

# 2016 Oregon State University Combined Research and Extension Plan of Work

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## I. Plan Overview

### 1. Brief Summary about Plan Of Work

The Oregon Agricultural Experiment Station (OAES) and the OSU Extension Service (OSUES) at Oregon State University provide the people of Oregon with research-based knowledge and education that focus on strengthening communities and economies, sustaining natural resources, and promoting healthy families and individuals. OAES is Oregon's principal source of knowledge relating to agricultural and food systems, and a major source of knowledge regarding environmental quality, natural resources, life sciences, and rural economies and communities worldwide. The mission of OSUES is to have positive impacts on community livability, economic vitality, natural resources sustainability, and the health and well-being of people. Projects conducted by OAES and OSUES cross disciplinary lines to more fully address critical issues at the local, regional and national level.

The College of Agricultural Sciences reflects these values:

- Value 1: Responsiveness - We react in a timely fashion to the needs of those we serve;
- Value 2: Partnership and cooperation - We collaborate with individuals, organizations, businesses, and agencies outside the University;
- Value 3: Teamwork and coordination - We synchronize our efforts among our units and with other units at the University;
- Value 4: Credibility - We focus on being known as a source of reliable, objective, research-based information and education.

The core values and operating principles of OSUES are:

- Value 1: Community-based - We value community relationships and connect OSU to local people and issues to enhance the present and the future of the people and communities of Oregon.
- Value 2: Accountability - We focus on achieving measurable outcomes, and document and communicate the impact and value of our work.
- Value 3: Credibility - We deliver relevant, research-based knowledge through our educational programs.
- Value 4: Diversity - We exhibit respect, value differing perceptions and world views, and encourage diversity.
- Value 5: Partnerships - We collaborate with academic, public, and private partners to achieve greater results and build community capacity. We value the public good that comes from collaborating with volunteers.
- Value 6: Responsiveness - We engage with community partners to identify priority issues and needs, to design timely responses, and to build future capability.

To carry out its mission in a manner consistent with University goals, OAES uses its resources to advance knowledge in the following areas of emphases:

- New value-added products and markets that leverage the economic contributions of Oregon agriculture.
- Natural resources management and policy through discovery and learning to improve understanding of nature as a system.
- Integrated management systems that help assure economically sustainable, environmentally sound agriculture.

The OSUES goals for advancing the organization's mission to align with the University's strategic plans include:

- Goal 1: Improve access to high-quality learner services - Extension will provide access to the knowledge resources of OSU by being focused and nimble in engaging Oregon's diverse people and communities in high-quality learner services that help build sustainable community futures.
- Goal 2: Invest for excellence and impact - Extension will increase and diversify its funding base and encourage program excellence through strategic investments within three thematic areas: strengthen communities and economies, sustain natural resources, and promote healthy families and individuals. This will create measurable outcomes and impacts that will be reported widely to stakeholders.
- Goal 3: Increase effectiveness with appropriate technology - Extension will use established and new technologies strategically to increase efficiencies, expand outreach and enhance and report the outcomes of its educational services.

This 2016-2020 Plan of Work (POW) is an update of the 2015-2019 POW and brings together the efforts of OAES and OSUES. It focuses on the five high-priority areas defined by NIFA. The plan reflects our desire to continually improve our process of responding to the needs and issues facing Oregon communities and people. The plan is also consistent with Oregon State University's strategic plan that identifies three areas of excellence ... Healthy People, Healthy Planet, Healthy Economy.

The OSUES on-line planning and reporting system, SOARS (Stories, Outcomes, and Accomplishments Reporting System) was fully implemented at the end of 2007, and allows us to collect specific OSUES data related to FTEs for planned programs, program outputs and outcomes, and publications for 2009 and beyond. As anticipated, SOARS greatly improved our ability to modify and update Oregon's federal plan of work more accurately with each passing year.

OAES continues to provide impact information on the College of Agricultural Sciences (CAS) web page. However, CAS plans to establish a new online reporting system to adhere to the OSU web format. Research results will be shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national, and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and an array of web pages of an array of types.

We have chosen to take a very conservative approach with this plan, not yet knowing where our staffing numbers will stabilize due to budget constraints. We predict modest increases in the percentage of participants who make changes in practices because we do not yet know how many FTE and resources we will be able to commit. We prefer to be realistic and not promise what we cannot deliver. 2013-2017 will give us the performance records needed to more accurately predict future outcomes. Future plans of work will be modified to reflect these data.

All units in the OAES/OSUES conduct performance evaluation of their faculty members. These reviews are conducted based on workplan objectives established during the previous review and in the faculty member's position description. In addition, all faculty members with OAES FTE are required to establish or participate in at least one station project, and they are required to submit both an OAES report and a REEport progress report. Faculty with extension appointments submits a report through the Extension Service's SOARS database. In both systems, faculty is asked to document accomplishments and outcomes. These reports are used in faculty evaluations. The performance evaluations are a good vehicle to assess our progress toward the goals in our plan of work. Beginning next year, OAES and Extension Services will submit project reports and responses to Periodic Review of Faculty (PROF) via an

online database supported by Digital Measures.

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	188.0	0.0	194.0	0.0
2017	188.0	0.0	194.0	0.0
2018	188.0	0.0	194.0	0.0
2019	188.0	0.0	194.0	0.0
2020	188.0	0.0	194.0	0.0

**II. Merit Review Process**

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

- Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

**2. Brief Explanation**

The Oregon Agricultural Experiment Station (OAES) consists of a central administrative and research center plus 11 branch stations, three of which are located at multiple locations; many of the branch stations are integrated research and extension centers. Oregon State University Extension (OSUES) faculty can be found in all 36 Oregon counties plus the Warm Springs Indian Reservation.

Faculty at each of the 15 station units, which have advisory committees and faculty affiliated with them, and OSUES faculty work closely with local stakeholders including farmers and ranchers, foresters, agency personnel, elected leaders, educators, health professionals, environmental organizations, researchers, and a myriad of other public and private entities to establish need and design appropriate programming. In many cases, stakeholders are directly involved in the programming as volunteers or by permitting demonstrations and applied research trials on their properties. Additionally, faculty members utilize critical demographic and economic data, and examine current research findings to identify societal needs and opportunities for significant social, environmental, and economic impacts. Programming is then planned based upon this input within OAES and in each of the four academic colleges/programs with Extension programs (Forestry, Agricultural Sciences, Health and Human Sciences, and Sea Grant). OSUES provides funding to these colleges on the basis of planned outcomes outlined in a biennial plan submitted by each college. All Extension FTE must be accounted for in these plans. The plans are reviewed annually and span a two-year timeframe. Annual

evaluations are conducted by the Director of OSUES to determine how effectively each planned program is addressing key needs and delivering the anticipated outcomes and impacts described in each plan.

OAES projects are reviewed annually on the basis of planned outcomes outlined in a five-year, peer reviewed proposal submitted to OAES and approved by NIFA. Project outcomes are also assessed against the Station's internal Strategic Intents, a strategic directive formulated with input from internal and external stakeholders. Each of the programs in some way supports objectives from one or more of the strategic challenges identified by NIFA, which currently targets Sustainable Energy, Climate Change, Global Food Security/Hunger, Food Safety, and Obesity. Annual evaluations of outputs and outcomes provides input into the modification of plans of work that better target state, regional, and USDA priorities and portfolios.

### **III. Evaluation of Multis & Joint Activities**

#### **1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?**

During the reporting period, OAES and OSUES reassess all programs used to address its internal strategic planning, which was formulated with input from internal and external stakeholders.

OAES faculty at the eleven branch stations (situated in 15 agro-ecozone locations) ensure that local stakeholder input is transmitted to OAES administrators and that feedback is generated. Each station is highly integrated into the surrounding industries, communities and governing bodies, as well as land management bodies. Representative stakeholders generally hold positions on the station advisory bodies and directly provide guidance on programming and issues and needs. Many of our stations are not only research locations but are integrated research and extension centers.

OSUES faculty work closely with local stakeholders, including farmers and ranchers, foresters, agency personnel, elected leaders, educators health professionals, environmental organizations, and a myriad of other public and private entities to establish need and design appropriate programming. In many cases, stakeholders are directly involved in the programming as volunteers or by permitting demonstrations and applied research trials on their properties. Additionally, faculty members utilize critical demographic and economic data, and examine current research findings to identify societal needs and opportunities for significant social, environmental and economic impacts. Programming is then planned based upon this input with each of the four academic colleges with Extension programs (Forestry, Agricultural Sciences, Public Health and Human Sciences, and Sea Grant). OSUES provides funding to these colleges on the basis of planned outcomes outlined in a biennial plan submitted by each college. All Extension FTE must be accounted for in these plans. The plans are reviewed annually and span a two-year timeframe. Annual evaluations are conducted by the OSUES Director to determine how effectively each planned program is addressing key needs and delivering the anticipated outcomes and impacts described in each plan.

The resulting programs in some way support objectives from one or more of the five strategic challenges identified by the National Institute for Food and Agriculture (NIFA) of the U.S. Department of Agriculture (USDA). The OAES programs were reviewed and edited to now also address the five new themes identified by NIFA, i.e., Bioenergy, Climate Change, Global Food Security/Hunger, Food Safety, and Obesity. Annual evaluations of outputs and outcomes provide input into the development of new or revised plans of work that better target state, regional, and USDA priorities and portfolios.

## **2. How will the planned programs address the needs of under-served and under-represented populations of the State(s)?**

Our ecozone-based Branch Stations and county-based Extension offices are the front line connection to the myriad sectors in the state. Their visible presence and customer service orientation puts them in direct contact with our stakeholders. They are also able to assess emerging issues and needs as well as new or underserved and under-represented populations. They are often the first to note new stakeholders or emerging groups within the general populations. They are not shy about informing the administrative branch about special needs or under-served populations.

