## 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 | 0% | | 5% | |
| 102 | Soil, Plant, Water, Nutrient Relationships | 0% | | 5% | |
| 112 | Watershed Protection and Management | 9% | | 10% | |
| 121 | Management of Range Resources | 7% | | 5% | |
| 122 | Management and Control of Forest and Range Fires | 15% | | 0% | |
| 123 | Management and Sustainability of Forest Resources | 8% | | 0% | |
| 135 | Aquatic and Terrestrial Wildlife | 17% | | 25% | |
| 136 | Conservation of Biological Diversity | 0% | | 5% | |
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants | 0% | | 5% | |
| 215 | Biological Control of Pests Affecting Plants | 0% | | 10% | |
| 311 | Animal Diseases | 0% | | 5% | |
| 601 | Economics of Agricultural Production and Farm Management | 0% | | 5% | |
| 605 | Natural Resource and Environmental Economics | 20% | | 0% | |
| 609 | Economic Theory and Methods | 0% | | 5% | |
| 610 | Domestic Policy Analysis | 0% | | 5% | |
| 723 | Hazards to Human Health and Safety | 24% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2014 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 10.0 | 0.0 | 70.0 | 0.0 |

| | | | | |
|---|---|---|---|---|
| **Actual Paid** | 3.8 | 0.0 | 15.0 | 0.0 |
| **Actual Volunteer** | 71.0 | 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** |
| 77974 | 0 | 1071640 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 77974 | 0 | 6901115 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 152064 | 0 | 5325344 | 0 |

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

### 1. Brief description of the Activity

The program includes studies that focus on development of models of community-level responses to perturbations, population dynamics and habitat management for individual aquatic and terrestrial species, and development of methods for monitoring ecosystem changes. The experimental approaches that will be used to meet the specific objectives of these subprograms include field studies in the Oregon, the Pacific Northwest, the U.S., and abroad. In addition, the experimental approaches will also include controlled laboratory experiments and database/model development.

Climate change adaptation focuses on adjusting existing practices in order to reduce negative consequences and take advantage of opportunities. Adaptation begins with identifying and characterizing the problem posed by climate change, a goal this report aims to serve. It then proceeds with identifying, assessing, and selecting alternative actions, and ultimately implementing, monitoring, and evaluating the selected actions. Many federal, state, local, and tribal entities in the Northwest are already engaged in various stages of climate change adaptation, including state-level climate change response strategies; however, adaptation is not yet wide-spread and few efforts have moved beyond planning to implementation. Climate change adaptation focuses on adjusting existing practices in order to reduce negative consequences and take advantage of opportunities. Adaptation begins with identifying and characterizing the problem posed by climate change, a goal this effort aims to serve. It then proceeds with identifying, assessing, and selecting alternative actions, and ultimately implementing, monitoring, and evaluating the selected actions. Many federal, state, local, and tribal entities in the Northwest are already engaged in various stages of climate change adaptation, including state-level climate change response strategies; however, adaptation is not yet wide-spread and few efforts have moved beyond planning to implementation.

Theoretical and empirical models will be developed to examine land-use policies and impacts on water quality, wildlife habitat, watershed health, and other ecological indicators. Models will be used to examine how resource and agricultural policy affects major land use and cropping patterns, and how these may affect water quality.

Research is often carried out at field sites in the state, region, nation, or overseas. We will develop and use novel soil-water instrumentation, update and expand the reference evapotranspiration data

currently available for Oregon, develop hydrologic models capable of simulating the interactions and processes between surface water and groundwater, conduct labortory and field observations of physical and biological processes and functions, benthic macroinvertebrate community, numerical and statistical models play critical roles in understanding the driving principles of watershed and river ecosystems and linkages. Watershed and river basin scale resource simulation models and decision tools will be used to examine coupled natural and human systems and trajectories of change under alternative future scenarios.

OSUES's approach to climate change outreach will involve both traditional and non-traditional methods. We will integrate climate change content into existing educational programs, and address climate-related impacts such as drought and adverse storm damage response. Programs will also be developed and delivered, based on current research, which shows mitigation strategies and adaptations that can be accomplished now. For example, our forest geneticists are now developing revised seed zone maps that account for changing climate. This can assist forest owners and managers who are making planting decision today for forests that will grow for over 50 years and are likely to be under the effects of a different climate 50 years from now.

