

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

**Program # 4**

**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
111	Conservation and Efficient Use of Water	0%		5%	
112	Watershed Protection and Management	0%		5%	
122	Management and Control of Forest and Range Fires	5%		5%	
123	Management and Sustainability of Forest Resources	0%		5%	
132	Weather and Climate	10%		5%	
133	Pollution Prevention and Mitigation	10%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		10%	
202	Plant Genetic Resources	5%		5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%		10%	
205	Plant Management Systems	0%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		10%	
212	Pathogens and Nematodes Affecting Plants	10%		10%	
216	Integrated Pest Management Systems	10%		5%	
402	Engineering Systems and Equipment	20%		8%	
404	Instrumentation and Control Systems	10%		2%	
605	Natural Resource and Environmental Economics	0%		5%	
610	Domestic Policy Analysis	5%		0%	
	<b>Total</b>	100%		100%	

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

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

Year: 2013	Extension		Research	
	1862	1890	1862	1890

Plan	20.0	0.0	65.0	0.0
Actual Paid Professional	21.0	0.0	79.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

**2. Institution Name:** Washington State University

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
169251	0	394215	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
169251	0	394215	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
4576558	0	9028020	0

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

**1. Brief description of the Activity**

Our work in climate change is focused on several objectives. One is research and outreach to increase stakeholder knowledge, especially related to strategies and technologies for mitigating the effects of anticipated climate change scenarios. Another is the development and application of technology and practices to decrease the release of greenhouse gases or sequester carbon in order to limit drivers of climate change. Our program is multifaceted as the potential outcomes of "normal" weather variation and short and long-term climate change were already and continue to be a major focus of our research and outreach. Washington State is extremely diverse climatically and we have developed specific agricultural efforts to address differences in weather from site to site. These variations in practice are applicable to anticipated changes in climate although perhaps at different locations than they are currently being used. Additionally, Washington is also subject to shorter-term changes that may fluctuate greatly over any given period of time. While this means we might be better prepared for systemic change than we might otherwise be, we still anticipate significant changes may be needed, especially in areas like water management. We are well positioned to address changes that could take place in the state.

We have and continue to monitor for invasive pests including weeds, insects, and pathogens. Our varied and constantly evolving production agriculture has made Washington a target for invasive species and that trend will continue with changing climate. Our plant breeding and molecular biology programs continue to develop new crop varieties that are able to withstand emerging disease and pest threats associated with climate change. We are also in the process of assessing climate change related policies and developing research and outreach programs to position Washington's agriculture and forestry industries effectively to increase sequestration of carbon and to benefit from future carbon trading protocols or other greenhouse gas mitigation policy mechanisms.

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

Target audiences for this program are very broad. Anyone involved in production or local agriculture could be affected. This would include everyone from the grower to those involved in end-product

development. This includes owners and managers of crop and rangelands, forest resources, and wood products industries, community leaders, the general public, and numerous public agencies and organization.

**3. How was eXtension used?**

Five faculty participated in Communities of Practice.

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

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	5536	45680	1961	2075

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	1	25	25

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

**Output Target**

**Output #1**

**Output Measure**

- Number of workshops and other educational venues delivered.

Year	Actual
2013	43

**Output #2**

**Output Measure**

- Number of peer reviewed (official) WSU Extension publications published per year.

<b>Year</b>	<b>Actual</b>
2013	1

**Output #3**

**Output Measure**

- Number of graduate students with a significant professional orientation in the area of Climate Change.

<b>Year</b>	<b>Actual</b>
2013	31

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

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

O. No.	OUTCOME NAME
1	Percentage of evaluated participants who demonstrated increased knowledge and skills relative to key learning objectives.
2	Percentage of evaluated program participants who applied knowledge attained from WSU.
3	Acres planted with WSU-developed crop varieties that are more adapted to environmental conditions or more resistant to emerging plant pests and diseases.
4	Number of farms employing anaerobic digestion or other methods to reduce GHG emissions or to sequester carbon.

## **Outcome #1**

### **1. Outcome Measures**

Percentage of evaluated participants who demonstrated increased knowledge and skills relative to key learning objectives.

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

- 1862 Extension
- 1862 Research

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

Change in Knowledge Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2013	61

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

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

The impacts of climate change on Washington State could be significant, with potential changes in irrigation water availability and seasonal growing conditions for crops statewide. New plant and animal pests and diseases are likely to emerge over time as well.

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

Program implementation utilized local, regional, and statewide efforts that involved research projects, outreach workshops, clinics, seminars, print and electronic publications, mass media, social networks, and other methods to disseminate research-based knowledge and other relevant information to target audiences.

#### **Results**

Program evaluations revealed that an average of 61% of program participants increased their knowledge and awareness of climate change mitigation and/or adaptation practices. This knowledge included basic understanding of climate change and steps to adapt to future changes and mitigate trends that are predicted.