A more formal method of delivering observations and information into the planning process for the Station are the annual development of unit and individual plans of work. Administrative review of these workplans allows more systematic compilation and assessment of these observations.

Partnerships are an effective means for greater "reach" for OAES and OSUES programs. We work (and look for opportunities to expand our relationships) with non-governmental organizations, businesses, and local, state, and federal agencies. Joint programming through cooperative agreements with these entities can be especially effective.

Under-served and under-represented audiences are identified through demographic analyses and through interaction with appropriate stakeholders including minority serving organizations. Extension faculty and program assistants are recruited with language skills and cultural knowledge to enable effective programming for specific target audiences. This includes active recruitment of faculty and paraprofessionals from within minority populations. These individuals have been extremely successful in delivering programming in ways that are compatible with the customs and cultures of these audiences. Specifically, programs described in this plan of work will be developed to reach Native American, Latino, African American, Russian, and Hmong audiences. Additionally, programs are planned to reach developmentally and physically challenged individuals and high risk populations such as inmates and persons on probation. Finally, significant resources are applied supporting programming designed to assist older adults and/or those with limited resources.

Our research projects often directly address the needs of rural, under-served, and under-represented populations in the state and the region, such as nutrition and lifestyle choices, evaluating nutrient elements in food. The results of these projects inform our programs, our strategic and implementation plans, and our agency and industry partners.

The important issues and topics of today are typically complex and multi-faceted. Addressing them often requires intellectual resources from multiple disciplines and multiple perspectives. OAES and OSUES place high priority on building connections among its component units and with other units within and outside the University where appropriate to advance education or research goals.

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

OAES faculty are expected to report annually on their accomplishments and programmatic outcomes. Their reports are edited and posted on Oregon Invests!, a searchable, web-based database which is accessible to the public. This online database was designed to be an outcome based system, providing information on economic, environmental, and societal benefits. Follow-on interviews are often conducted with the faculty member to elicit additional information to clarify points. Outcomes can be sorted by outcome type, topic, location, work unit or discipline. Reports are forwarded to the Station's communication unit to be used in the semi-annual Station magazine, "Oregon Agricultural Progress," as the basis for press releases about the work, as the basis for the Oregon State University research magazine ("Terra"), departmental reports, and as input into a Provost's Annual Report. These

reports can also be used by the departments as part of the faculty performance review. In addition to Oregon Invests!, faculty also annually report their accomplishments in CRIS, and NIMSS if appropriate. Further, faculty with any Extension appointment also report their accomplishments and impacts to OSUES through the on-line SOARS accountability system. This platform will be replaced by Digital Measures for next year's reporting. Digital Measures accomplishes much the same thing as SOARS but provides a better user interface and a searchable database that can provide customized reports in real time. Much of the information contained in SOARS will be migrated to the new database and beginning in 2015, OAES faculty with dual appointments will begin using Digital Measures as their primary reporting portal.

SOARS was developed in 2007 to aid in documentation of outcomes and impacts of programming. Now in its sixth full year of operation, SOARS has increased in usability and provides easier connections between the different levels within OSUES (e.g. local programming, campus specialists, Extension program areas, college and Extension administration, and NIFA). This system provides a uniform process based on the Logic Model for all faculty to report the outcomes of their programming, and how the results of local programming are contributing to the long-term outcomes identified by each Extension program area. To facilitate this assessment, individual faculty members conduct on-site evaluations to determine the degree of learning that occurs within programs conducted. Additionally, follow up surveys and site visits are used to document the extent of application of knowledge acquired through Extension programs. Finally, blocks of programming called "program work areas" are evaluated at least once during each 5-year period to assess the long-term social, environmental, and economic benefits of the Extension programming. Funding is allocated to each college with Extension programs and applied to support an in-depth analysis of the impacts of the programs utilizing recognized and appropriate evaluation procedures and tools.

In 2010 OAES had begun a pilot to evaluate the impact of our projects and programs on the state and region (in terms of economic, societal, and behavior change). Eight projects were selected to be included in this pilot study. The pilot study impact results are available on the College of Agricultural Sciences website.

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

The portfolio approach begun in the 2007-2011 OAES Plan of Work encouraged the development of partnerships and collaboration on integrated questions or similar activities within departments. OAES continues to encourage further integration of efforts across colleges, departments, and branch stations, as well as across function. These multi- and interdisciplinary activities should produce more cohesive and reportable impacts into the future as we retool projects. The consolidation has modified the way we develop Station-wide metrics and has streamlined the way we ask our faculty to report. Our impact analysis project will also help us develop better ways to approach the development of programs and to identify appropriate outcome measures to tackle. Currently, OAES has six collaborative projects that address all five NIFA focus areas with two projects addressing food security. Two other collaborative projects are currently undergoing peer review prior to submission to NIFA.

Annual OSUES assessments of program effectiveness through SOARS are used to determine if programs are reaching the desired audiences, the cost of program delivery, the amount of learning taking place, and the degree of application of learning. These data allow OSUES leadership to make tactical decisions about changes in program design or reallocation of resources to more effectively and efficiently reach target audiences leading to desired outcomes and impacts. Additionally, new technologies are incorporated to augment program efficiency and to improve and expand the reach of programming. This includes application of technologies such as digital video devices, delivery of live educational events through video conferencing, active Internet-based teaching, and extensive use of web-based information

delivery. Additionally, OSU actively participates in the development of the eXtension initiative. New and exciting materials are now available through this resource.

#### **IV. Stakeholder Input**

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (cspan)

##### **Brief explanation.**

OAES, through the Colleges of Agricultural Sciences (College), Public Health & Human Sciences (CPHHS) and Veterinary Medicine (CVM), regularly solicits stakeholder input on program direction. Advisory Committees or Commodity Groups, and a statewide citizen advocacy network inform OAES; the latter group represents local constituencies and stakeholders, gathers local impact stories for the statewide programs, and relays critical information back to their peers in both locality and communities of interest. This ongoing network permits fluid, continual information flow back and forth. OAES also hosts a multisectoral stakeholder workshop periodically to gather input. They come from a cross-section of diverse food and natural resources systems across the state. This meeting is used to balance regional perspectives and needs and develop a statewide program. This process also helps our diverse clientele understand the needs of the state in light of their own perspective. Additional input comes from College websites and a general email address, and from the departments and branch stations, as well as posted responses and changes in programs in response to stakeholder input. The deans and directors of the College and OAES informally receive input while attending farm and station field days around the state, visiting county-based Extension offices, and participating in other "road trips" around the state or wherever stakeholders congregate. The College's External Relations Director organizes alumni and stakeholder events, hosts special events at county and State fairs and a variety of conferences, receives and transmits input from stakeholders, and makes sure responses are delivered. CAS has implemented current social media technological methods for gathering input and relaying information such as blogs and MySpace pages.

Input is solicited by OSUES through a statewide advisory network that directly advises the Vice Provost for Outreach and Engagement and Director of Extension. This advisory committee is made up of individuals representing production agriculture and forestry, environmental groups, county government, youth and family-serving organizations, organizations representing coastal issues, and business and industry. The committee meets 1-2 times per year for two days. Additionally, the committee is connected with the Vice Provost's and Director's office via email,

conference calls and webinars throughout the year. In 2009 a similar group was formed to advise Extension leadership on needs and issues primarily related to Oregon's urban populations in the Portland Metro area.

Every county in the state maintains an advisory structure. These include both general broad-based advisory systems and those that are more specific to programming areas. These advisory groups generally meet 4-12 times per year to actively review programming and to provide input to county faculty and Extension leadership. Each academic college with Extension programming maintains advisory structures at the college and departmental level. These inform Extension programming within each of these units.

**2(A). A brief statement of the process that will be used by the recipient institution to identify individuals and groups stakeholders and to collect input from them**

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (blogs, fairs, websites,)

**Brief explanation.**

Many mechanisms are used to identify individuals, groups, and organizations that are stakeholders. Some specific efforts are cited below.

- Internet searches are used to identify organizations with stakes in various programs.
- We confer with partnering organizations to identify and engage appropriate stakeholders.
- We confer with existing advisors about other groups and individuals that should provide input.
- We actively solicit internal input about appropriate stakeholders to add to advisory structures or to survey about need and effectiveness of Station and Extension programming.
- We utilize demographic data to ensure that all segments of society are adequately represented among identified stakeholder groups and especially among those groups providing input to the decision-making processes.

In 2006, Extension added a full-time demographer to the faculty in order to access, interpret, and respond to Oregon's demographics more effectively. In 2007 we collaborated with WSU and their Center for Bridging the Digital Divide in a visioning project that helped define the possibilities for OSU in the year 2017. This project, a series of in-depth interviews with key stakeholders, yielded both formative and summative data for planning purposes. In 2009 and early 2010 a faculty panel for organizational transformation was charged to develop a holistic framework to engage stakeholders in identifying and exploring issues and needs facing Oregon communities and people. From the data collected a menu of opportunities were developed and shaped the Plan of Work for 2012-2016 and also are reflected in the 2013-2017 plan.



**2(B). A brief statement of the process that will be used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them**

**1. Methods for collecting Stakeholder Input**

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey of the general public
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

**Brief explanation.**

We use field days, formal meeting events, commodity groups and other association groups, faculty and staff, legislative aides, websites, blogs, email addresses, relayed messages, surveys, and students to help us identify individuals and groups. Feedback obtained at workshops, seminars, and training events also provides valuable insights for program development and delivery.

