic digester, as well as off campus laboratories and farm sites. These facilities are utilized by three full time and six part time research scientists; supported by the Institute's Agricultural and Environmental Research Station. The Graduate program in Biotechnology has been beneficial to the research scientists by providing technical capacity that did not exist prior to its establishment. In 1997, WVSU entered into a voluntary agreement with West Virginia University to create the West Virginia Association of Land-Grant Institutions; committed to providing education benefiting and improving the lives and communities of citizens of West Virginia. Triggered by a USDA-CSREES mandate in 2005, a Comprehensive Plan was developed between the two Universities, assuring appropriate coordination between both institutions to avoid duplication of efforts relating to research and extension programming; thus being a more efficient investment of state resources.

### Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	0.0	16.0
2012	0.0	0.0	0.0	16.0
2013	0.0	0.0	0.0	16.0

**Estimated Number of Professional FTEs/SYs total in the State.**

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	0.0	16.0
2015	0.0	0.0	0.0	16.0

**II. Merit Review Process****1. The Merit Review Process that will be Employed during the 5-Year POW Cycle**

- Combined External and Internal University External Non-University Panel

**2. Brief Explanation**

During the months of April and May, all research programs are subjected to a review process. This process includes an internal and external evaluation. An oral presentation at the WVSU Annual Research Symposium is also a key component of the overall evaluation and is required for all land-grant sponsored researchers. Stakeholders identified by procedures outlined below are invited to participate in the Symposium. The internal evaluation consists of an Office and/or Department appraisal by the executive staff. Additionally, all participants in land-grant sponsored research critically assess the work of their peers for developmental purposes. As an internal review procedure, the University has also appointed a committee (Land-Grant Advisory Committee) comprised of faculty and staff with the main purpose of tracking progress and provide guidance to some of the programming. An external research advisory panel conducts the external evaluation component of the overall Land-Grant research programs offered by the University. This panel consists of local scientists with a wide variety of backgrounds, business leaders and community members considered to be suitable stakeholders for research programs. The evaluations from these panels were utilized to restructure research programming and help rank and allocate funds to specific land-grant programs. Evaluation of research productivity versus resources spent is included in the ranking of continuing projects to facilitate funding decisions for the 2010 budget year.

**III. Evaluation of Multis & Joint Activities****1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?**

Critical strategic issues affecting West Virginia are identified by advisory panels and drive the design of planned research programs. The proposed programs in the new POW have been reviewed by internal and external panels. External stakeholders comprising the advisory panel consist of a group of individuals and professionals from related fields being addressed by the research programs. Each year the programs are fine-tuned according to the stakeholders input so they can be responsive to the relevant issues in the state. In addition, research scientists also cultivate links to individuals, institutions, and organizations and use feedback to tailor their projects to specific needs expressed by stakeholders. WVSUs planned programs are closely coordinated with WVUs programs so that no duplication of effort occurs and also to take advantage of collaborative opportunities. Issues related to the protection of the environment and its natural resources are considered critical in West Virginia as the chemical and coal industries have had impacts on water quality, soil conservation, wildlife, and natural resources. Thus, planned programs at WVSU have an environmental component that should provide solutions to these problems, and facilitate better management of the environment and its resources. Specific multi state and joint activities for each program include: Plant Genomics: US Vegetable Research laboratory USDA /ARS South Carolina, Plant Breeding Coordinating Committee, Alcorn State University, Alabama A&M, Texas A&M, Cornell, Penn State, University of Florida and Ohio State University. Alternative Agriculture: 1890 Universities Aquaculture Consortium, Mississippi State University, Cold and Cool Water Fish Laboratory, Mississippi State, USDA ARS, University of Minnesota, West Virginia University, Arkansas, Kentucky State, and Cornell University. -Renewable Resources & Environment: University of Chapingo, Mexico, EnviroControl, LTD.

