V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			10%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
112	Watershed Protection and Management			10%	
121	Management of Range Resources			10%	
135	Aquatic and Terrestrial Wildlife			10%	
212	Pathogens and Nematodes Affecting Plants			10%	
311	Animal Diseases			10%	
601	Economics of Agricultural Production and Farm Management			10%	
605	Natural Resource and Environmental Economics			10%	
723	Hazards to Human Health and Safety			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	18.0	0.0
Actual Paid Professional	0.0	0.0	13.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	355916	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2480024	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	9544970	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The project investigators have identified that a critical area in the study of conservation biology and restoration ecology is the dynamics of populations and natural resources in decline. The risk of extinction increases when population sizes are small, in part because changes in abundance or distribution become less predictable. Ecological processes may become highly variable and unstable when they approach low levels. The composition of communities may shift dramatically and interactions between species change at low abundances. The goal of this program is to inform the public and policy makers about changes in ecosystem function and processes that result from natural resources use and to identify ways to minimize negative consequences and develop knowledge and technologies that enable ecosystem restoration. This entails robust analyses of data deriving from research of these investigators and that available from work within the broader scientific community. The proposed program encompasses diverse scientific expertise of faculty whose training and specialization ranges from ecological modeling to population and community ecology. The project team has identified seven specific focal areas for study that will illuminate processes and consequences related to resources in decline. 1. Develop ecological community models that predict community response to perturbations and disease pathogens; 2. Investigate the function of stream ecosystems and assess the response of these ecosystems to restoration practices; 3. Examine the effects of habitat fragmentation on small populations of amphibians and salmonids and develop watershed restoration planning and prioritization methods; 4. Investigate factors and mechanisms that cause differences between hatchery and wild fish; 5. Evaluate influences of habitat change on populations and communities of vertebrates; 6. Develop and assess techniques and strategies for wetland restoration and management; and 7. Investigate fish life history and evaluate the

impacts of
management strategies and fish restoration efforts on population trends. Over time, the data and information generated as
part of this Program will contribute to ecosystem restoration policy decisions and to the continued development of the

theoretical understanding of processes affecting aquatic and terrestrial organisms and ecosystem function

The collaborative project is enabling us to identify agricultural sectors that are at risk to climate-driven changes, to explore potential adaptation technologies and training opportunities, and to design efficient policy and management strategies to deal with the adverse impacts of these changes. These pieces of the research and outreach agendas are critical needs as Oregon moves forward with a goal to sustain our physical, natural and human capital investments and to supports our country's food and fiber needs.

We will enhance existing agricultural response models, life cycle models and economic/policy models, then couple them (formally and informally) to better understand interactions and feedback among climate, crop and land use changes, ecological and environmental changes, and prices and policy factors.

2. Brief description of the target audience

The project approach creates understanding of habitat, population and community ecology for ecological modeling of systems. The seven elements of the project include studies that focus on the development of models of community-level responses to perturbations, population dynamics and habitat management for 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 elements include field studies in Oregon and beyond, and controlled laboratory experiments and database/model development. Over the mid- to long-term, the data and information generated as part of this Program will contribute to ecosystem restoration policy decisions and to the continued development of the theoretical understanding of processes affecting aquatic and terrestrial organisms and ecosystem function.

The stakeholder involvement will be in the form of active participation in the enhanced AgTools^{TM} software to explore the economic potential for both mitigation and adaption strategies, using the existing advisory committees for the CAS and the departments to explore climate change related issues. As mentioned before, the policy and economic dimensions of climate change will be the topic of a forum sponsored by the Center for Agricultural and Environmental Policy (CAEP). The information and materials from this project will also be featured on a project "climate-driven changes in Oregon agriculture" website that is linked from the CAS home page and incorporates other climate science undertaken at OSU by the OCCRI. (http://oregonstate.edu/research/oregon-climate-change-research-institute-occri-0). Production system teams will provide information from the economic studies to their stakeholders at field days and through their online resource systems. Team 1 members plan to provide presentations to local production communities when opportunities arise. This process and format will be studies for its impacts and adopted by the other pilot teams with appropriate modifications. Our intent will be to have biannual forums.