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

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities
- Other (Strategic Intent)

**Brief explanation.**

Determining OAES and OSUES strategic direction is an on-going, shared responsibility, especially in entities as diverse as these partners at OSU. The power of our planning derives from the process. As noted above, that process includes our continuing dialog with Oregonians and the inevitable distillation of their needs. It also includes matching of faculty strengths with opportunities for outside funding, consistent with our mission. Much of the critical decision-making is at the unit level. Because responsibility is shared between OAES and OSUES administrations and their units, our strategic planning documents are best seen as a reference for subsequent and

continuing conversations between the administrations and the individual units. Such conversations will be a regular part of how we operate. In addition, budgets reduced by declining state revenues starting in 2002 and exacerbated by the nation's deep recession starting in 2008 only began to slightly recover in the 2015-2016 state fiscal year. Current budgets suggests a very modest increase of 3% above continuing service levels but remain below expected continuing service amounts based on inflation, increasing cost of salary and benefits, and the need to replace aging infrastructure and equipment.

At stakeholder workshops administrators pose questions and listen to what attendees have to say, and then compile these stakeholders' comments, observations, and suggestions. The summaries are posted on the College and OSUES website and points are incorporated into the annual Action Plans.

OAES and OSUES have and continue to solicit and receive thoughtful critiques and sometimes views that differ from its own. Responses are prepared in a timely fashion and posted either to the particular individual or on webpages or in newsletters maintained by the administration or their units.

In 2009, Oregon State University instructed its colleges to develop plans that would implement structural and programmatic change throughout the university to better position it for a future with a predicted small state-supported "footprint." This mandate included restructuring of units, programs, and curricula. Stakeholders, both inside and outside the College and OSUES, contributed ideas and suggestions that were used to shape new plans. Discussions throughout 2014 and 2015 among internal and external stakeholders continue to refine the design. While most of our stakeholders have said they understand the need for us to be creative at addressing our budget challenges, they also hope that we will be creative in meeting their local needs as well.

Beginning in 2013, the College of Agriculture Sciences initiated a Strategic Intent process that focused faculty and leadership attention on student success, international presence, communications, faculty success, research emphases, diversity, equity, and inclusion, outreach and engagement, graduate education, resources/business plan, our role in STEM education and infrastructure/facilities. The strategic intent document is now an important decision aid tool for all the priorities mentioned above and will continue to affect program priorities, staffing, and budget decisions throughout the next decade. The Strategic Intent document is also dynamic and is updated as conditions change.

Stakeholder input is widely used by OAES and OSUES to set priorities at all levels of the organization. This influences budgetary outlays for various programs and subsequently affects program delivery. Stakeholders serve on virtually all faculty search committees and thus directly affect hiring decisions. The process of involving stakeholders in the hiring process works well, with stakeholders feeling a greater commitment to helping new hires be successful in their assignments. Stakeholders who have a vested interest in the program and/or community are the most effective.

**V. Planned Program Table of Content**

S. No.	PROGRAM NAME
1	Sustainable Energy
2	Climate Change
3	Global Food Security and Hunger
4	Food Safety
5	Childhood Obesity

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

### **Program # 1**

#### **1. Name of the Planned Program**

Sustainable Energy

#### **2. Brief summary about Planned Program**

Worldwide energy demand is expected to rise from 404 quads/yr in 2001 to about 640 in 2025, with nearly 86% to be met by oil and other carbonaceous materials, and generating more than 11 billion tons of CO<sub>2</sub>. But with nearly two-thirds of the world's proven oil reserves located beneath Saudi Arabia and its neighbors, the U.S. and other nations must rely increasingly on the politically volatile Middle East for oil. Also, as the economies of China, India, and other populous countries grow, competition for oil will increase, potentially accompanied by rising geopolitical tensions. Clearly, clean, safe, and sustainable sources of energy are needed in order to meet large, projected increases in demand, to provide energy and economic security for the U.S. and other nations, and to relieve environmental stresses related to fossil fuel use, including global climate change. Such sources must be more economical and environmentally sustainable than fossil fuels. Because of its unique wealth of natural resources, Oregon has many opportunities for alternative energy production, including bio-energy crops, utilization of forest slash, wind, solar, and wave energy. Activities in Oregon under this program area will improve the biological production of bioproducts, including biofuels, from sunlight and agricultural, cellulosic or microbial feedstocks. In addition to improved and enhanced bioproduct development, the program will increase knowledge and understanding of the biofuels supply chain and the energy-water nexus. We will conduct field experiments analyzing crop production responses, including methods that help reduce irrigation water demand in various crops were conducted. A major analysis is underway to determine the effects of wind turbines on Irrigated agriculture. A graduate student started in the winter of 2014. Current status is the development of data analysis algorithms. Large Eddy simulations have been performed in conjunction with collaborators at the University of Utah to determine the synergistic effects of wind turbines and field patch size on evaporation. A manuscript in under review of this work.

**3. Program existence :** Mature (More than five years)

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

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

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

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		5%	
111	Conservation and Efficient Use of Water	0%		15%	
112	Watershed Protection and Management	0%		5%	
125	Agroforestry	10%		0%	
131	Alternative Uses of Land	0%		5%	
132	Weather and Climate	0%		5%	
133	Pollution Prevention and Mitigation	0%		5%	
402	Engineering Systems and Equipment	0%		10%	
403	Waste Disposal, Recycling, and Reuse	40%		10%	
511	New and Improved Non-Food Products and Processes	0%		10%	
601	Economics of Agricultural Production and Farm Management	20%		10%	
608	Community Resource Planning and Development	20%		0%	
609	Economic Theory and Methods	0%		10%	
903	Communication, Education, and Information Delivery	10%		10%	
	<b>Total</b>	100%		100%	

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

## 1. Situation and priorities

Worldwide energy demand is expected to continue rising exponentially and generate more than 11 billion tons of CO<sup>2</sup>. But with nearly two-thirds of the world's proven oil reserves located beneath politically volatile Middle Eastern countries, the U.S. and other nations face an uncertain supply. Also, as the economies of China, India, and other populous countries grow, competition for oil will increase.

The U.S. economy has been built on inexpensive fossil-based energy sources which are diminishing. We must reduce our reliance on petroleum and shift to the use of renewable, biobased resources. Recent passage of renewable fuels policies has stimulated demand for and rapid increases in production of first-generation bio-based feedstocks, contributing to an economic boom in some sectors, to economic hardships in others (e.g., livestock, vegetable), and to record increases in food prices and related concerns about food security. Important environmental impact (e.g., water use and quality) and carbon footprint questions remain to be answered as well.

Achieving the nation's renewable energy and greenhouse gas goals will require the development of second-generation biorefineries (e.g., cellulosic), new feedstocks (e.g., algae, manure, waste products), small-scale distributed systems, and systems that minimize the unintended consequences. In the future,

agriculture can be the base for the manufacture of products such as transportation fuels, energy, plastics, synthetic fibers, lubricants, solvents, and paints. Agriculture also will be integral to the manufacture of pharmaceuticals, cosmetics, building materials, biocatalysts, and other biobased, nonfood products. The growth of biobased industries also will revitalize agricultural communities as transportation logistics and infrastructure may necessitate locating many bio-based industries in rural areas. The creation of value-added products from by-products not only provides economic benefit but could also positively impact the environment. Improved technologies and processes will enhance the industry and the nation's economy while reducing inputs, such as water, and impacts of that industry.

Productivity of this emerging sector will be critical to long-term success. Examining the types and sources of productivity, the principal source of long-run growth and prosperity, strongly complements other research areas such as biotechnology, trade, natural resources, and rural development. Besides developing new and better measures of technical change and productivity growth, we need to understand why the observed growth patterns take place. Life cycle analyses of energy production systems will suggest areas for improved efficiencies and effectiveness.

Sources of energy developed must be more economical and environmentally sustainable than fossil fuels. Because of its unique wealth of natural resources, Oregon has many opportunities for alternative energy production, including bio-energy crops, utilization of forest slash, wind, solar, and wave energy. That being said, the current low cost of fossil energy continues to greatly reduce capital and research dollars for these efforts. Secondly, special interest groups continue to lobby heavily against tax incentives for biofuel and byproduct development, and efforts continue to repeal the RFS making investors wary of additional investment.

Current LCA models fail to adequately account for water demands associated with biofuel production. The GREET model is applied to a variety of landscape level analyses of the the potential impacts to watersheds from adoption of renewable energy approaches. Based on these previous results we will attempt to develop water use metrics that will incorporate the net energy value of the renewable energy, type of water (green/blue/gray water) and the water stress index at the watershed scale. The metrics for nitrogen and phosphorous use can be similar to EROWI concept described above. This metric will account for the net energy value of the fuel and the quantity of the nutrient used and therefore can be used to compare different technology alternatives. We caution that much of this research requires access to private lands and privately held data that can be difficult to obtain.

## **2. Scope of the Program**

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

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

### **1. Assumptions made for the Program**

The key assumptions of this research and extension area are that:

- Clean, safe, and sustainable sources of energy are needed in order to meet large, projected increases in demand, to provide energy and economic security for the U.S. and other nations, and to relieve environmental stresses related to fossil fuel use, including global climate change.

- Industry and university biotechnology research not only is a rapidly growing industry in its own right, but is widely regarded to be the principal engine of innovation in U.S. food systems.
- Technological solutions are available.
- Water will continue to be a scarce resource in the West.
- Public interest in clean, sustainable energy will continue as we are faced with vital issues such as climate change, ecosystem health, and other pressures regarding fossil fuels.
- Funds will be available from federal and state sources to establish and maintain research and Extension programs on sustainable energy.

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

The goal of this program is develop sustainable, environmentally friendly and economically viable technologies and bio-based products from the utilization of renewable bioresources.