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

<b>KA Code</b>	<b>Knowledge Area</b>
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
122	Management and Control of Forest and Range Fires
123	Management and Sustainability of Forest Resources

132	Weather and Climate
133	Pollution Prevention and Mitigation
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

## **Outcome #2**

### **1. Outcome Measures**

Percentage of evaluated program participants who applied knowledge attained from WSU.

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

- 1862 Extension
- 1862 Research

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

Change in Action Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2013	55

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

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

The impacts of climate change on Washington State could be significant, with potential changes in irrigation water availability and seasonal growing conditions for crops statewide. New plant and animal pests and diseases are likely to emerge over time as well.

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

Program implementation utilized local, regional, and statewide efforts that involved research projects, outreach workshops, clinics, seminars, print and electronic publications, mass media, social networks, and other methods to disseminate research-based knowledge and other relevant

information to target audiences.

### **Results**

Fifty-five percent of program participants indicated and intent to apply the knowledge gained from one or more of the 43 educational events delivered in this program area. This implied a growing willingness among audiences to act on the information and recommendations provided.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
122	Management and Control of Forest and Range Fires
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

### **Outcome #3**

#### **1. Outcome Measures**

Acres planted with WSU-developed crop varieties that are more adapted to environmental conditions or more resistant to emerging plant pests and diseases.

Not Reporting on this Outcome Measure

### **Outcome #4**

#### **1. Outcome Measures**

Number of farms employing anaerobic digestion or other methods to reduce GHG emissions or to sequester carbon.

## 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2013	22

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Farm and processor waste lead to major unproductive releases of fixed carbon from the agroecosystems as carbon dioxide and methane. By using anaerobic digestion (AD) to recover some of the energy content of this waste, less fossil fuel is needed and the energy associated with waste disposal is reduced. The economics of AD operations in animal production in Washington is best when tipping fees for disposal of other waste products are also available

#### What has been done

WSU scientists have conducted extensive research on anaerobic digestion (AD) as a technology to recover methane (energy), stable carbon, and nutrients from organic wastes such as manure, food processing wastes and the organic fraction of municipal solid wastes. We have evaluated the technical and economic performance of commercially available systems, developed improved AD reactors, and commercialized WSU patented nutrient recovery technology.

#### Results

22 commercial farm-based AD projects are now operating in the PNW (WA, OR, ID), processing 7,800+ tons / day of organic wastes (104,000 Wet Cow Equivalents, 161 tons / day food waste) representing ~30 MW electrical capacity installed, mitigating more than 1 MMT CO<sub>2</sub>e annually and representing an estimated \$125 million in capital invested. 4 commercial scale nutrient recovery facilities have been installed nationally based on WSU patented technology. Data was collected from survey of project developers and estimates based on existing research.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
133	Pollution Prevention and Mitigation
205	Plant Management Systems
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

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

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

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

### **Brief Explanation**

There are numerous factors that influence our work on climate change. There is some resistance to the idea of climate change and several of our stakeholders are unwilling to accept this type of research and outreach as valuable or needed. Additionally, as in many of our programs, there were reduced baseline appropriations from the state to support our work. However, the concept of "climate change" as applied to marginal growing conditions has always been important in Washington State and we have traditionally and much more so recently, sought grants and outside investments that have allowed this program to move forward with research on the margin of weather, even in the face of political opposition to the issue of climate change.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Our work in Climate Change includes animal and plant production systems and integrates Extension education in disseminating research results. Most of our effort can be classified as mitigation of climate change but is seen by our stakeholders as the type of incremental adaptation that has become routine in breeding and in adapting farm operations to altered economics of inputs and products. While we probably could be more aggressive in pointing out that there may be an underlying motivation for some of these incremental changes, our audiences are often unwilling to acknowledge this, raising the possibility of rejection of all of our related work.

Increased knowledge and adoption of improved agricultural systems that support carbon sequestration is a primary focus of our work in climate change. Audiences were receptive to procedures and materials that will allow them to adapt to changing conditions, even as some reject the concept that some of the practice changes are motivated by an evolving climate. Self-reported knowledge increase by 61% of program participants and the intent to apply that knowledge by 55% of participants were the metrics selected to evaluate outcomes achieved through 43 educational events in this planned program. Deployment of anaerobic digesters on 22 farms was another measure of evaluation utilized.

## **Key Items of Evaluation**

Approximately 61% of program participants indicated they acquired increased knowledge and skills relative to key learning objectives of this program. This measure is a calculated average of evaluations across program events where participants reported increased knowledge or skill through their participation.

55% of program participants indicated an intention to use or apply one or more principles gained from 43 educational events delivered in this program area. This implied a growing willingness among audiences to act on the information and recommendations provided.

22 farms employed anaerobic digestion or other methods to reduce GHG emissions or to sequester carbon.