## **2. How will the planned programs address the needs of under-served and under-represented populations of the**

Historically, West Virginia has been an economically depressed state. As a result, from an income perspective, many of the state's citizens are considered underserved and/or underrepresented. Landowners are a primary focus of research programs, with various agricultural and environmental issues being addressed. Small farms benefit from plant genomics research to improve insect and disease resistance of vegetable crops, potentially reducing cost and improving yield. Agricultural, municipal and industrial processes have significant economic and environmental impact on local communities around the state. The renewable resources and environment program explores value added efforts to address this issues.

## **3. How will the planned programs describe the expected outcomes and impacts?**

The expected impact of this research on the state will be commensurate to the impact of each individual project. The collection of projects results in medium or long term programs, with both short-term and long-term outcomes. Each program is designed so measurable impacts to the identified stakeholders are quantified. It is important to point out that while some research projects within each program are very fundamental and may only result in advancing research tools or techniques, others have the potential to have an impact on government regulatory agencies, private businesses, and individual citizens within the state and/or region. The expected impacts for each program are: Competitive and Sustainable Agricultural Systems: (1) increase genomic resources to facilitate plant breeding; (2) Production of superior cultivars of vegetable and fruit crops; (3) More profitable operations through novel production methods and practices that improve competitiveness; Sustainable Environment and Renewable Resources: (1) Increased awareness of soil remediation technology among stakeholders; (2) Increase knowledge of anaerobic bacteria; (3) Increase digester efficiency; (4) Increase knowledge of microbial biomass-to-bioenergy conversion process. Food Systems, Nutrition and Wellness: is to be developed.

## **4. How will the planned programs result in improved program effectiveness and/or efficiency?**

Research programs at West Virginia State University continue to evolve based on the outputs and outcomes measured from past projects. The research administrative unit continuously reviews all projects within the program areas. The projects and programs that progress and produce yearly outputs, and demonstrate the potential for longer term outcomes, have been selected for further funding in this current plan of work. Specific benefits to each program through joint and multi state cooperation include: Competitive and Sustainable Agricultural Systems increase intellectual capacity through University and Federal Links; access to novel plants and genetic materials; better opportunity to obtain exterior grant funding, access to more resources for research activities; access to facilities and resources; and increased opportunity to develop novel research proposals. Sustainable Environment and Renewable Resources increase access to resources not available at WVSU and increased intellectual capacity. Food Systems, Nutrition and Wellness: To be developed.

## **IV. Stakeholder Input**

### **1. Actions taken to seek stakeholder input that encourages their participation**

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals

#### **Brief explanation.**

Potential stakeholders (individuals) are invited to participate on a review panel to evaluate the University's land-grant research programs. Research administrators and research scientists seek individuals and groups within a specific area of expertise or understanding to provide input and shape the direction of the research programs in order to better address the needs of those individuals or groups. Several collaborations have been formed as a result of these activities. Traditional stakeholder groups include industry, departments of agriculture, and individual farmers. Non-traditional groups include non-profit environmental organizations, alternative energy groups and cooperatives, and under-served landowners who have been impacted by mineral extraction.

**2(A). A brief statement of the process that will be 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
- Other (Researcher Interactions)

**Brief explanation.**

The research advisory committee consists of several individuals representing the different areas addressed by the programs. Target areas are defined based on the research portfolio at the Institution. Within each target area (e.g. farm owners, government agencies, industry, etc.) individuals are identified and invited to participate. These individuals advise the scientists on possible stakeholders and issues important to those stakeholders. The individual research scientists attend professional seminars, special interest meetings and other relevant conferences and have identified stakeholders through interactions with groups or individuals interested in our research.

**2(B). A brief statement of the process that will be 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
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups

**Brief explanation.**

Inputs are collected during the research advisory review through a specific survey and at the meetings. Minutes and surveys are collected and analyze to guide the programming process of each semester-cycle.

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

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

**Brief explanation.**

Stakeholder input is necessary to maintain the relevance of the research program. Emerging issues in a specific field may redirect the program or eliminate the need for a specific project within the program. Staffing for particular programs is based in part on the need and importance of that project or program to stakeholders.