3. How was eXtension used?

eXtension will be used to disseminate modeling results and findings to producers, decisionmakers and NGOs and as part of the educational role of faculty and extension personnel.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	110	500	0	0

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
Actual	4	50	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- 1. EFFECTS ON AND PROTECTION OF ENVIRONMENTAL HEALTH AND ECOLOGY 1...natural history, e.g., fish life history variation, seasonal distributions of endangered great whales; 2... insect biodiversity, conservation and dynamics; 3...riparian systems and relationships; 4 ... soils factors, fluxes, respiration, landscape evolution, and microbial
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- 2. PROVIDE ADDITIONAL UNDERSTANDING FOR PLANT AND ANIMAL PROTECTION FROM DISEASES AND PESTS 1 - biology and control of diseases in plants, e.g., fire blight and blackberry rust, such as genetic mechanisms, disease spread, and effects of landscape variables; 2 - characterization and control of diseases in animals, including fish, mammals and invertebrates; control of invasive pests): 3 - determining appropriate variables and models, including those that increase our knowledge about impacts of and adaptations to climate change.
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- 3. STUDIES TO DECIPHER GENOMES, GENETICS AND MECHANISMS OF PLANTS AND ANIMALS 1 - determine life history strategies through emerging statistical and molecular genetic techniques, including those of marine and estuarine species, such as salmon, groundfish, and oysters; 2 - develop selective breeding programs, repositories, and resource center for various species; 3 - identify aspects of human biology and biotechnology of viruses and bacteria that affect human health
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- 4. PROVIDE TECHNICAL, ECONOMIC AND MARKETING MODELS AND ANALYSES THAT INFORM DECISION-MAKERS, INDUSTRY, AND PEERS 1 - develop models, market mechanisms, and policies for water resources, e.g., agricultural and non-agricultural uses, riparian zones; 2 - develop models to characterize and make predictions about habitat and their adaptations to climate change; 3 - develop models for stock assessment and management
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- 5. DEVELOP EDUCATIONAL STRATEGIES AND DISTANCE EDUCATION OUTLETS TO FURTHER REACH CLIENTELE. - adults and youth will have increased awareness and knowledge of ecosystem processes and functions and how they may adapt to climate change as well as methods for restoring degraded habitats
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- 6. OTHER SCHOLARLY EXCELLENCE: participation on professional society panels and boards, as well as science panels, and receipt of awards or recognition
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- K-1. To assess the aggregate and distributional tradeoffs and consequences of policies, programs, and investments to enhance the adaptive capacity of our managed agroecosystems and thus reduce the downside of exposure and vulnerability to climate change and climate variability, to environmental change, and to changes in economic and policy-based incentives. This includes advancing fundamental knowledge about the flexibility and resilience of agricultural (managed) ecosystems to increased variability in climate -LCA and to better understand and expand technologies, innovation and systems that can adapt to increases in uncertainty in environmental conditions and increases in climate variability, regionally and within Oregon

Year	Actual

2013	0

Output #8

Output Measure

- K-2 To assess the technical and economic potential to engage in mitigation strategies for Oregon agricultural and managed resource sectors while quantifying the costs of alternative mitigation efforts for the agricultural and managed resource sectors in Oregon and the Pacific Northwest (PNW).

Year	Actual
2013	0

Output #9

Output Measure

- K-3 To provide educational opportunities for undergraduate students, graduate students, and stakeholders in the areas of climate change, risk, agroecosystem technologies, and interdisciplinary policy analysis. We will also enhance partnerships with industry and stakeholders for innovative and more resilient technologies, practices, policies and management strategies.