Other activities will include volunteer-based programs such Climate Masters and Master naturalists, workshops and seminars, consultations and facilitations, web-based instructional programs, web sites, stand alone and web-based videos, publications of all types, mass media, and social networking.

In summary, we will:

- conduct research experiments
- collect data
- conduct assessments
- develop monitoring protocols
- develop products, curriculum resources
- conduct workshops & meetings
- present seminars and professional talks
- provide training
- deliver services
- provide counseling
- partnering
- facilitating

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

- The general public and those in natural resource-based communities, including growers, ranchers and fishermen
- The research community including scientists working in governmental, industrial, and academic sectors, including biomedical researchers, oceanographers, climatographers, virologists
- Growers, crop consultants, extension faculty and researchers in the agricultural industry; and ecologists, economists, and managers concerned with invasive species.
- Salmonid and other fisheris
- State and federal natural resources management and regulatory agencies, including land managers
- Policy makers.
- Typical citizens in urban settings
- Engineering profession
- Undergraduate and graduate students

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

| 2014 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 1247 | 1742 | 810 | 2018 |

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

**Patent Applications Submitted**

Year: 2014

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

| 2014 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 4 | 14 | 0 |

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

**Output Target**

**Output #1**

**Output Measure**

- Conference Presentations

| Year | Actual |
|---|---|
| 2014 | 21 |

**Output #2**

**Output Measure**

- Number of Courses Developed that include the Planned Program and State Defined Outcomes as part of the curriculum

| Year | Actual |
|---|---|
| 2014 | 3 |

## V(G). State Defined Outcomes

### V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Developed new or better tools, technologies, practices, and models for understanding and managing: water and irrigation, soil, food production (crops and animals) systems and land, pests and pathogens, natural resources, and land-use |
| 2 | Understand impacts of climate change on and responses of: food systems, land use, watersheds and water systems, species, habitat and ecosystems, genes, pests and pathogens, marine food webs |
| 3 | Evaluated resource management strategies and best practices for climate change mitigation, such as: a) chemical control, b) biological control, c) stock assessments, d) fishery management tools, e) nitrogen applications, f) water use efficiency, g) acres planted for carbon sequestration, h) coastal hazards, i) community resilience |
| 4 | Understand changes in societal views with regard to the value of habitats and conservation and how to manage them |
| 5 | Understand changes in ecosystems from carbon management strategies, soil microbial health, natural resource or ecosystem policies |
| 6 | New genotypes developed and planted that show enhanced adaptive capacity to climate change |
| 7 | Understand the role of international trade as a vehicle by which adaptations can be made to global climate change: a) key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; b) Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large. |
| 8 | Conservation strategies adopted, for example: - Conservation bio-control strategies are implemented differently and active restoration strategies occur. Land owners and managers assess ecosystem services provided by their riparian restorations via a user-friendly web tool. - Watershed councils, watershed stewards and Oregon Water Schools implement projects or programs based upon knowledge transmitted - Growers adopt improved, scale-dependent practices selected for various market niches with emphasis on reducing environmental degradation and impact. Commercial small farms will have more diverse and economically viable technologies and production techniques or systems available for their use - Growers implement drip irrigation and produce more marketable yields of onions, potatoes, and poplar trees than with furrow or sprinkler irrigation, and achieve efficient use of soil nitrate and the other available N sources under drip irrigation. - Generation of the viral vectors for grapevine disease control and functional genomics vectors have a potential for replacing current strategies of using chemical fungicides and bactericides with viral biocontrol strategies. |
| 9 | Participants who increase their knowledge of management practices and understanding of climate variability and change. (Percentage) |
| 10 | Participants in educational programs who improve mitigation strategies for climate, such as reducing greenhouse gas emissions and increasing carbon sequestration in agricultural production and natural resource management systems. (Percentage) |
| 11 | Clients who employ climate adaptation strategies or incorporate climate-based management practices. (Percentage) |

**Outcome #1**

**1. Outcome Measures**

Developed new or better tools, technologies, practices, and models for understanding and managing: water and irrigation, soil, food production (crops and animals) systems and land, pests and pathogens, natural resources, and land-use