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Sustainable Environment and Renewable Resources
2	Food Systems, Nutrition and Wellness
3	Competitive and Sustainable Agricultural Systems

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

Sustainable Environment and Renewable Resources

**2. Brief summary about Planned Program**

The Sustainable Environment Renewable Resources Program is comprised of two existing research areas and one new area: Renewable Sources of Energy, Natural Resources Management and Microbial Ecology. Renewable Sources of Energy is an emerging area which is being built on expertise gained through the agricultural waste management research conducted at WVU during the last 6 years; Waste management research, and the use of a thermophilic anaerobic pilot digester, has provided scientists with valuable knowledge in process engineering and microbiology regarding the utilization of poultry waste for production of biogas, which is a sub-product of the anaerobic digestion process. This program will also explore other alternatives of renewable sources energy such as biodiesel and hydrogen. The Natural Resources Management program explores environmentally sound and agronomically productive use of agricultural, municipal, and industrial waste streams and byproducts in soil. Using basic soil chemistry, biology and soil physics, the program explores practices to enhance efficient use of natural resources and to increase soil and water systems resiliency to anthropogenic stresses. An important component of this program is the incorporation of anaerobically fermented chicken litter to promote soil microbial activity and improve soil properties. Mined surfaces are treated with this solid waste to improve organic properties and restore the microbial-soil-plant interaction. Solid and liquid effluent from the pilot plant digester has been used as a fertilizer. The organically-rich waste is a key promoter of microbial-soil-plant interactions and is promising in the restoration of mined-land soils. Microbial Ecology is also a continuing research area currently consisting of two related investigative projects that utilize molecular and genomic methods. These methods enable the roles of specific populations in the digestion process to be elucidated and the impact of environmental variables to be tested. The first objective is to characterize the diversity of microbial communities within an anaerobic digester. Second is to link microbial diversity to functionality and bioenergy conversion in digesters. This research will advance the development of a predictive science of anaerobic digester biotechnology. A new area of study within Microbial Ecology is focused on understanding the effects of selenium contamination from surfacing mining on the microbial ecology of freshwater ecosystems. This research will provide insight into the forces which structure microbial communities and will link microbial community composition and function with surface mine-induced selenium concentrations over time and space. This information is an essential first step for the development of sustainable management practices of surface mine contaminated water resources.

**3. Program existence :** Intermediate (One to five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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				40%
102	Soil, Plant, Water, Nutrient Relationships				10%
133	Pollution Prevention and Mitigation				10%
403	Waste Disposal, Recycling, and Reuse				40%
	<b>Total</b>				100%

**V(C). Planned Program (Situation and Scope)****1. Situation and priorities**

Agricultural, municipal and industrial processes produce large quantities of organic wastes that have significant economic and environmental impact on surrounding communities. Anaerobic digesters can minimize the environmental impact of these wastes. Use of anaerobic digester technology in waste management is becoming an attractive option for adding value to manure and improving nutrient management of associated nitrogen and phosphorus. Current available technological alternatives based on thermophilic anaerobic digestion for residuals treatment are diverse. A modified design of a typical continuous stirred tank reactor, used at WVSU, has proven effective in terms of process stability and capability to manage considerable large amounts of residuals at relatively low operational cost. Although there has been advancement in the science of anaerobic digestion, very little is known about the metabolic diversity of the microbial communities essential for digester function. The focus of Microbial Ecology research at WVSU is to develop predictive models that link microbial diversity to digester performance, molecular, genomics and chemical methods are being utilized to characterize the microbial populations within a pilot plant digester and experimental laboratory-scale reactors, under specific environmental conditions. Other research at West Virginia State University addresses the remediation of current threats to water and air resources, improve productivity of marginal land and explore safe use of solid waste to improve soil function. Mining and other extractive industries are primary economic source in West Virginia. With nearly 40% of the coal acquired through surface mining, a process resulting severe disturbance of vast areas. Reclamation efforts that restore the productivity and ecological functions are essential for the soil to attenuate the mobility and availability of pollutants, and provide the essential resources needed to sustain desirable ecosystem or land-use of choice. Understanding of soil processes is important in order to accelerate restoration of mined-land soils, and in order to promote desired soil functions such as agronomic productivity. Preliminary studies have shown promising results in relation to land and vegetative restoration of mined/reclaimed soils. Other studies include the use of various organic and inorganic materials in the soil with the purpose of improving drainage properties, and to also enhance management practices, and storm water quality. In addition, recent state and federal regulations require implementation of storm water management practices by all Municipal Separate Storm Sewer Systems in urbanize areas and populated counties (with more than 100,000 inhabitants). Meeting threshold values for selected components of environmental concern in the runoff water and implementation of soil-based runoff mitigation practices is required. Development of cost-effective practices to achieve these goals is essential.