Year	Actual
2013	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	1. New or better analytical tools, practices, and models for irrigation and water management, soil management, food production, natural resources management, and land-use decisions
2	2. Impacts of land use change on water quality, species and ecosystems
3	3. 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
4	4. Species, habitat and ecosystem responses to changes in environment as well as resource management strategies to mitigate
5	5. Genetic responses to climate and other environmental factors
6	6. Understand environmental and ecological factors affecting pathogenesis and spread of pathogens and pests
7	7. Understand use of water and production lands
8	8. Improved technologies and practices for control of pests and pathogens in crop and animal production
9	9. New approaches for combating diseases to provide improved health and safety
10	10. Improved strategies are used to manage natural resources
11	11. Understand changes in environments for food systems, e.g., managing plant disease, stable marine food webs
12	12. Understand changes in societal views with regard to the value of habitats and conservation and how to manage them
13	13. Understand changes in ecosystems from carbon management strategies, soil microbial health, natural resource or ecosystem policies
14	A1. New genotypes developed and planted that show enhanced adaptive capacity to climate change
15	14. Show that international trade will be an important vehicle by which adaptations can be made to global climate change * key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade. * Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large
16	A2. Conservation strategies adopted, for example: o 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. o 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 o 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. o 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.
17	15 - Understand how climate change will be related to changes in comparative advantage in international crop production, and in turn the pattern and volume of trade.
18	16-New or improved models and understanding about water resources related to organisms, soils, or management systems
19	K-1: Develop an applied policy framework to quantify the direct and indirect impacts of alternative policy options and mandates for a sustainable biofuel system and explicitly address the economic and environmental tradeoffs at multiple scales. This will include a science-based methodology for assessing the tradeoffs (production levels, economic, environmental, social) associated with alternative management practices and technologies and a regional Computable general equilibrium model for assessing the regional impacts of changes in the PNW
20	K-2 Develop a web-based decision support tool (AgToolsTM) for growers to assess alternative management pathways for sustaining agricultural production under a changing climate. The tool will integrate data from ongoing OSU field work in these areas and will establish a structured process to solicit input from growers regarding adaptation choices under alternative price, policy and climate scenarios
21	K-3 Develop an integrated research framework that is linked to carbon supply curves, leveraging the efforts of biological and social research and findings. These findings will be used as a means to gauge grower interest in mitigation policies such as carbon sequestration and carbon trading.
22	K-4 Provide a first level assessment of impacts of changing climate for dryland production systems, rangeland animal production systems, and marine fisheries. The team will identify critical variables that need to be measures, data collection schemes, and a subset of critical analyses that need to be undertaken over the next decade in useful outcomes are to be expected. A second task is, armed with the preliminary findings of the first task, to make some assessment of the priorities for the research efforts with a given subset of activities and sectors. The researchers in the first six months will determine a scheme for prioritizing efforts and determining reasonable scopes/scales of the efforts. The decision-criteria for selection of projects will be transparent and modified as new information, collaborators (personnel) and data are developed
23	K-5 Consequential life cycle models will be explored to understand indirect effects such as land use change and market fluctuations on agricultural production in specific areas. Realistic economic data on land use changes at the strata scale will be generated by the TOA component and at the regional scale by the CGE model (see related outcomes). Technology adoption will be generated using TOA-MD models. Results from the attributional LCA will also be used as an input to the consequential LCA. In summary, the results from the LCA will be useful to assess policy option impacts on environmental concerns such as reductions in GHG emissions . Attributional LCA results will be useful in quantifying the environmental impacts of alternative technologies adopted at the farm scale.
24	K-6 Develop and promote undergraduate classes on climate change impacts to Oregon Agriculture, both on-line and on-campus offerings. Develop an interdisciplinary graduate seminar on impact assessment methods and biological and crop science information that pertains to climate change. Workshops and educational/training forums will be co-sponsored

by appropriate federal and state agencies using AgToolsTM and other software programs. Workshops will include participation from non-OSU researchers with appropriate expertise.

Outcome #1

1. Outcome Measures

1. New or better analytical tools, practices, and models for irrigation and water management, soil management, food production, natural resources management, and land-use decisions

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

2. Impacts of land use change on water quality, species and ecosystems

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The state, region, nation, and world face enormous challenges in conserving intact and functioning resources and in restoring species and resources that are declining because of habitat loss and change. The desire of Oregonians to restore altered resources and systems requires information at many spatial and social scales. Conservation and restoration actions must be designed at scales ranging from local habitats to stream reaches, stands, watersheds, ecoregions, the state of Oregon, and the Pacific Northwest. Any restoration attempt must determine the degree to which human intervention is needed to accomplish the desired future conditions and explicitly identify the risks associated with either active or passive restoration. All management actions must decide whether it would be most effective to restore processes, physical structure, populations, or community structure. Local resource managers are expected to understand the status of the state's resources, identify trends in their abundance, and then manage those resources appropriately.