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2014 | 0 |

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

**Issue (Who cares and Why)**
Broad expansion of microirrigation is needed. Unless timely action is taken, it is anticipated that water supply and water quality related crises will affect economies and resources of national and international importance. Microirrigation can reduce the waste of water to a negligible amount and reduce the transport of contaminants to surface water and groundwater. Irrigation events can be fine-tuned to spoon feed water and nutrients just in time to minimize plant water stress. Microirrigation can optimize crop production (more crop per drop) and in many cases increase the quality of agricultural products. Successful experimental microirrigation results will be scaled up to commercial size through this project. Microirrigation information will be transferred to growers through many venues.

**What has been done**
Technical advances in soil water sensors and their increasing commercial viability help focus the need for more research and extension of soil-based irrigation scheduling. Confirming the reliability and improving the convenience and accessibility to growers of soil water sensors will be addressed in a number of studies. Remote grower access to soil water data by computer or smart phone will be evaluated for irrigation scheduling. In OR, soil-based scheduling for onion will be compared to weather-based scheduling, and a fixed irrigation schedule compared to soil- and weather-based scheduling for seed production from native plants.

**Results**

Soil-, weather-, and plant-based or combined microirrigation scheduling approaches will provide valuable choices for a diverse clientele of growers to improve their crop production and profitability while reducing irrigation withdrawals. Increased adoption and proficient management of microirrigation scheduling by growers will improve water productivity and promote improved water quality over a wider range of end-user characteristics and constraints.
Risks of negative impacts to environment, soil, and water quality that affect all of society through massive irrigation methods will be minimized through reduced leaching or other off-site /non-target chemical movement possibly opening up previously non- productive lands to microirrigation.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 123 | Management and Sustainability of Forest Resources |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants |
| 601 | Economics of Agricultural Production and Farm Management |
| 605 | Natural Resource and Environmental Economics |
| 723 | Hazards to Human Health and Safety |

**Outcome #2**

**1. Outcome Measures**

Understand impacts of climate change on and responses of: food systems, land use, watersheds and water systems, species, habitat and ecosystems, genes, pests and pathogens, marine food webs

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2014 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Changes in precipitation and increasing air temperatures are already having, and will continue to have, significant impacts on hydrology and water resources in the Northwest. Reduced snowpack and shifts in streamflow seasonality due to climate change pose an additional challenge to reservoir system managers as they strive both to minimize flood risk and to satisfy warm season water demands. Reduced water supply combined with increased water demands in the summer could lead to water shortages, reducing the proportion of irrigable cropland and the value of agricultural production.

**What has been done**
Models were constructed for individual water basins using historical flow data and irrigation demand and the historical data was subjected to 20 separate climate models that project rainfall and snowpack levels through 2080.

**Results**
Researchers simulated potential climate change effects on reservoir system operations and irrigated agriculture in a regional River Basin. Using modeled historical streamflow and current water demands and infrastructure, the simulated River Basin experienced water shortages (i.e., years in which substantial prorating of deliveries to junior water users was required) in 14% of years between 1940 and 2005. Using downscaled climate simulations from 20 climate models, showed that the number of years with water shortages under the SRES-A1B scenario (continued" "growth of greenhouse gas (GHG) emissions peaking at mid-century) is projected to increase from the historical 14% to 27% (with a range of 13?49% acres of the 20 models)in the 2020s, to 33% in the 2040s, and to 68% in the 2080s without adaptations. For the SRES-B1 scenario characterized by substantial emissions reductions, water shortages occur in 24% (7?54%) of years in the 2020s, 31% for the 2040s, and 43% for the 2080s.
The scenarios also indicate an increasing frequency of historically unprecedented conditions in which senior water rights holders suffer shortfalls (Vano et al. 2010). Such water shortages could impact the amount of acreage in the region that can be irrigated and the amount of water that can be applied during the growing season.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants |
| 601 | Economics of Agricultural Production and Farm Management |

| | |
|---|---|
| 605 | Natural Resource and Environmental Economics |
| 609 | Economic Theory and Methods |
| 723 | Hazards to Human Health and Safety |