Research to support this program goal includes:

- a) the production of bioenergy and biofuels and other bioproducts from a variety of cellulosic and waste feedstocks, particularly municipal and dairy effluents, agricultural residues and forestry residues.; and
- b) the development of life cycle analyses related to the biofuel supply chain.

OSUES will contribute to the nation's energy independence by developing crops and/or agricultural and forestry residues used for biofuels and producing value-added, bio-based. We will also engage in outreach activities related to wind, solar, and wave energy.

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

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	6.0	0.0	3.0	0.0
2017	6.0	0.0	3.0	0.0
2018	6.0	0.0	3.0	0.0
2019	0.0	0.0	3.0	0.0
2020	0.0	0.0	0.0	0.0

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

**1. Activity for the Program**

In summary:

- Conduct basic and applied research
- Develop models and simulation tools including LCA and LES.
- Develop new culture strains and metabolic engineering tools
- Develop energy saving techniques and recycling of green waste

- Develop products, resources
- Conduct surveys and assessments
- Conduct data analyses
- Conduct workshops
- Lead short course and training seminars
- Provide training
- Partner and engage with community and environmental organizations
- Contribute to trade and peer reviewed journal publications

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

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>● Education Class</li> <li>● Workshop</li> <li>● Group Discussion</li> <li>● One-on-One Intervention</li> <li>● Demonstrations</li> <li>● Other 1 (journal publication)</li> <li>● Other 2 (seminars)</li> </ul>	<ul style="list-style-type: none"> <li>● Newsletters</li> <li>● Web sites other than eXtension</li> <li>● Other 1 (station magazine)</li> <li>● Other 2 (press releases)</li> </ul>

**3. Description of targeted audience**

The target audiences are:

- public sector
- private sector
- economists
- policy makers
- agricultural biotechnology firms
- farmers and agricultural managers
- livestock growers and managers
- energy (including bioenergy/biofuel, hydrogen and fuel cells) industry,
- forest owners and managers
- research community at large
- environmental organizations
- community members



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

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

#### **1. Output Measure**

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

O. No	Outcome Name
1	Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and bioproducts, including co-products (number of new technologies developed, feedstocks (crops or organisms) investigated, residues or invasive species addressed)
2	Improved agricultural or engineering applications to advance production systems for bioenergy, such as, a) new technologies, such as improved water use and quality, optimized photobiological processes to yield higher energy efficiencies, use of waste biomass (such as animal wastes and the organic component of urban wastewater) as feedstock to yield bioenergy and reduce waste and pollution sources, b) improved feedstock logistics c) resource inputs, outputs and quality
3	Enhanced or improved bioeconomy (analyses of the number of new jobs, increased revenues, gallons of biofuels produced or consumed, gallons of fossil fuel displaced), numbers of farms involved in feedstock production)
4	Increased knowledge regarding the use of agricultural crops for energy production (percent increase in knowledge of attendees to workshops, field days and demonstrations)
5	Improved sustainability of alternative energy supply chain, including evaluations of land use changes, biodiversity, acreages and tonnage of feedstocks produced and used, distributed conversion and processing,
6	Increased knowledge regarding the use of forest biomass as an energy source (Percentage increase in knowledge of attendees to workshops, field days, and demonstrations)
7	Increased knowledge of wave energy, particularly by coastal stakeholders (Percent increase in knowledge of attendees to workshops, field days, and demonstrations)
8	A framework for the attributional LCA based on the ISO standards will be extended to include water use metrics. These metrics will be defined based on source (confined and unconfined aquifers, surface runoff and precipitation), quality, quantity (consumptive and degradative use) and water stress index (volume of withdrawals in the watershed compared to the annual recharge) by adapting several published methods. Metrics for nitrogen and phosphorous utilization will also be developed along similar lines.
9	Biodiesel production from camelina in the Pacific Northwest region will be used as a test case for the methodology developed for water use as an LCA component. Previously developed process models incorporating feedstock handling, pretreatment, transesterification, and coproduct utilization, waste water handling will be further refined to incorporate process efficiency variations. Cellulosic ethanol production from agricultural residues such as wheat straw and grass straw will be used to test the methodology. Algal biofuels production will be modeled based on algae biomass production using dairy waste water as a nutrient source will be performed. Algae will be used to capture nutrients such as nitrogen and phosphorus and the dried algae biomass will be evaluated as a replacement for peat.
10	Examine idealized cases with LES utilizing simulation modeling compared with theoretical and field work. Construct a model to represent the local topography of an individual farm to investigate the coupled effects of topography, spatial variability in water application and wind turbines
11	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

## **Outcome # 1**

### **1. Outcome Target**

Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and bioproducts, including co-products (number of new technologies developed, feedstocks (crops or organisms) investigated, residues or invasive species addressed)

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

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

- 125 - Agroforestry
- 133 - Pollution Prevention and Mitigation
- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse
- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 609 - Economic Theory and Methods
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

## **Outcome # 2**

### **1. Outcome Target**

Improved agricultural or engineering applications to advance production systems for bioenergy, such as,

a) new technologies, such as improved water use and quality, optimized photobiological processes to yield higher energy efficiencies, use of waste biomass (such as animal wastes and the organic component of urban wastewater) as feedstock to yield bioenergy and reduce waste and pollution sources,

b) improved feedstock logistics

c) resource inputs, outputs and quality

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

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

- 125 - Agroforestry
- 133 - Pollution Prevention and Mitigation
- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse

- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 608 - Community Resource Planning and Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 3**

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

Enhanced or improved bioeconomy (analyses of the number of new jobs, increased revenues, gallons of biofuels produced or consumed, gallons of fossil fuel displaced), numbers of farms involved in feedstock production)

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

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

- 125 - Agroforestry
- 402 - Engineering Systems and Equipment
- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 608 - Community Resource Planning and Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 4**

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

Increased knowledge regarding the use of agricultural crops for energy production (percent increase in knowledge of attendees to workshops, field days and demonstrations)

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

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

- 403 - Waste Disposal, Recycling, and Reuse

- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 608 - Community Resource Planning and Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 5**

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

Improved sustainability of alternative energy supply chain, including evaluations of land use changes, biodiversity, acreages and tonnage of feedstocks produced and used, distributed conversion and processing,

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

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

- 125 - Agroforestry
- 133 - Pollution Prevention and Mitigation
- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse
- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 608 - Community Resource Planning and Development
- 609 - Economic Theory and Methods
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 6**

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

Increased knowledge regarding the use of forest biomass as an energy source (Percentage increase in knowledge of attendees to workshops, field days, and demonstrations)

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

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

- 125 - Agroforestry
- 403 - Waste Disposal, Recycling, and Reuse
- 608 - Community Resource Planning and Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 7**

**1. Outcome Target**

Increased knowledge of wave energy, particularly by coastal stakeholders (Percent increase in knowledge of attendees to workshops, field days, and demonstrations)

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

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

- 608 - Community Resource Planning and Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension

**Outcome # 8**

**1. Outcome Target**

A framework for the attributional LCA based on the ISO standards will be extended to include water use metrics. These metrics will be defined based on source (confined and unconfined aquifers, surface runoff and precipitation), quality, quantity (consumptive and degradative use) and water stress index (volume of withdrawals in the watershed compared to the annual recharge) by adapting several published methods. Metrics for nitrogen and phosphorous utilization will also be developed along similar lines.

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water

- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land
- 132 - Weather and Climate
- 402 - Engineering Systems and Equipment

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

- 1862 Extension
- 1862 Research

### **Outcome # 9**

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

Biodiesel production from camelina in the Pacific Northwest region will be used as a test case for the methodology developed for water use as an LCA component. Previously developed process models incorporating feedstock handling, pretreatment, transesterification, and coproduct utilization, waste water handling will be further refined to incorporate process efficiency variations. Cellulosic ethanol production from agricultural residues such as wheat straw and grass straw will be used to test the methodology.

Algal biofuels production will be modeled based on algae biomass production using dairy waste water as a nutrient source will be performed. Algae will be used to capture nutrients such as nitrogen and phosphorus and the dried algae biomass will be evaluated as a replacement for peat.

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land
- 132 - Weather and Climate
- 402 - Engineering Systems and Equipment
- 511 - New and Improved Non-Food Products and Processes
- 601 - Economics of Agricultural Production and Farm Management
- 609 - Economic Theory and Methods
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 10**

**1. Outcome Target**

Examine idealized cases with LES utilizing simulation modeling compared with theoretical and field work. Construct a model to represent the local topography of an individual farm to investigate the coupled effects of topography, spatial variability in water application and wind turbines

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land
- 132 - Weather and Climate
- 402 - Engineering Systems and Equipment
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 11**

**1. Outcome Target**

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. Outcome Type : Change in Knowledge Outcome Measure**

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land
- 403 - Waste Disposal, Recycling, and Reuse
- 511 - New and Improved Non-Food Products and Processes



- 601 - Economics of Agricultural Production and Farm Management
- 609 - Economic Theory and Methods
- 903 - Communication, Education, and Information Delivery

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

- 1862 Research

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

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

#### **Description**

World energy use increases faster than production can occur, which may spur technological development. However, changes in appropriations, economy, and public priorities may reduce research funding availability. Implementation of this plan is subject to both funding and competing topics. While we expect to continue, and perhaps broaden, our work in alternative energy, we will make adjustments in programmatic themes and efforts on an ongoing basis.