What has been done

The fish and habitat information expands the technical basis for conservation and restoration opportunities in the Willamette River and eastern Oregon, as well as establishes ecological priorities for guiding river management. Overall, researchers aim to restore the natural function of waterways, which addresses several goals of the state, including the improvement of water quality based on temperature, and the levels of nutrients and toxins. Prior to this study, no monitoring system of fish communities in the Willamette tied to conservation planning had been completed before. Thermal work established that there is a temperature threshold above which steelhead performance declines rapidly and in a nonlinear manner, a temperature above which populations are likely at risk.

Results
OSU researchers developed ways to measure the population of fish communities and habitat quality in the upper Willamette River to its mouth, finding that the mainstem of the waterway supports 24 native fish species and 17 non-native species; more than 90 percent of the fish found the river were native. Another project studied how animal populations and communities are influenced by rapid changes to their habitats, such as fragmentation through agricultural practices, burning and/or climate change. Researchers seek answers to the extent and length of disruptions to bird and mammal habitats, including how fast birds and other wildlife return to affected areas and if so, how long do these animals stay, and what is the food chain like OSU investigators also studied four forest fire test cases, the longest being nearly 30 years after the burning event. Researchers counted birds and nests to measure reproductive success, trapped small mammals to estimate populations, among other field work. In addition, the effect of livestock grazing practices on the habitat of grassland animals and their ecological functions was studied. OSU researchers continue to study the value of remnant wetlands in the Willamette Valley and the biological function they serve to insects and birds. Researchers intend to establish which freshwater species are declining, threatened and/or endangered. For example, investigators are measuring the thermal habitat quality of eastern Oregon streams and how this relates to the health and survival of native fish. OSU researchers developed a quick, non-lethal, and accurate experiment to measure thermal quality of streams based on the level of heat shock proteins, which are indicators of thermal stress in a fish's body.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

3. 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

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

4. Species, habitat and ecosystem responses to changes in environment as well as resource management strategies to mitigate

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

5. Genetic responses to climate and other environmental factors

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

6. Understand environmental and ecological factors affecting pathogenesis and spread of pathogens and pests

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

7. Understand use of water and production lands

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

8. Improved technologies and practices for control of pests and pathogens in crop and animal production

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

9. New approaches for combating diseases to provide improved health and safety

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

10. Improved strategies are used to manage natural resources

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Work on forest fragmentation effects on small vertebrates and birds in Panama have prompted parallel collaborative projects across tropical forests of the world; a "Tropical Forests in a Changing World" NSF Research Coordination Network has brought together ornithologists together to evaluate ways forward in Latin America, Southeast Asia, and tropical Australia. Other team research indicated that while agricultural wetlands may not contribute as much to regional invertebrate biodiversity, are important as producers of food for species that feed on aquatic insects. Research on grasslands concluded that grassland preferring species appear soon after a fire but disappear within 10 years as shrubs return to the landscape; some forest bird species will not or cannot commute across open habitats between fragments of forest; and that habitat isolation can contribute to loss of species diversity for decades afterward. OCAMP and Oregon STEM activities have reached dozens of teachers and their students, as well as bringing $1.3 million (over 5 years) in educational funds and science programs to two economically and socially challenged areas of Oregon.

What has been done
Another project studied how animal populations and communities are influenced by rapid changes to their habitats, such as fragmentation through agricultural practices, burning and/or

climate change. Researchers seek answers to the extent and length of disruptions to bird and mammal habitats, including how fast birds and other wildlife return to affected areas and if so, how long do these animals stay, and what is the food chain like OSU investigators also studied four forest fire test cases, the longest being nearly 30 years after the burning event. Researchers counted birds and nests to measure reproductive success, trapped small mammals to estimate populations, among other field work. In addition, the effect of livestock grazing practices on the habitat of grassland animals and their ecological functions was studied. OSU researchers continue to study the value of remnant wetlands in the Willamette Valley and the biological function they serve to insects and birds. Researchers intend to establish which freshwater species are declining, threatened and/or endangered.

Results
Our research findings and many others were distributed via a public website, extension bulletins and agency reports. Our work and outreach has affected policy indirectly through scientific publications that have been used in species recovery plans and fishery management plans, and through direct interactions with management agencies and councils. Our Oregon Hatchery Research Center colleagues have been a major partner in two large educational projects, the Oregon Coast Aquatic Marine Project (OCAMP) and the Oregon Coast STEM Center (Oregon STEM).