**Outcome #3**

**1. Outcome Measures**

Evaluated resource management strategies and best practices for climate change mitigation, such as: a) chemical control, b) biological control, c) stock assessments, d) fishery management tools, e) nitrogen applications, f) water use efficiency, g) acres planted for carbon sequestration, h) coastal hazards, i) community resilience

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2014 | 0 |

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

**Issue (Who cares and Why)**
Human responses to climate change have the potential to impact aquatic ecosystems. Irrigation diversions, trade-offs between hydropower and flow augmentation (released from storage reservoirs) for endangered salmon, and changes to water supply infrastructure all have the potential to affect the survival of native and endangered species, as well as the distribution and extent of suitable habitat. As streamflow rates decline during the summer, irrigators are likely to rely more heavily on storage allocations and increased usage of groundwater supplies to fulfill their water demands.

**What has been done**
New storage facilities may alter temperature regimes downstream, inundate habitat, and create migration barriers. Design and construction of these facilities will need to take into account the potential for such projects to impact natural systems. Reservoir operations may mitigate temperature increases through the release of cold water from lower layers in the reservoir, however the uniform temperature regime of these bottom draw releases may also disrupt important environmental cues for spawning and migration. Researchers are working with agricultural and municipal watershed managers to design measures that will minimize impacts on water dependent species.

**Results**
Adaptation opportunities in response to a decrease in summer streamflows. Conservation practices and improvements in water use efficiency such as upgrading to more efficient agricultural water application systems and intensive irrigation management techniques, changing to crops that require less water, and adapting to dryland agriculture would help mitigate the effects of a reduced supply. Groundwater and surface water supply assessments, evaluations of projected drought risk, impacts, and vulnerabilities, and expanding remote sensing and streamflow monitoring capabilities would help prepare for a decrease in available supply. Adaptation in response to changes in the timing of peak runoff. The development of new storage and retention structures, modification of current water delivery systems, and aquifer recharge using early season runoff would increase the available water supply. Improved forecasting and prediction methods can be developed to assist in decision-making for water management planning and operations. Existing laws, regulations, and policies related to water allocation and management could be modified, and flood control rules for reservoir operations could be changed to allow greater flexibility and adaptation to an altered hydrologic regime.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 605 | Natural Resource and Environmental Economics |
| 610 | Domestic Policy Analysis |
| 723 | Hazards to Human Health and Safety |

**Outcome #4**

**1. Outcome Measures**

Understand changes in societal views with regard to the value of habitats and conservation and how to manage them

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

| | |
|---|---|
| 2014 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Farmer-to-farmer learning is a well-documented strategy for nhancing information sharing that encourages adoption of better practices, and it is important to facilitate interactions among farmers and other stakeholders. Collaboration with farmers and their associates drives development of multiple extension-based projects in REACCH that inform them about agriculture and climate change. Three examples of specific farmer-focused REACCH projects currently underway include:(1) surveys, (2) a decision tool for climate change communication, and (3) case studies.

**What has been done**
Several grower case studies are being developed by REACCH as digital documents that include short video pieces. The goal is to highlight farmers? conscientious efforts to improve their current farming strategies?strategies that may also allow them to adapt to a changing climate. The case studies focus on a variety of practices with specific environmental and economic benefits in four agroecological zones (AEZs), including: (1) variable-rate nitrogen application in the high rainfall zone; (2) intensive and alternative crop rotation in the intermediate rainfall zone; (3) flex cropping in the low rainfall zone; and (4) diverse crops, intensive rotation, and cover cropping in the irrigated zone. Each one examines how farmers make decisions and manage risk and offers suggestions about the challenges and benefits that farmers have experienced when implementing these practices.

**Results**
Products from the three projects identified in this report are expected this coming year. Involving farmers and their associated stakeholders in needs assessments and resource development is crucial for creating effective education materials and decision support. In the face of new challenges, it is necessary to learn from past experiences. Farmers have tremendous creativity and experience when dealing with risks, and REACCH will continue to collaborate with them in meeting future challenges and opportunities.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants |
| 601 | Economics of Agricultural Production and Farm Management |
| 605 | Natural Resource and Environmental Economics |
| 609 | Economic Theory and Methods |
| 610 | Domestic Policy Analysis |

## Outcome #5

### 1. Outcome Measures

Understand changes in ecosystems from carbon management strategies, soil microbial health, natural resource or ecosystem policies

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2014 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Soil carbon (C) sequestration is a major agriculturally based strategy for mitigating rising atmospheric concentrations of greenhouse gases. Soil organic carbon (SOC) levels are dynamic, depending on C additions and losses. Carbon is added from unharvested plant residues and roots, organic amendments, and erosional deposits. Carbon is lost through decomposition of organic materials and C transport via soil erosion. Conversion of native lands to agricultural production results in a 20 to 60% loss of SOC within 40 to 50 years.