### **V(K). Planned Program - Planned Evaluation Studies**

#### **Description of Planned Evaluation Studies**

Oregon State University uses a variety of evaluation methods to track changes in knowledge, attitudes, and behavior, as well as project and program progress. During, Before-After, After only evaluation studies and Life Cycle Analyses will be used to test efficiency of processes and improvements in feedstocks, energy production and water usage. Data collection methodologies may also include sampling, observation, and on-site surveys. Many faculty also obtain approval through the Institutional Review Board (IRB) and publish the results of their evaluation studies. Quantitative data are compiled and are used in the faculty evaluation process. Additionally, OSUES has a full time Evaluation Specialist on staff to assist with program evaluation, an important part of the program delivery process. Extension faculty conduct program evaluations and report impacts in the annual SOARS reporting system but will be utilizing Digital Measures for the 2016 ARA.

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

### **Program # 2**

#### **1. Name of the Planned Program**

Climate Change

#### **2. Brief summary about Planned Program**

The National Academy of Sciences projects additional warming of 2.0 to 11.5 degrees F over the 21<sup>st</sup> century, on top of the 1.4 degrees F already observed over the past 100 years. Anticipated climate changes will affect agricultural production and locations as well as natural resources, particularly water resources. Land and sea are expected to provide food, fiber, and fuel in sustainable production systems for an increasing population, as well as "ecosystem services" for planet health.

Projected climate impacts include the following:

- Water availability will decrease in many areas that are already drought-prone and in areas where rivers are fed by glaciers or snowpack.
- A higher fraction of rain will fall in the form of heavy precipitation, increasing the risk of flooding and, in some regions, the spread of water-borne illness.
- People and ecosystems in coastal zones will be exposed to higher storm surges, intrusion of saltwater into freshwater aquifers, and other risks as sea levels rise.
- Agricultural producers will have to adapt to changing climates with new agronomic practices, breeding of better adapted crops, adapt to new pests and pathogens, and adjust to changing markets due to global changes in food production and availability

New and traditional audiences will need research and outreach related to the effects, adaptation and mitigation of climate change. They will need to understand how to reduce their carbon and environmental imprints, and reduce reliance on energy intensive practices, chemical use, water use, etc. Changes in practices such as new crop varieties, insect and disease control strategies, seed zone changes and other management practices need further research and subsequent outreach to user groups. As climate models become more robust and down scalable, there will be more interest in using them to predict outcomes and influence management practices on an ownership level. This program works to advance knowledge about production systems, the environment and natural resources, and to foster sustainable economic growth. Maintaining and restoring ecosystem function and processes are key to sustainable food production and use of natural resources. How these resources interact and are managed depends, in part, on improved understanding of the role humans play in modifying ecosystem structure and function. We assume that a multidisciplinary effort will be needed to develop knowledge of complex production and ecosystem relationships and restoration technologies that are beyond the scope of a single researcher, ranging from ecological modeling to habitat, population and community ecology, agronomy and hydrology. The data and information generated will contribute to ecosystem restoration and management policy decisions and to the continued development of the theoretical understanding of processes affecting aquatic and terrestrial organisms and ecosystem function. Further, Extension is uniquely positioned to use the university-based knowledge and local reach through county offices to make real differences in how people adapt to climate change

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

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

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

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

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
101	Appraisal of Soil Resources	5%		5%	
102	Soil, Plant, Water, Nutrient Relationships	8%		5%	
103	Management of Saline and Sodic Soils and Salinity	4%		5%	
112	Watershed Protection and Management	8%		5%	
121	Management of Range Resources	5%		5%	
122	Management and Control of Forest and Range Fires	5%		0%	
123	Management and Sustainability of Forest Resources	5%		0%	
125	Agroforestry	5%		5%	
135	Aquatic and Terrestrial Wildlife	5%		10%	
136	Conservation of Biological Diversity	5%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	8%		5%	
212	Diseases and Nematodes Affecting Plants	5%		5%	
215	Biological Control of Pests Affecting Plants	5%		5%	
302	Nutrient Utilization in Animals	4%		5%	
303	Genetic Improvement of Animals	5%		5%	
311	Animal Diseases	4%		5%	
604	Marketing and Distribution Practices	4%		5%	
605	Natural Resource and Environmental Economics	5%		5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		5%	
723	Hazards to Human Health and Safety	5%		5%	
	<b>Total</b>	100%		100%	

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

## 1. Situation and priorities

As the world's human population grows, land and water resources increasingly will be expected to provide not only food, fiber and fuels in sustainable production systems, but also "ecosystem services" to

maintain the health of the planet. The goal of this program is to advance fundamental knowledge about the environment and natural resources, particularly how to address the effects of climate variability and change. This knowledge will help foster and maintain economic growth and sustainability in the face of climate change and in a manner that is protective of human and environmental health. Maintaining and restoring ecosystem function and processes are key to sustainable food production and use of natural resources. How these resources are managed depends, in part, on improved understanding of the role humans play in modifying ecosystem structure and function. We assume that a multidisciplinary effort will be needed to develop knowledge of complex ecosystem relationships and restoration technologies that are beyond the scope of a single researcher.

Diverse scientific expertise that ranges from ecological modeling to habitat, population and community ecology is needed to support ecosystem research. 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. Improving the use and sustainability of terrestrial and marine resources in Oregon and the Pacific Northwest will require us to anticipate the future, balance risks with opportunities, and seamlessly integrating research, outreach, and teaching responsibilities.

Economic issues underlie many of the political debates over land and water use in Oregon and the West. Some of the most pressing policy issues include how land and water are and will be managed in the coming decades and questions involving land use in the rural-urban interface. Further, we need to make significant contributions toward providing a stable, sustainable, and healthy supply of food, fuel, and fiber for the nation while strengthening Oregon's rural communities. Research and extension efforts for all ecosystems will focus on three principal themes: 1) increasing efficiency and sustainability of resource based enterprises, (2) designing multiple use management strategies that ensure and sustain productivity, biodiversity, and stability of watersheds and ecosystems, and (3) expanding humankind's understanding and stewardship of the region's ecology. Supportive strategies are to create basic knowledge and to inform decisions on biological control of pathogens, pests, and weeds (a feasible component of integrated pest management programs), on the best use of Oregon's soil resources, and to broadly study the involvement of microorganisms in the health of the world and its plant, animal and human inhabitants.

Water scarcity, or competing uses for finite water resources, will only increase in the future. Given the uncertainty associated with changing availability of water resources (IPCC 2007), critical questions remain regarding the effects of water scarcity and hazards on people and the environment of Oregon and our ability to limit and mitigate those effects. Our efforts will identify the major resource constraint issues and to provide water resource management decision-makers with the best scientific information available for addressing the allocation, management and engineering of soil and water resources. The integrated program encompasses natural ecosystems at the watershed or stream scale, as well as quantifying anthropogenic impacts related to site contamination or water use for irrigation and their effects on the natural ecosystem. Water related research and extension will focus on three activity areas: 1) Improved agricultural water management, 2) Watershed enhancement and sustainability, including effects on forests, and the impacts of climate on marine and coastal waters.

## **2. Scope of the Program**

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

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

### **1. Assumptions made for the Program**

- Policymakers recognize the impact that economic behavior has in social decisions regarding management of water and land resources and these policymakers also value economic analysis when addressing issues related to management of land and water
  - Growers, crop consultants, agricultural researcher and extension faculty, and ecologists and managers of natural ecosystems desire improved knowledge on plant diseases, invasive weeds, and storage decay
  - Faculty maintain on-going contact with professional peers across the OSU campus, around the state of Oregon, the country, and world. They work in cooperation with peers in state, regional, and federal agencies. They work with county extension and branch research station faculty. They are members of successful national competitive grants. Through this array of contacts they have a keen awareness of local, state, regional, national, and international research needs in the soil sciences
  - OAES and its Extension colleagues continue to advance fundamental knowledge about the environment and natural resources, and foster economic growth and sustainability in a manner that is protective of human and environmental health.
  - Maintaining and restoring ecosystem function and processes are key to sustainable food production and use of natural resources
  - Oregonians from individuals to communities seek ways to use natural resources in a sustainable manner. The outcomes of the program are deliverables that can be used by individuals, communities, regulatory and management agencies, and natural resources users to maintain or improve ecosystem health. We assume this knowledge will enable citizens and policy makers to make informed decisions and management choices that allow sustainable use of natural resources.
  - Microorganisms are ubiquitous and can be viewed in certain cases as limiting agricultural productivity and in other cases as supporting agricultural productivity.
  - The program also assumes that water resource issues will become even more important to society due to water scarcity or competing uses for finite water resources that will only increase in the future. Watershed enhancement and sustainability affect river restoration and management. The intersecting uses and water interfaces require a wide range of interrelated research and technological approaches within this program. There remains a need to identify the major resource constraint issues and develop models and decision-making tools for all levels of governance. Oregon society takes a great interest in and participates in natural resource issues.

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

To apply scholarship and technology to enhance the capacity of managed and wild landscapes and their biota to adapt to climate change and to optimize the production of ecosystem services, such as: carbon sequestration, wastewater treatment, bioremediation, maintenance of biodiversity, and others

#### **Program objectives**

- To generate new knowledge that enhances adaptive capacity to climate change by production and natural systems and communities
  - To improve climate mitigation strategies and their adoption
  - To conduct research to understand, sustainably utilize, and support terrestrial, aquatic, and marine resources and ecosystems.
  - To develop a better understanding of agroecosystems and their impact on natural ecosystems as well as developing synergies that complement each system.
  - To establish biological and other novel control approaches for diseases of agricultural importance, thereby reducing reliance on more conventional economically and environmentally sensitive and

unsustainable practices.