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
605	Natural Resource and Environmental Economics

Outcome #11

1. Outcome Measures

11. Understand changes in environments for food systems, e.g., managing plant disease, stable marine food webs

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The project investigators have identified that a critical area in the study of conservation biology and restoration ecology is the dynamics of populations and natural resources in decline. The risk of extinction increases when population sizes are small, in part because changes in abundance or distribution become less predictable. Ecological processes may become highly variable and unstable when they approach low levels. The composition of communities may shift dramatically and interactions between species change at low abundances. The goal of this program is to inform the public and policy makers about changes in ecosystem function and processes that result from natural resources use and to identify ways to minimize negative consequences and develop knowledge and technologies that enable ecosystem restoration.

What has been done

Results
Our Nassau grouper work discovered that the entire adult population of Little Cayman Nassau grouper can be found in one small discrete location, making them extremely vulnerable to overfishing. Results of this work led to the management agency recommending to the Cayman Islands Parliament the expansion of protections to include both seasonal and spatial closures of the fishery to protect spawning adults (pending rule of law).

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
135	Aquatic and Terrestrial Wildlife
212	Pathogens and Nematodes Affecting Plants
311	Animal Diseases
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

Outcome #12

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #13

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #14

1. **Outcome Measures**

A1. New genotypes developed and planted that show enhanced adaptive capacity to climate change

Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

14. Show that international trade will be an important vehicle by which adaptations can be made to global climate change * key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade. * 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 #16

1. **Outcome Measures**

A2. Conservation strategies adopted, for example: o 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. o 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 o 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. o 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.

Not Reporting on this Outcome Measure

Outcome #17

1. **Outcome Measures**

15 - Understand how climate change will be related to changes in comparative advantage in international crop production, and in turn the pattern and volume of trade.

Not Reporting on this Outcome Measure

Outcome #18

1. **Outcome Measures**

16-New or improved models and understanding about water resources related to organisms, soils, or management systems

Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

K-1: Develop an applied policy framework to quantify the direct and indirect impacts of alternative policy options and mandates for a sustainable biofuel system and explicitly address the economic and environmental tradeoffs at multiple scales. This will include a science-based methodology for assessing the tradeoffs (production levels, economic, environmental, social) associated with alternative management practices and technologies and a regional Computable general equilibrium model for assessing the regional impacts of changes in the PNW

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This new climate change collaborative research provides a unique opportunity to link the economic and feasibility components to both the attributional LCA, which addresses farm scale impacts, and the consequential LCA which represents a more aggregated (regional) scale.

What has been done
Work has begun that represents a systematic assessment of both the economic and environmental implications of policy options for achieving sustainable regional biofuels production and commercialization that meet the expressed demand for aviation fuel. Unique to this project is the integrated research framework which encompasses three components: engineering/environmental aspects of Life-Cycle Analysis, environmental/economic aspects of multi-dimensional Tradeoff Analysis, and the economic/market aspects of Computable General Equilibrium analysis.

Results
Team members have developed LCA models, including attributional and consequential LCA frameworks (aLCA and cLCA). These models have been applied them to several projects involving climate change technologies including the production of ethanol from napier grass. In a recent paper, the team demonstrated that water and energy use, both of which are impacted by climate change and changes in environmental and economic conditions, in cellulosic ethanol plants is dependent on technologies used for conversion of feedstock.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

Outcome #20

1. Outcome Measures

K-2 Develop a web-based decision support tool (AgToolsTM) for growers to assess alternative management pathways for sustaining agricultural production under a changing climate. The tool will integrate data from ongoing OSU field work in these areas and will establish a structured process to solicit input from growers regarding adaptation choices under alternative price, policy and climate scenarios

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order for producers to respond to a changing climate, decision tools need to be developed that can compare adaptation strategies against current agricultural production systems to better identify and understand constraints, opportunities and trade-offs associated with production management, policy frameworks and pricing mechanisms.

What has been done
Team members are working with graduate students who are developing enterprise budgets and software (AgToolsTM) for alternative agricultural crops and systems in the grains in the PNW. These budgets and software tools will be modified to reflect the systems and areas of interest in this more inclusive climate change project. The enterprise budget analysis is described at the AgToolsTM website (https://www.agtools.org/).