**What has been done**
Overall objectives under REACCH regarding SOC are to: (1) continue to quantify agricultural impacts on SOC sequestration for dryland cropping systems in different agroecological zones (AEZs) of the Pacific Northwest; (2) characterize site-specific changes in SOC (0 to 1.53 m) due to management practices within fields typical of the region; and (3) assess chemical, physical, and biological methods of measuring active SOC pools.

**Results**
They reported SOC changes under different soil management scenarios: native conversion, adoption of NT, and use of a mixed perennial-annual rotation (Table 1). These analyses showed that 75% of converted native land lost at least 0.14 to 0.70 Mg C ha-1 yr-1 over an average of 55 to 74 years depending on AEZ. Converting from CT to NT was predicted to increase SOC at least 0.12 to 0.21 Mg C ha-1 yr-1 over 10 to 12 years in 75% of studies analyzed and was also AEZ specific. Compared to annual cropping, mixed perennial-annual systems would be expected to gain at least 0.69 Mg C ha-1 yr-1 over 12 years in 75% of AEZ
2 (annual cropping) sites. Regional assessments of active SOM pools in long-term REACCH

study areas in each of three dry land AEZs as well as an irrigated site were initiated in 2013.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 136 | Conservation of Biological Diversity |
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants |
| 601 | Economics of Agricultural Production and Farm Management |
| 605 | Natural Resource and Environmental Economics |

**Outcome #6**

**1. Outcome Measures**

New genotypes developed and planted that show enhanced adaptive capacity to climate change

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2014 | 0 |

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

**Issue (Who cares and Why)**
OSU plant breeders have been working to develop new wheat and barley strains that are more resistant to drought and diseases associated with warmer temperatures

**What has been done**
Plant breeding trials have been completed for a new varietal of winter soft wheat and spring hard red wheat. One new varietal of barley that can be grown in rotation with dry land winter wheat has been developed.

**Results**
All three varieties have been released.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 203 | Plant Biological Efficiency and Abiotic Stresses Affecting Plants |
| 601 | Economics of Agricultural Production and Farm Management |

**Outcome #7**

**1. Outcome Measures**

Understand the role of international trade as a vehicle by which adaptations can be made to global climate change: a) key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; b) Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large.

Not Reporting on this Outcome Measure

**Outcome #8**

**1. Outcome Measures**

Conservation strategies adopted, for example: - Conservation bio-control strategies are implemented differently and active restoration strategies occur. Land owners and managers assess ecosystem services provided by their riparian restorations via a user-friendly web tool. - Watershed councils, watershed stewards and Oregon Water Schools implement projects or programs based upon knowledge transmitted - Growers adopt improved, scale-dependent practices selected for various market niches with emphasis on reducing environmental degradation and impact. Commercial small farms will have more diverse and economically viable technologies and production techniques or systems available for their use - Growers implement drip irrigation and produce more marketable yields of onions, potatoes, and poplar trees than with furrow or sprinkler irrigation, and achieve efficient use of soil nitrate and the other available N sources under drip irrigation. - Generation of the viral vectors for grapevine disease control and functional genomics vectors have a potential for replacing current strategies of using chemical fungicides and bactericides with viral biocontrol strategies.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2014 | 0 |

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

**Issue (Who cares and Why)**
The goals of the State IPM Coordination program are to advance PAMS IPM in all of its applications in Oregon: the critical needs being addressed include development of statewide partnerships to enable the benefits of IPM to be leveraged in the marketplace, and establishment of a more integrated suite of decision support tools that enable farmers to respond to increasing uncertainties in climate, pests and markets. The goals of the Specialty and Agronomic Crop IPM component of this program are to engage in effective IPM and pesticide stewardship with farmers, to maximize the impact of IPM in pest suppression and environmental protection, and to increase adoption of biologically based IPM.