- To address issues associated with the role of microbes in maintaining the health of the Earth and its inhabitants, and in sustaining agricultural productivity.
- To provide water resource management decision-makers with the best scientific and technical information available for addressing the allocation, management and engineering of water resources in the areas of: 1) Improved agricultural water management and 2) Watershed enhancement and sustainability.
- To examine pressing policy issues regarding how land and water are and will be managed in the coming decades, both in rural areas and in the rural-urban interface.
- To inform 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.

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.

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

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	10.0	0.0	50.0	0.0
2017	10.0	0.0	50.0	0.0
2018	10.0	0.0	50.0	0.0
2019	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0

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

**1. Activity for the Program**

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.

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

**Extension**

<b>Direct Methods</b>	<b>Indirect Methods</b>
<ul style="list-style-type: none"> <li>● Education Class</li> <li>● Workshop</li> <li>● Group Discussion</li> <li>● One-on-One Intervention</li> <li>● Other 1 (peer publications)</li> <li>● Other 2 (presentations)</li> </ul>	<ul style="list-style-type: none"> <li>● Public Service Announcement</li> <li>● Newsletters</li> <li>● TV Media Programs</li> <li>● Web sites other than eXtension</li> <li>● Other 1 (newspaper)</li> <li>● Other 2 (trade magazines)</li> </ul>



### 3. Description of targeted 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, economists, extension faculty and researchers in the agricultural industry
- Ecologists and managers concerned with invasive species
- Salmonid and other fisheries
- State and federal natural resources management and regulatory agencies, including land managers
- Policy makers.
- Citizens in urban settings
- Engineering professionals
- Undergraduate and graduate students

The stakeholder involvement for the collaborative project will be in the form of active participation in the enhanced AgTools™ 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 studied for its impacts and adopted by the other pilot teams with appropriate modifications. Our intent will be to have biannual forums.

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

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

### **1. Output Measure**

- Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

O. No	Outcome Name
1	Developed new or better tools, technologies, practices, and models for understanding and managing water and irrigation systems, 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 these changes
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 in global climate change can be made, such as: a) Key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; and 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 nitrogen 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).
12	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

13	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).
14	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.

**Outcome # 1**

**1. Outcome Target**

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

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

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

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of Animals
- 311 - Animal Diseases
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

## **Outcome # 2**

### **1. Outcome Target**

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. Outcome Type** : Change in Knowledge Outcome Measure

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

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of Animals
- 311 - Animal Diseases
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

## **Outcome # 3**

### **1. Outcome Target**

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. Outcome Type** : Change in Knowledge Outcome Measure

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 121 - Management of Range Resources
- 123 - Management and Sustainability of Forest Resources
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

## **Outcome # 4**

### **1. Outcome Target**

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

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

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

- 112 - Watershed Protection and Management
- 121 - Management of Range Resources
- 123 - Management and Sustainability of Forest Resources
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 5**

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

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

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

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

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 6**

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

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

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

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

- 201 - Plant Genome, Genetics, and Genetic Mechanisms

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

- 1862 Extension
- 1862 Research

## **Outcome # 7**

### **1. Outcome Target**

Understand the role of international trade as a vehicle by which adaptations in global climate change can be made, such as:

- a) Key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; and
- b) Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large.

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

## **Outcome # 8**

### **1. Outcome Target**

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

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

- 112 - Watershed Protection and Management



- 121 - Management of Range Resources
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 215 - Biological Control of Pests Affecting Plants
- 302 - Nutrient Utilization in Animals
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 9**

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

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

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

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

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of Animals
- 311 - Animal Diseases
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

#### **Outcome # 10**

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

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).

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 121 - Management of Range Resources
- 123 - Management and Sustainability of Forest Resources
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

#### **Outcome # 11**

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

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

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 121 - Management of Range Resources

- 123 - Management and Sustainability of Forest Resources
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 12**

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

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

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

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

- 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
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

### **Outcome # 13**

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

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).

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 311 - Animal Diseases
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

**Outcome # 14**

**1. Outcome Target**

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.

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

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

- 101 - Appraisal of Soil Resources

- 102 - Soil, Plant, Water, Nutrient Relationships
- 103 - Management of Saline and Sodic Soils and Salinity
- 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
- 125 - Agroforestry
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 212 - Diseases and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of Animals
- 311 - Animal Diseases
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

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

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

#### **Description**

All of the following factors could affect the ability of OSU to effectively implement this plan of work. While the Pacific Northwest is no stranger to natural disasters, state support for the Oregon Agricultural Experiment Station and OSU Extension Service has decreased over the past two biennia. Plan implementation is contingent on stable federal, state, and local funding, as well as supplemental funding from contracts and grants. Consequently, it is critically important that those implementing this program have the flexibility to react to important new policy initiatives that may become important over the next five years.

- The short-term nature of many funding sources and rapidity with which research priorities seem to change does not allow for long-term research or research with longer-term economic benefit.
- An assessment of the impacts of policy on land and water use is critically dependent on the policies in place at present and other policies that are to be implemented or are under consideration. Likewise, unexpected legal rulings can suddenly create policy issues that demand analysis and educational programs for the public and policymakers.
- Unanticipated changes in marine and fishery laws could influence adaptation, as could major changes in market and or resource stock conditions, and changes in the state and coastal economies. Public opinion is also a powerful force in determining both state and federal resource commitments necessary to sustain this program.
- Climate shocks such as the drought in California and Oregon could alter program priorities and force attention away from theoretical responses to more applied approaches that address immediate issues and problems.

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(K). Planned Program - Planned Evaluation Studies**

### **Description of Planned Evaluation Studies**

Evaluations of the projects and efforts of this program occur on a regular basis through the grant award process. Grants are awarded on the basis of past productivity and the relevance and quality of planned experiments. Further, evaluation of results occur in the form of reports that list productivity of

each subprogram (and of the program as a whole) in terms of articles published in journals or other venues, conference communications, patents awarded, etc. and other forms of productivity and recognition generated by activities.

Other evaluation studies include During, Before-After and After-Only evaluations. The most prevalent data collection Methodologies are the sampling, observation, on-site survey.

A host of program evaluation procedures are used routinely by the OSUES. A full-time Evaluation Specialist is on staff to assist with this important part of the program delivery process. Extension faculty are expected to conduct program evaluations and report impacts in the annual Digital Measures reporting system. Some combination of the above listed evaluation methods are used each year by Extension faculty members. Quantitative data are compiled and are used in the faculty evaluation process.

Many faculty also obtain approval through the Institutional Review Board (IRB) and publish the results of their evaluation studies.

CAS faculty 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.

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

### **Program # 3**

#### **1. Name of the Planned Program**

Global Food Security and Hunger

#### **2. Brief summary about Planned Program**

As the world's human population grows, land and water resources increasingly will be expected to provide not only food and fiber in sustainable production systems, but also "ecosystem services" to maintain the health of the planet. Sustainable agricultural systems must be economically viable, utilize ecological principles that preserve environmental quality, enhance food safety and security, and promote healthy communities. A combination of approaches will be needed to ensure production of food, fiber, and fuels in a sustainable fashion, despite decreasing availability of water, labor, and land. Increasing market demand require growers to meet new sustainability standards in order to maintain access to markets, as well as creating new market opportunities for integrated farming and food systems that support rural and urban economic development. Outcomes of research may include development of new plant varieties, support of sustainable production systems, new knowledge about agroecosystems, a wide range of plants developed for use in the delivery of plant-based ecosystem solutions to environmental problems, sustainable use of aquatic and marine ecosystems, new engineering schemes, new economic methods of valuation, new agricultural policies, and others. Outcomes of Extension activities may include support of adoption of new plant varieties, sustainable production systems, a wide range of plants developed for use in the delivery of plant-based ecosystem solutions to environmental problems, sustainable use of aquatic and marine ecosystems, new engineering schemes, new economic methods of valuation, new agricultural policies, and others.

Global food security represents access to food at many levels. Worldwide, millions of people live hungry due to poverty or lack food security intermittently. As the global population grows, the need to develop better ways of providing enhanced food quality and production and improving land use while preventing food degradation, as well as distributing the food efficiently and without spoiling, will become key research foci. The health of the animal food sources, as well as plants sources, is important to maintain and expand the nutrition of populations. However, disease is still common in food sources. Many pathogens evolved to survive in the prevailing conditions existing during the course of food production and food conservation may be deficient even in the developed world. Further, if the source of the food is diseased, for example, Johne's disease in cattle or *Vibrio tubiashii* in seafood or *Clostridium perfringens* infections in several meat animals (pork, poultry, etc), the security of food will be compromised. This project will address aspects associated with food animal security, that is, developing diagnostic tests and vaccines and creating a better understanding of the mechanisms of pathogenesis of or immunity to many virulent bacteria, viruses and health conditions.

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

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

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

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



**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
102	Soil, Plant, Water, Nutrient Relationships	8%		5%	
111	Conservation and Efficient Use of Water	8%		5%	
121	Management of Range Resources	8%		5%	
202	Plant Genetic Resources	0%		5%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
205	Plant Management Systems	15%		5%	
206	Basic Plant Biology	0%		5%	
216	Integrated Pest Management Systems	15%		5%	
301	Reproductive Performance of Animals	0%		5%	
302	Nutrient Utilization in Animals	0%		5%	
307	Animal Management Systems	15%		5%	
311	Animal Diseases	10%		5%	
501	New and Improved Food Processing Technologies	0%		5%	
502	New and Improved Food Products	0%		5%	
601	Economics of Agricultural Production and Farm Management	5%		5%	
602	Business Management, Finance, and Taxation	0%		5%	
603	Market Economics	0%		5%	
607	Consumer Economics	0%		5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		5%	
903	Communication, Education, and Information Delivery	6%		5%	
	<b>Total</b>	100%		100%	

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

## 1. Situation and priorities

Citizens are increasingly concerned about the source of their food as well as quality and safety. There are enormous educational opportunities for people to understand food systems, from the

development of a crop to its production and processing to its transport and handling prior to purchase. Strengthening local food systems can provide positive economic and community development. Market certification, carbon and water footprint, and sustainable production methods, including the use of integrated pest management, are increasingly demanded by consumers, the ultimate end user. Continued urban development will accelerate competition for existing land and water resources; global climate change may further jeopardize water supplies. Increasing labor costs and availability concern producers of high-value crops; they seek technologies that will reduce their dependence on migrant labor and increase their efficiencies.