Results
AgToolsTM will be part of the suite of frameworks we are adopting to quantify economic impacts and identify technology innovations in Oregon and the PNW. AgToolsTM is a body of information designed to help agricultural producers make short, medium and long-run capital investment and management decisions. The program consists of a suite of software: AgProfitTM, AgLeaseTM, and AgFinanceTM ; budget files containing return and cost information for crops and livestock; and educational programs such as AgToolsTM Academy, and online grower training courses with video instruction modules.

AgProfitTM helps producers make short, medium, and long-term capital investment decisions, such as assessing profitable crop and livestock systems, conservation practices, and/or implementing technologies. AgLeaseTM helps growers and landowners establish equitable short and long run crop share and cash rent payment leases based on their contributions to the lease. AgFinanceTM is designed to assist agricultural producers make long run decisions on a whole farm and ranch basis centered on financial ratios and performance measures.

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
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

Outcome #21

1. Outcome Measures

K-3 Develop an integrated research framework that is linked to carbon supply curves, leveraging the efforts of biological and social research and findings. These findings will be used as a means to gauge grower interest in mitigation policies such as carbon sequestration and carbon trading.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Climate change is linked to carbon emissions. Some agricultural tillage, cropping, and grazing practices can reduce carbon emissions but these practices must be incentivized by developing carbon supply curves that determine price signals that will engage producers in mitigation practices.

What has been done
The efforts for this objective are in the form of a pilot project the team is evaluating the extent that mitigation policy and carbon sequestration are part of the current policy options in Oregon. Team members have numerous papers on estimating carbon supply curves for dryland wheat agriculture and this research can serve as the foundation for additional methods and applications in Oregon. Other supporting data and ongoing field trails by researchers at the OSU Ag research stations will be used in the pilot analysis. The results may help to fine-tune further field work and data development and visualization.

Results
An assessment of the technical potential to engage in GHG mitigation strategies will require a full LCA of carbon use and emissions in agricultural industries for both baseline practices and for proposed new technologies and management practices. The LCA project has been initiated as part of another outcome for this project.

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
723	Hazards to Human Health and Safety

Outcome #22

1. Outcome Measures

K-4 Provide a first level assessment of impacts of changing climate for dryland production systems, rangeland animal production systems, and marine fisheries. The team will identify critical variables that need to be measures, data collection schemes, and a subset of critical analyses that need to be undertaken over the next decade in useful outcomes are to be expected. A second task is, armed with the preliminary findings of the first task, to make some assessment of the priorities for the research efforts with a given subset of activities and sectors. The researchers in the first six months will determine a scheme for prioritizing efforts and determining reasonable scopes/scales of the efforts. The decision-criteria for selection of projects will be transparent and modified as new information, collaborators (personnel) and data are developed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The need to begin to establish baseline data for each production system is necessary to develop the fundamental relationships and connections to changes in climate and the technical potential of each system to to adapt to a changing climate.

What has been done
Researchers have initiated a process for prioritizing efforts and determining reasonable scopes/scales for each effort.

Results
There are no results to report at this time. This project was only recently approved.

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
135	Aquatic and Terrestrial Wildlife
311	Animal Diseases
723	Hazards to Human Health and Safety

Outcome #23

1. Outcome Measures

K-5 Consequential life cycle models will be explored to understand indirect effects such as land use change and market fluctuations on agricultural production in specific areas. Realistic economic data on land use changes at the strata scale will be generated by the TOA component and at the regional scale by the CGE model (see related outcomes). Technology adoption will be generated using TOA-MD models. Results from the attributional LCA will also be used as an input to the consequential LCA. In summary, the results from the LCA will be useful to assess policy option impacts on environmental concerns such as reductions in GHG emissions . Attributional LCA results will be useful in quantifying the environmental impacts of alternative technologies adopted at the farm scale.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Attributional LCAs (aCLA?s) are appropriate for estimating environmental impacts that are directly attributable to activities at the farm and firm level and comparing environmental performances among individual farms and firms. Despite their suitability to compare environmental impacts at individual farm and firm level, aLCA?s are unsuitable for understanding the indirect effects of large scale production changes caused interaction effects, climate and policy initiatives. Consequential LCAs (cLCA) are designed to account for these interactions and thus are suitable to investigate the environmental impacts of different policy choices, technology adoption behaviors of farmers and interaction effects.