**2. Scope of the Program**

- In-State Research
- Multistate Research

**V(D). Planned Program (Assumptions and Goals)****1. Assumptions made for the Program**

This research program is supported by both NIFA and external funding. The scientists conducting research have specific knowledge of pilot plant operation and engineering, soil chemistry and physics, as well as, molecular DNA, plant and microbial techniques and operation of specialized experimental and analytical equipment

necessary to conduct this research. Currently, WV SU provides laboratories and equipment for this program, including a 10,000 gallon pilot plant digester and several laboratory scale reactors. Regional and international collaborations are being pursued to empower the research program, including the University of Georgia, and the Mexican Universities of Chapingo and Coahuila. Stringent regulations by state and federal agencies on anthropogenic activities impact on soil and water quality require the development of cost-effective technologies and practices for reducing adverse impacts and restoring soil quality in impacted lands. Both extraction and end use of coal are important to the economy of West Virginia. With worldwide energy demand increasing, the price and demand for coal has sharply increased. Associated with more extraction of coal from surface and deep mines is the depletion and disturbance of soil. Likewise, increase urbanization and land development operations result in highly disturbed lands and stressed soil and water systems. This research program addresses these issues. Local, state, and federal groups and agencies may be able to use the findings of this research to maintain current production levels while restoring soil quality and function to pre-disturbance state.

**2. Ultimate goal(s) of this Program**

- Overall enhancement of pilot plant anaerobic digester performance during pre-digestion, digestion, and post-digestion phases (e.g. operational efficiency, equipment improvement, co-digestion). - Evaluation of hydrodynamic effects resulting from modifying the digester's geometry. - Developing of mathematical models which can be applied to improve digester performance. - Anaerobic digester microbial community characterization: develop an understanding of microbial community processes that enable biomass-to-bioenergy conversions. - Develop predictive profiles of microbial diversity that can be used as a monitoring tool for operator and engineers. - Repairing soil quality and vegetative growth of mined soils by utilizing treated solid waste to alleviate pollution and contamination, as well as improve productivity, and develop innovative drainage systems. - To understand the forces which structure microbial communities and link community composition and function with mine-induced selenium concentrations.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	0.0	3.3
2012	0.0	0.0	0.0	3.3
2013	0.0	0.0	0.0	2.3
2014	0.0	0.0	0.0	2.3
2015	0.0	0.0	0.0	2.3

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

**1. Activity for the Program**

- Conduct field, greenhouse and laboratory experiments - Present and/or publish the results

**2. Type(s) of methods to be used to reach direct and indirect contacts**

**Extension**

Direct Methods	Indirect Methods
• Other 1 (Scientific Conferences)	• Web sites

**3. Description of targeted audience**

- Watershed and Environmental groups - Mine operators - Mine and Land owners- Environmental regulators- local and state government

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

**1. Standard output measures**

**Target for the number of persons(contacts) to be reached through direct and indirect contact methods**

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	5	0	0	0
2012	5	0	0	0
2013	5	0	0	0
2014	5	0	0	0
2015	5	0	0	0

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

**2011:0                      2012:0                      2013:0                      2014:0                      2015:0**