Global food security will provide adequate access to food for the world's population. Worldwide, millions of people live with inadequate nutrition due to poverty or lack of access to food security. As the global population grows, there is a need to increase productivity per hectare, enhance water use efficiency and improve the nutritional value of crops in order to provide enhanced food quality. Increasing production must coincide with improving land use and reducing negative environmental impacts of intense agriculture. Finally, these accomplishments must take place in response to a changing climate and the resulting abiotic stresses that can influence production. This project provides a coordination of research in plant breeding and genetics to make fundamental and applied contributions to plant science that will lead to economic development and an equitable, sustainable and nutritious food supply. Objectives include a) accelerated programs to create desirable traits in crop cultivars; b) identification of novel genes and molecular breeding techniques for adapted germplasm; c) identification of growth and development pathways; and d) a better understanding of the mechanisms and resistance to abiotic and biotic stresses.

## **2. Scope of the Program**

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

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

### **1. Assumptions made for the Program**

Faculty members will effectively collaborate with professional peers on the various OSU campuses, university and governmental scientists in the state, region and the country and with peers around the world. They work with commodity commission and grower association leaders. They converse directly with end users of their products. They are members of successful regional and national competitive grant consortia. Through this array of contacts they have a keen awareness of local, state, regional, national and international research needs in crop production practices, pest management, and alternative crops.

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

This interdisciplinary program will develop, enhance and apply improved tools of agronomy, plant pathology, soil science, weed science, animal science, biology, and social science to sustainably address challenges facing agricultural producers of food, feed, fiber, and horticulture. It is expected that our efforts will enhance the capacity of the global food system; and produce a more sustainable, diverse and resilient food system.

This program serves the following objectives:

1. Improve knowledge of plant and animal biology, including genetics and molecular studies.
2. Improve breeding, cultural practices and technologies, and efficiencies in production systems (crops, ornamentals, animal, fisheries) to improve profitability
3. Reduce the number and severity of agricultural pest and disease outbreaks
4. Identify disease mechanisms, animal models, vaccines, and antibiotic resistance that mitigate the consequences of animal disease in agricultural and food systems
5. Develop improved environments (aquatic and terrestrial), soil and water quality, biodiversity, and ecosystem services from increased use of integrated pest management and other biologically-based agricultural production systems.
6. Expand domestic market opportunities and increase the efficiency of agricultural marketing systems.
7. Develop effective communication networks to enable timely communication and utilization of knowledge and technologies.
8. Enhance community life based on social networking associated with local food systems; and social change from mitigating aspects of the urban/rural divide.
9. Create social change through new perceptions of green technologies and social value of horticultural landscapes to enhance human health, wellness and social networks, and ecosystem services.
10. Improve agricultural leadership and literacy.
11. To study mechanisms of important bacterial diseases affecting food sources in seafood production and meat production.
12. To create diagnostic approaches to important conditions such as bovine herpesvirus.
13. To develop strategies to increase immunity, including the development of vaccines, against pathogens that impact the food sources.
14. To study toxins that affect food sources.
15. To enhance partnerships with industry and stakeholders for the application of resilient technologies, practices, and management strategies.
16. Use molecular breeding tools to develop resistance to abiotic and biotic stressors and to improve traits related to human health and nutrition in cultivars of importance in agriculture systems.
17. Use a systems biology approach to better understand mechanisms affecting target traits in cultivars of importance in agriculture systems.
18. Evaluate new germ plasm, cultivars or varieties for commercial viability.

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

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	60.0	0.0	65.0	0.0
2017	60.0	0.0	65.0	0.0
2018	60.0	0.0	65.0	0.0
2019	0.0	0.0	65.0	0.0
2020	0.0	0.0	65.0	0.0

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

### **1. Activity for the Program**

In Oregon there are over 38,000 farms producing crops on over 16 million acres. Because 25% of Oregon's economy is based on agriculture; successful breeding programs directly influence and affect the success of a good portion of that value. Fruits, nuts, berries, vegetables, seed and specialty crops are produced on over 320,000 acres, and production has been increasing by 12% per year, generating \$30-50 million per year. Cereal grains, potatoes and row crops account for over 10% of agricultural farm gate value in a typical year. The Oregon greenhouse and nursery industry typically accounts for approximately 15% of farm gate value annually.

Oregon crops are hosts to a wide variety of pathogens, pests, and stresses for which durable resistance genes are actively sought. At the same time, allelic variation in genes and gene networks associated with plant growth and development are targets for optimization in order to ensure maximum plasticity, productivity, and efficiency. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal).

The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs.

Organic, value-added, and technological (bio-based, information-centered, robotic, nanotechnology, etc.) approaches complement conventional agriculture. By utilizing contemporary research tools in agronomy, animal or soil science, plant nutrition and pest management, and molecular or genetic techniques, this program will develop improved practices for crop and animal production systems. New or enhanced techniques and information will enhance the potential use of alternative crops, reduce soil erosion, reduce the economic, social, and environmental costs of crop pests, and maintain or increase soil biological, chemical and physical properties. New knowledge will reduce disease, wastes and discharges in animal systems while improving husbandry, productivity and food safety.

Research and extension will also look at key areas of various social changes in the marketplace impacting producers, retailers and consumers. The research aims to determine (1) how technology impacts producers/retailers/consumers in the market place; (2) how society impacts consumer demand for goods and services with a goal of improving the well-being of consumers; and (3) how to develop economic linkages among producers, retailers, and consumers for the community development.

In addition, a broad coalition of agricultural, environmental and food groups has coalesced around the need for integrated efforts for sustainable agriculture and food systems information, research, and education. Outcomes include more economically and ecologically sustainable farms and ranches; a more resilient rural economy; stronger bonds between rural, urban, and periurban residents; and a healthier environment for all Oregonians.

- Conduct Research Experiments
- Conduct surveys
- Conduct Workshops, Meetings
- Deliver Services
- Develop Products, Curriculum, Resources
- Provide Training
- Provide Demonstrations
- Provide Counseling
- Assessments
- Work with Media
- Partnering

- Facilitating

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

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>• Education Class</li> <li>• Workshop</li> <li>• Group Discussion</li> <li>• One-on-One Intervention</li> <li>• Demonstrations</li> <li>• Other 1 (presentations)</li> <li>• Other 2 (case studies)</li> </ul>	<ul style="list-style-type: none"> <li>• Newsletters</li> <li>• TV Media Programs</li> <li>• Web sites other than eXtension</li> <li>• Other 1 (publications)</li> <li>• Other 2 (trade magazines)</li> </ul>

**3. Description of targeted audience**

- Professional peers and scientific communities, veterinarians, vaccine producers
- State commodity commissions, grower groups, packers, crop consultants
- Natural resource industry clientele - growers, field representatives, grower co-ops and partnerships, processors and handlers, export companies, importing companies
  - County, state and federal agencies - USDA-ARS, Oregon Department of Agriculture, Natural Resources Conservation Service, Bureau of Indian Affairs, Confederated Tribes of the Umatilla Indian Reservation, US Forest Service, and Bureau of Land Management.
- Policy makers, public health officials, and community leaders
- Teachers and students, and other educators
- Genetic companies
- Nutritional consultants
- Nonprofit conservation groups and ecologists
- General public and consumers

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

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

#### **1. Output Measure**

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

O. No	Outcome Name
1	Improved and sustainable plant and animal production systems, including precision systems, cultural practices, conservation and population management strategies, innovations, pest control, organic systems, better fertility and reduced uterine infections in dairy and beef cattle and sheep, as well as <u>better understanding of reproductive genetics and developmental biology</u>
2	Expanded nutrient knowledge in plant and animal systems
3	Improved plant and animal breeding for improved or novel attributes and for human health benefits, <u>including fertility, health, and productivity</u>
4	Develop optimum pest management by identifying factors affecting herbicide activity, controlling weeds in organic and no-till production; learning basic pest biology, registering new herbicides or pesticides, finding application rates, and identifying risks associated with a pest as it becomes established
5	Conduct economic studies to help Producer groups learn about factors shaping global markets and <u>productivity-convergence effects on US agricultural and processed food production and trade</u>
6	Number of growers (commercial, small and fresh market) that adopt new varieties and methods to reduce yield losses and expenses, rejuvenate orchards, achieve better productivity and efficiency, provide environmental benefits (less fungicide applications, etc.), and effectively compete on the world market
7	Number that adopt conservation strategies and practices
8	Number in improved agricultural and fisheries/aquaculture sectors, e.g., commodities
9	Number of policy makers and other stakeholders that are better informed about plant or animal <u>production methods, technologies, and management techniques</u>
10	Improved knowledge of consumer and market conditions and factors that affect business survival and competitiveness such as market conditions, process map, business management, types of consumers and their food choices, motivations for food choice, marketing approaches for local markets and <u>community food systems</u>
11	Improved information about biology, control and resistance of viral, bacterial, fungal diseases, especially disease reproduction, transport and spread; postharvest decay; models to predict risk; and <u>relationships between disease susceptibility and disease resistance</u>
12	Produce the next generation of growers and agricultural educators by integrating agricultural education <u>into high school curriculums and community education</u>
13	Number whose consumer business knowledge leads to improved opportunities, and more successful starts, activity, survival, and profitability in food enterprises, as well as new and improved value-added products
14	Study mechanisms of important bacterial diseases affecting food sources in seafood production by <u>enhancing the capacity and sustainability of salmon and trout populations.</u>
15	Develop targeted intervention strategies to prevent pathogen contamination in bivalve rearing <u>systems.</u>
16	To study mechanisms of important bacterial diseases affecting food sources in meat production.
17	To create diagnostic approaches to characterize the genetic difference between bovine herpesvirus <u>type 1 variants and vaccine strains.</u>
18	Develop strategies to increase immunity, including the development of vaccines, against pathogens <u>that impact food sources. Identify the role of mother cow immunization on calf protection against MAP.</u>
19	Develop new strategies to increase immunity in animals through dietary supplementation of selenium <u>and development of vaccines against influenza.</u>
20	Evaluate the toxicity of various mycotoxins in food.