**What has been done**
Develop three short courses (each course involves a full day in winter and a full day in summer) in three distinct Oregon farming systems over three years; the dry plains row cropping systems of eastern Oregon, the Columbia Plateau orchard systems of the Columbia Gorge area vegetable systems of the Willamette Valley. The target audience will be farmers and personnel that support the implementation of agricultural conservation practices that include and are not limited to industry, conservation, non-profit and extension personnel. The winter course content will include examples of functional agricultural biodiversity practices and research appropriate to the different farming systems maximizing local resources and support personnel connections. The winter course will be coupled with a summer 2015-17 field courses on at least one site worked upon in each class.

**Results**
Preliminary results will be available during the next reporting period.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 215 | Biological Control of Pests Affecting Plants |

| | |
|---|---|
| 601 | Economics of Agricultural Production and Farm Management |
| 605 | Natural Resource and Environmental Economics |

**Outcome #9**

**1. Outcome Measures**

Participants who increase their knowledge of management practices and understanding of climate variability and change. (Percentage)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2014 | 0 |

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

**Issue (Who cares and Why)**
{No Data Entered}

**What has been done**
{No Data Entered}

**Results**
{No Data Entered}

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 123 | Management and Sustainability of Forest Resources |

| | |
|---|---|
| 136 | Conservation of Biological Diversity |
| 215 | Biological Control of Pests Affecting Plants |
| 311 | Animal Diseases |
| 605 | Natural Resource and Environmental Economics |
| 723 | Hazards to Human Health and Safety |

**Outcome #10**

1. **Outcome Measures**

   Participants in educational programs who improve mitigation strategies for climate, such as reducing greenhouse gas emissions and increasing carbon sequestration in agricultural production and natural resource management systems. (Percentage)

   Not Reporting on this Outcome Measure

**Outcome #11**

1. **Outcome Measures**

   Clients who employ climate adaptation strategies or incorporate climate-based management practices. (Percentage)

   Not Reporting on this Outcome Measure

**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
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (climatic or environmental conditions)

**Brief Explanation**

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

**Evaluation Results**

The impact of climate change on agricultural production practices and natural systems functions is only now beginning to be understood. With drought conditions prevalent across much of the west, water management and conservation has become a critical issues as people, endangered species and agricultural producers compete for the same resource. While we are making significant progress, some impacts may already be beyond our ability to react with sufficient speed to mitigate these impacts.

Many of the changes set in motion are unavoidable, caused by greenhouse gases already emitted (Solomon et al. 2009), though they may be temporarily obscured by the Northwest's highly variable climate (Hawkins and Sutton 2009; Deser et al. 2012). What risks will a changing climate bring for the region as a whole and for specific sectors and locations? What strategies are emerging for evaluating and altering management of regional water and energy supplies, infrastructure, transportation, health, and ecological and agricultural systems to address these risks? To what extent is the region preparing?

Much of our works has been to begin to synthesize currently available information to provide answers to these questions. It focuses on impacts that matter for the region as a whole, chosen with an eye toward the likely major drivers of regional change and consequences of highest regional and local importance. Our work will provide an assessment of existing knowledge that builds on and augments previous assessments (e.g., Climate Impacts Group 2009, Oregon Climate Change Research Institute 2010) and draws on a wealth of resources from local government and state agency reports to academic peer-reviewed journal articles. It is intended to be a resource for preparing the Northwest for climate change.

## Key Items of Evaluation

While we can do our best to discern the most likely consequences of climate change for NW ecosystems and communities, the ultimate consequences of the changes now in motion remain partially contingent on future societal actions and choices. Whether the consequences of the climate impacts outlined in this report are severe or mild depends in part on the degree to which regional social, economic, and infrastructural systems are adjusted to align with the changing climate, and the degree to which natural systems are provided with the room, flexibility, and capacity to respond. The regional consequences of climate change will also be strongly shaped by past choices--of what to build where, what to grow where--and by the laws, institutions, and procedures that shape how natural resources are managed and allocated, risks from natural hazards are identified, and trade-offs among conflicting objectives resolved.