**3. Expected Peer Review Publications**

Year	Research Target	Extension Target	Total
2011	2	0	0
2012	2	0	0
2013	2	0	0
2014	2	0	0
2015	2	0	0

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

**1. Output Target**

- Scientific presentations and publications

**2011:4                      2012:3                      2013:2                      2014:2                      2015:2**

**V(I). State Defined Outcome**

<b>O. No.</b>	<b>Outcome Name</b>
1	Increased awareness of soil remediation technology among stakeholders
2	Development of a novel technique for soil remediation
3	Develop soil rating for soil-based runoff mitigating practices
4	Increase digester efficiency
5	Develop techniques for digester control
6	Increase knowledge of anaerobic bacteria
7	Increase knowledge of microbial biomass-to-bioenergy conversion process

**Outcome # 1**

**1. Outcome Target**

Increased awareness of soil remediation technology among stakeholders

**2. Outcome Type :** Change in Knowledge Outcome Measure

**2011:0                      2012:0                      2013:0                      2014:0                      2015:0**

**3. Associated Knowledge Area(s)**

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 133 - Pollution Prevention and Mitigation
- 403 - Waste Disposal, Recycling, and Reuse

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 2**

**1. Outcome Target**

Development of a novel technique for soil remediation

**2. Outcome Type :** Change in Action Outcome Measure

**2011:0                      2012:0                      2013:0                      2014:0                      2015:0**

**3. Associated Knowledge Area(s)**

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 133 - Pollution Prevention and Mitigation
- 403 - Waste Disposal, Recycling, and Reuse

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 3**

**1. Outcome Target**

Develop soil rating for soil-based runoff mitigating practices

**2. Outcome Type :** Change in Knowledge Outcome Measure

**2011:2                      2012:2                      2013:2                      2014:0                      2015:0**

**3. Associated Knowledge Area(s)**

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships

- 133 - Pollution Prevention and Mitigation
- 403 - Waste Disposal, Recycling, and Reuse

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 4**

**1. Outcome Target**

Increase digester efficiency

**2. Outcome Type : Change in Condition Outcome Measure**

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Associated Knowledge Area(s)**

- 403 - Waste Disposal, Recycling, and Reuse

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 5**

**1. Outcome Target**

Develop techniques for digester control

**2. Outcome Type : Change in Knowledge Outcome Measure**

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Associated Knowledge Area(s)**

- 403 - Waste Disposal, Recycling, and Reuse

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 6**

**1. Outcome Target**

Increase knowledge of anaerobic bacteria

**2. Outcome Type : Change in Knowledge Outcome Measure**

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Associated Knowledge Area(s)**

- 102 - Soil, Plant, Water, Nutrient Relationships
- 403 - Waste Disposal, Recycling, and Reuse

#### 4. Associated Institute Type(s)

- 1890 Research

#### Outcome # 7

##### 1. Outcome Target

Increase knowledge of microbial biomass-to-bioenergy conversion process

##### 2. Outcome Type : Change in Knowledge Outcome Measure

2011:0	2012:0	2013:0	2014:0	2015:0
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##### 3. Associated Knowledge Area(s)

- 403 - Waste Disposal, Recycling, and Reuse

#### 4. Associated Institute Type(s)

- 1890 Research

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

##### 1. External Factors which may affect Outcomes

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities

##### Description

{NO DATA ENTERED}

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

##### 1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

##### Description

{NO DATA ENTERED}

##### 2. Data Collection Methods

- Other (Site Experimentation)

##### Description

On site (reclaimed land at coal mines) experimentation is currently being designed. Data in relation to microbial and soil improvement (organic characteristics) will be collected.

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

**Program # 2**

**1. Name of the Planned Program**

Food Systems, Nutrition and Wellness

**2. Brief summary about Planned Program**

As a new planned program still being developed, Food Systems, Nutrition and Wellness covers two areas of focus: (1) Food Safety and (2) Global and Regional Food Security, and is currently in the planning phase. This program will be coupled with WVSU Extension Service Innovative Kitchen at the Economic Development Center. Food security research will include the production of innovative products (including packaging methodologies) utilizing the regional resources. This program will also include research related to food safety. Biosensors and other innovative technology (nontechnology) will be investigated to propose new alternatives of food safety monitoring as well as preservation.