What has been done
A key challenge in implementing this approach is characterizing the degree of heterogeneity that may be observed as a result of this new system, defined as the spatial variability in expected returns from the system. In addition to economic outcomes, the TOA-MD model can incorporate quantifiable environmental or social outcomes. In this project, farm-level outcomes estimated by the LCA will be used to estimate environmental parameters of outcome distributions. Outcome selections can be modified to meet specific project and stakeholder needs.

Results
Team members have been adapting findings from an existing NIFA funded project. The project includes the input of producers, bioenergy researchers, and bioenergy commercialization groups for key calibration information for technical and policy analysis. The outputs of this project include: (a) a set of enterprise budgets and processing costs that reflect the production of camelina under alternative scenarios and management schemes and are responsive to policy-induced prices changes for energy and commodities; (b) an integration framework that employs the economic and environmental models, and (c) a suite of empirical results that capture the sensitivity of the economic and environmental outcomes for this regional biofuels system to changes in prices for energy inputs, to the presence of an aviation biofuels mandate(s), and to changes in related federal, state and local policies. This approach serves as a template for conducting the LCA on production systems other than bioenergy crops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #24

1. Outcome Measures

K-6 Develop and promote undergraduate classes on climate change impacts to Oregon Agriculture, both on-line and on-campus offerings. Develop an interdisciplinary graduate seminar on impact assessment methods and biological and crop science information that pertains to climate change. Workshops and educational/training forums will be co-sponsored by appropriate federal and state agencies using AgToolsTM and other software programs. Workshops will include participation from non-OSU researchers with appropriate expertise.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research on climate change impacts to agricultural operations need to be shared with undergraduate and graduate students, stakeholders, and appropriate federal agencies. Workshops and other venues will be used to provide information to producers, decision makers, and other stakeholders.

What has been done
Three new classes have been developed and additional classes are in the pipeline for the next fiscal year.

Results
Each new class was taught as a 1hr credit class to adjust the curriculum to student interest and participation. All three classes will be taught as three hour classes next academic year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
135	Aquatic and Terrestrial Wildlife
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

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 condit)

Brief Explanation

Changes in environmental conditions, in climate variability, and in economic and policy factors over the next number of decades will affect agricultural production patterns, management/technology alternatives, and spatial and locational choices as well as impact the current levels of use of many key resources including water and land. In 2010, the U.S. government announced many major new research initiatives to deal with these factors including one on climate change impact and adaptation, in part under the U.S. Department of Agriculture's newly reorganized research agency, the National Institute for Food and Agriculture, as well as other federal agencies (see also National Research Council 2010). Thus it is an opportune time to research and assess agriculture's ability to adapt to possible types of climate and environmental/economic changes and the policy implications, and to consider how to improve our research capabilities to understand and address the impacts of changing environmental and economic landscapes. These are critical needs as we move forward with a research agenda that focuses on the sustaining our physical, natural and human capital investments and at the same time supports our food and fiber needs.

The climate change outcomes from the National Institute for Food and Agriculture (NIFA) planned program guidelines provided by U.S. Department of Agriculture (USDA) include the following:

- Enhance the adaptive capacity of production and natural systems to reduce exposure and vulnerability to climate change and variability
- Improve mitigation strategies for reduction of greenhouse gas (GHG) emissions, including carbon sequestration practices
- Development of new knowledge and technologies and transfer of this knowledge to clientele and stakeholders

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Significant progress has been made linking LCA and economic models to better understand the impacts of climate change on production agriculture. Work is continuing to develop stakeholder input that can be incorporated in enterprise budgets to guage grower responses to new cropping, tillage, and grazing responses to climate change. Previous work conducted by OSU researchers is complementing this effort.

Key Items of Evaluation

Co-PI's Antle, Capalbo and Reimer are currently involved in a Regional Approaches to Climate Change in the PNW (REACCH, a five year NIFA-CAP project) which also uses the Tradeoff Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD). TOA-MD is designed to simulate the impacts (economic, environmental or social) of farms adopting a new production technology (Antle 2011; Antle and Valdivia 2006). This approach has been adopted by many researchers and institutions around the world (including projects at international agricultural research centers) on projects dealing with new technology assessment, and environmental and resource changes.. This collaborative project builds on the ongoing work to model wheat-based systems in the PNW region as part of the project the Regional Approaches to Climate Change in the PNW project. Antle and Capalbo are also engaged in numerous projects dealing with impact assessment of agricultural systems, and with the National Climate Assessment as lead authors for regional chapters.