**3. Program existence :** New (One year or less)

**4. Program duration :** Short-Term (One year or less)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** No

**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				35%
502	New and Improved Food Products				35%
503	Quality Maintenance in Storing and Marketing Food Products				20%
504	Home and Commercial Food Service				10%
	<b>Total</b>				100%

**V(C). Planned Program (Situation and Scope)**

**1. Situation and priorities**

This program is currently being developed.

**2. Scope of the Program**

- In-State Extension
- In-State Research

**V(D). Planned Program (Assumptions and Goals)**

**1. Assumptions made for the Program**

This program is still being planned.

**2. Ultimate goal(s) of this Program**

This program is still being planned.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	0.0	1.0
2012	0.0	0.0	0.0	1.0
2013	0.0	0.0	0.0	1.0
2014	0.0	0.0	0.0	1.0
2015	0.0	0.0	0.0	1.0

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

**1. Activity for the Program**

This program is still being planned.

**2. Type(s) of methods to be used to reach direct and indirect contacts**

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>• Workshop</li> <li>• Demonstrations</li> </ul>	<ul style="list-style-type: none"> <li>• Web sites</li> </ul>

**3. Description of targeted audience**

-food industry

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

**1. Standard output measures**

**Target for the number of persons(contacts) to be reached through direct and indirect contact methods**

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Expected Peer Review Publications**

Year	Research Target	Extension Target	Total
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0

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

**1. Output Target**

- Scientific publications and/ presentations

2011:0                      2012:1                      2013:1                      2014:1                      2015:1

**V(I). State Defined Outcome**

O. No.	Outcome Name
1	Outcomes are still being defined.

**Outcome # 1**

**1. Outcome Target**

Outcomes are still being defined.

**2. Outcome Type : Change in Knowledge Outcome Measure**

**2011:0                      2012:0                      2013:0                      2014:0                      2015:0**

**3. Associated Knowledge Area(s)**

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 503 - Quality Maintenance in Storing and Marketing Food Products
- 504 - Home and Commercial Food Service

**4. Associated Institute Type(s)**

- 1890 Research

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

**1. External Factors which may affect Outcomes**

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities

**Description**

{NO DATA ENTERED}

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

**1. Evaluation Studies Planned**

- Retrospective (post program)
- During (during program)

**Description**

{NO DATA ENTERED}

**2. Data Collection Methods**

- Other ()

**Description**

{NO DATA ENTERED}

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

Competitive and Sustainable Agricultural Systems

**2. Brief summary about Planned Program**

The Competitive and Sustainable Agricultural Systems program is comprised of three research areas: Plant Genomics, Alternative Agriculture and Aquaculture. Plant Genomics includes four components: (1) DNA marker development, molecular phylogenies and QTL Mapping, (2) Physical mapping using BAC technology and gene cloning, (3) Functional genomics and epigenetics, and (4) Basic genetic research using model plant Arabidopsis and other genetic models. Using these genomic techniques, WVSU scientists are seeking to develop higher quality peppers, sweet potatoes, melons, pumpkins and tomatoes with increased levels of antioxidants, vitamins and medicinal properties, as well as superior taste, higher insect and disease resistance. The primary objectives of the Plant Genomics projects at WVSU are: (1) to develop DNA markers to map specific traits, such as yield, quality, and pest and disease resistance in pepper, sweet potato, melon, cucurbit and tomato crops; (2) Develop large insert libraries and make pools of BAC DNAs and integrate these platforms with the previously archived low resolution genetic maps; (3) To understand and isolate the genes and gene networks involved in fruit development and ripening in cucurbit crops; and (4) Develop and integrate new technologies, currently identified in model plant Arabidopsis into crop genetics. Alternative Agriculture, at WVSU, is striving to improve production efficiency and quality of alternative food products to be grown and marketed in West Virginia. Projects are focused in three areas: hydroponics, sustainable and ornamental. Each area involves varietal selection, germplasm characterization and evaluation; nutrient and pest management; soil/media quality and plant performance; production practices and postharvest quality; and production practices to improve plant systems. The overall objective is to develop and demonstrate hydroponic, sustainable and ornamental technology and/or production systems suitable for use by small producers. Current aquaculture research is focused on improving aquaculture production efficiency of cool water and warm water fishes to be grown and marketed in West Virginia. Activities are centered on a genomic-enabled nutritional approach, studying the genome-wide influences of nutrition or dietary compounds on the transcriptome, proteome and metabolome of cells, tissues or organisms at a given time, with emphasis on aquaculture finfishes, especially rainbow trout and channel catfish. Future studies to be explored are: 1) the role of mitochondrial function, in both catabolic and anabolic pathways, as well as how environmental factors affect the various stages of metabolism. 2) the efficiency of antioxidant systems, possible site-specific defects along the respiratory chain, transportation of substrates and energy into and out of the cell; 3) the roles of the crosstalk between mitochondrially encoded and nuclear-encoded genes in oxidative phosphorylation.

**3. Program existence :** Intermediate (One to five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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				30%
202	Plant Genetic Resources				15%
204	Plant Product Quality and Utility (Preharvest)				30%
205	Plant Management Systems				10%
302	Nutrient Utilization in Animals				10%
307	Animal Management Systems				5%
	<b>Total</b>				100%

**V(C). Planned Program (Situation and Scope)****1. Situation and priorities**

The success of agriculture is dependent on the ability of growers to sustainably produce high quality crop products. As the intensive use of pesticides, water, and energy becomes costly, developing crops that have enhanced traits is imperative for local growers to remain competitive in the US market. Likewise, alternative products and practices such as organic farming, aquaculture, and hydroponic systems are becoming an important component in North American agriculture. These novel techniques and alternative approaches to growing traditional crops, along with development of new or exotic products not currently grown on large-scale basis in the US, can provide a greater return on small producer investment compared to traditional products and practices. In areas like southern WV with economic instability (due to transition from an economy that is industrial based to one that is service or technology based), income from small farms can provide an important source of income for landowners. Also, the increasing demand, along with the abundant supply of waters from inactive deep coal mines and the proximity to large population bases provide opportunity for aquaculture to become a promising new agricultural industry in WV.

**2. Scope of the Program**

- In-State Extension
- In-State Research
- Multistate Research
- Multistate Extension
- Integrated Research and Extension

**V(D). Planned Program (Assumptions and Goals)****1. Assumptions made for the Program**

This research program is supported by both NIFA funding and external grants. The scientists heading the projects have specific and extensive knowledge in molecular genetics, horticulture and aquaculture. They are assisted by undergraduate and graduate students, as well as research technicians. Projects and activities are conducted in laboratories, greenhouses and campus field plots as well as partnering farms. Collaborations have been established between the PDs and scientists at other institutions and agencies, like Texas A&M, Cornell, Mississippi State University, National Center for Cool and Cold Water Aquaculture and Catfish Genetic Research Unit, and many others.

**2. Ultimate goal(s) of this Program**

-Develop extensive genomic resources for the crops under study and identify diverse germplasm with pest/disease resistance and nutraceutical genes. -Build multiple gene recombinants that have favorable allele combinations (gene pyramiding) for economically important traits. -Develop and demonstrate hydroponic, sustainable and ornamental technology, and/or production systems suitable for use by small producers -Develop a greenhouse beefsteak tomato variety for southern greenhouse tomato producers. -Reduce aquaculture feed cost. -Reduce nutrient discharge from aquaculture facilities into waterways

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	0.0	5.2
2012	0.0	0.0	0.0	5.2
2013	0.0	0.0	0.0	5.2
2014	0.0	0.0	0.0	3.2
2015	0.0	0.0	0.0	3.2

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

**1. Activity for the Program**

- Conduct research experiments - Publications and presentations - Workshops

**2. Type(s) of methods to be used to reach direct and indirect contacts**

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>● Workshop</li> <li>● Demonstrations</li> <li>● Other 1 (Scientific Publications and Conf)</li> </ul>	<ul style="list-style-type: none"> <li>● Web sites</li> <li>● Other 1 (Web sites)</li> </ul>

**3. Description of targeted audience**

-Horticulturists -Germplasm Collectors -Plant Genetics Researchers -Plant Breeders -Private seed companies - Producers/Growers  
 -Graduate and undergraduate students  
 -High school students and teachers  
 -Aquaculture Industry

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

**1. Standard output measures**

**Target for the number of persons(contacts) to be reached through direct and indirect contact methods**

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	100	500	0	0
2012	100	500	0	0
2013	200	500	0	0
2014	200	0	0	0
2015	200	0	0	0

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

**2011:0                      2012:0                      2013:0                      2014:0                      2015:0**

**3. Expected Peer Review Publications**

Year	Research Target	Extension Target	Total
2011	1	0	0
2012	1	0	0
2013	1	0	0
2014	1	0	0
2015	1	0	0

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

**1. Output Target**

- Scientific publications and/or presentations

**2011:8                      2012:8                      2013:6                      2014:6                      2015:6**

**V(I). State Defined Outcome**

O. No.	Outcome Name
1	Develop tomatoes for greenhouse production with disease and insect resistance.
2	Genetic maps and genes for vegetable crops
3	Increase state production and sales of alternative agricultural products
4	Increase profitability of aquaculture operations
5	Reduce nitrogen and phosphorus in discharge water
6	Lower aquaculture feed costs

**Outcome # 1****1. Outcome Target**

Develop tomatoes for greenhouse production with disease and insect resistance.

**2. Outcome Type : Change in Knowledge Outcome Measure**

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Associated Knowledge Area(s)**

- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 2****1. Outcome Target**

Genetic maps and genes for vegetable crops

**2. Outcome Type : Change in Knowledge Outcome Measure**

2011:0                      2012:0                      2013:0                      2014:0                      2015:0

**3. Associated Knowledge Area(s)**

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 202 - Plant Genetic Resources

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 3****1. Outcome Target**

Increase state production and sales of alternative agricultural products

**2. Outcome Type : Change in Condition Outcome Measure**

2011:2                      2012:3                      2013:3                      2014:4                      2015:4

**3. Associated Knowledge Area(s)**

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 4**

**1. Outcome Target**

Increase profitability of aquaculture operations

**2. Outcome Type : Change in Condition Outcome Measure**

2011:0	2012:0	2013:0	2014:0	2015:0
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**3. Associated Knowledge Area(s)**

- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 5**

**1. Outcome Target**

Reduce nitrogen and phosphorus in discharge water

**2. Outcome Type : Change in Condition Outcome Measure**

2011:0	2012:0	2013:0	2014:0	2015:0
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**3. Associated Knowledge Area(s)**

- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems

**4. Associated Institute Type(s)**

- 1890 Research

**Outcome # 6**

**1. Outcome Target**

Lower aquaculture feed costs

**2. Outcome Type : Change in Action Outcome Measure**

2011:0	2012:0	2013:0	2014:0	2015:0
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**3. Associated Knowledge Area(s)**

- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems

#### **4. Associated Institute Type(s)**

- 1890 Research

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

##### **1. External Factors which may affect Outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Government Regulations
- Other (Appropriation Changes)

##### **Description**

Loss or meaningful reduction in funding could significantly affect timing of outcomes.

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

##### **1. Evaluation Studies Planned**

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

##### **Description**

State statistics are appropriate; surveys as needed.

##### **2. Data Collection Methods**

- Sampling
- Mail
- Other (web sampling)

##### **Description**

{NO DATA ENTERED}