21	Use molecular breeding tools to develop resistance to abiotic and biotic stressors and to improve traits related to human health and nutrition in cultivars of importance in agriculture systems. a)Conduct a systematic evaluation of germplasm resources to identify sources of genetic variation i.Develop new high throughput markers anchored in genome sequences ii.Map genes/QTLs determining target traits iii.Characterize gene/QTL networks and interactions iv.Measure gene/QTL x environment interaction v.Validate and fine map putative genes/QTLs vi.Transfer identified genes/QTLs into economically useful backgrounds, using accelerated generation advance strategies
22	Improve the nutritional value of important food grains; 2) reduce the impact of wheat storage proteins on human health; and 3) target nutrient development with ripening control. Examples at OSU include barley (Hayes and Ross), wheat (Zemetra, Flowers, and Ross), and grape (Deluc).
23	The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs.
24	Fundamental Research Supporting Multiple Breeding Programs. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal).
25	Evaluation of wheat cultivars for performance and resistance to stripe rust.

**Outcome # 1**

**1. Outcome Target**

Improved and sustainable plant and animal production systems, including precision systems, cultural practices, conservation and population management strategies, innovations, pest control, organic systems, better fertility and reduced uterine infections in dairy and beef cattle and sheep, as well as better understanding of reproductive genetics and developmental biology

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 121 - Management of Range Resources
- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 502 - New and Improved Food Products
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation



- 603 - Market Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 2**

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

Expanded nutrient knowledge in plant and animal systems

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 121 - Management of Range Resources
- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 502 - New and Improved Food Products
- 603 - Market Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 3**

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

Improved plant and animal breeding for improved or novel attributes and for human health benefits, including fertility, health, and productivity

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 502 - New and Improved Food Products

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

- 1862 Extension
- 1862 Research

## **Outcome # 4**

### **1. Outcome Target**

Develop optimum pest management by identifying factors affecting herbicide activity, controlling weeds in organic and no-till production; learning basic pest biology, registering new herbicides or pesticides, finding application rates, and identifying risks associated with a pest as it becomes established

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

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

- 202 - Plant Genetic Resources
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems

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

- 1862 Extension
- 1862 Research

## **Outcome # 5**

### **1. Outcome Target**

Conduct economic studies to help Producer groups learn about factors shaping global markets and productivity-convergence effects on US agricultural and processed food production and trade

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

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

- 601 - Economics of Agricultural Production and Farm Management
- 603 - Market Economics
- 607 - Consumer Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Research

**Outcome # 6**

**1. Outcome Target**

Number of growers (commercial, small and fresh market) that adopt new varieties and methods to reduce yield losses and expenses, rejuvenate orchards, achieve better productivity and efficiency, provide environmental benefits (less fungicide applications, etc.), and effectively compete on the world market

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems

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

- 1862 Extension
- 1862 Research

**Outcome # 7**

**1. Outcome Target**

Number that adopt conservation strategies and practices

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 121 - Management of Range Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 8**

**1. Outcome Target**

Number in improved agricultural and fisheries/aquaculture sectors, e.g., commodities

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

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

- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 9**

**1. Outcome Target**

Number of policy makers and other stakeholders that are better informed about plant or animal production methods, technologies, and management techniques

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

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

- 205 - Plant Management Systems
- 216 - Integrated Pest Management Systems
- 307 - Animal Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 10**

**1. Outcome Target**

Improved knowledge of consumer and market conditions and factors that affect business survival and competitiveness such as market conditions, process map, business management, types of consumers and their food choices, motivations for food choice, marketing approaches for local markets and community food systems

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

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

- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics

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

- 1862 Extension
- 1862 Research

### **Outcome # 11**

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

Improved information about biology, control and resistance of viral, bacterial, fungal diseases, especially disease reproduction, transport and spread; postharvest decay; models to predict risk; and relationships between disease susceptibility and disease resistance

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems

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

- 1862 Extension
- 1862 Research

### **Outcome # 12**

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

Produce the next generation of growers and agricultural educators by integrating agricultural education into high school curriculums and community education

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

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

- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

### **Outcome # 13**

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

Number whose consumer business knowledge leads to improved opportunities, and more successful starts, activity, survival, and profitability in food enterprises, as well as new and improved value-added products

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

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

- 502 - New and Improved Food Products
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 14**

**1. Outcome Target**

Study mechanisms of important bacterial diseases affecting food sources in seafood production by enhancing the capacity and sustainability of salmon and trout populations.

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

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

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 15**

**1. Outcome Target**

Develop targeted intervention strategies to prevent pathogen contamination in bivalve rearing systems.

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

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

- 307 - Animal Management Systems
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 16**

**1. Outcome Target**

To study mechanisms of important bacterial diseases affecting food sources in meat production.

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

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

- 307 - Animal Management Systems
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research



**Outcome # 17**

**1. Outcome Target**

To create diagnostic approaches to characterize the genetic difference between bovine herpesvirus type 1 variants and vaccine strains.

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

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

- 311 - Animal Diseases

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

- 1862 Extension
- 1862 Research

**Outcome # 18**

**1. Outcome Target**

Develop strategies to increase immunity, including the development of vaccines, against pathogens that impact food sources. Identify the role of mother cow immunization on calf protection against MAP.

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

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

- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 19**

**1. Outcome Target**

Develop new strategies to increase immunity in animals through dietary supplementation of selenium and development of vaccines against influenza.

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

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

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities

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

- 1862 Extension
- 1862 Research

**Outcome # 20**

**1. Outcome Target**

Evaluate the toxicity of various mycotoxins in food.

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

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

- 311 - Animal Diseases
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 21**

**1. Outcome Target**

Use molecular breeding tools to develop resistance to abiotic and biotic stressors and to improve traits related to human health and nutrition in cultivars of importance in agriculture systems.

a)Conduct a systematic evaluation of germplasm resources to identify sources of genetic variation

- i. Develop new high throughput markers anchored in genome sequences
- ii. Map genes/QTLs determining target traits
- iii. Characterize gene/QTL networks and interactions
- iv. Measure gene/QTL x environment interaction
- v. Validate and fine map putative genes/QTLs
- vi. Transfer identified genes/QTLs into economically useful backgrounds, using accelerated generation advance strategies

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 206 - Basic Plant Biology

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

- 1862 Extension
- 1862 Research

**Outcome # 22**

**1. Outcome Target**

Improve the nutritional value of important food grains; 2) reduce the impact of wheat storage proteins on human health; and 3) target nutrient development with ripening control. Examples at OSU include barley (Hayes and Ross), wheat (Zemetra, Flowers, and Ross), and grape (Deluc).

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems

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

- 1862 Extension
- 1862 Research

### **Outcome # 23**

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

The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs.

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

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

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems

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

- 1862 Extension
- 1862 Research

### **Outcome # 24**

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

Fundamental Research Supporting Multiple Breeding Programs. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal).

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 603 - Market Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

#### **Outcome # 25**

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

Evaluation of wheat cultivars for performance and resistance to stripe rust.

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

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

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 603 - Market Economics
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

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

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

## Description

Projections of appropriations assume that state and federal budget will remain level or available through the five years in the plan. The level of funding or relative importance that our collaborating agencies, e.g., USDA/FS or BLM, put on research will be important for our continued success. Likewise, we are also dependent on competitive grant funds such as USDA/SARE or AFRI. Our continued success and productivity will partially, if not greatly, depend on our competitive success. Success with competitive grants will depend on our publication track record, relevance of proposed research and the ability of the federal government to continue funding these important research programs.

Government subsidies and programs can dramatically affect crop production. If subsidies exist for the production of a particular crop, despite long-term economic projections, acreage can be driven toward that crop. As fuel and fertilizer prices climb, growers may be forced to make production decisions based on available dollars versus any other factors. US immigration policy will affect the labor force available for field and processing work. US immigration policy affects the ability of students to come to the US for advanced study.

Where plans of work include field studies (resistance tests, pesticide trials, seed bulking, etc.), weather can always affect outcomes. Where plans of work include laboratory studies, results can be influenced by building infrastructure and repair of equipment. Turnover of personnel can disrupt progress, but can also bring opportunities for new investigators with different skill sets.

Economics and public policy are the critical. Changing or stricter rules on domestic productivity versus marketing (for imported commodities) create hardship for domestic growers in a global market.

Public concerns may result in the untimely removal of certain classes of pesticides from use before effective alternatives are identified.

The unintended introduction or identification of internationally quarantined pests could result in wholesale loss of the value of some agricultural enterprises - recent examples in other areas include Karnal bunt in wheat and mad cow disease.

Niche marketing to foreign countries is dependent on the balance of trade between the US and that country. If many goods are being shipped by container to the US and empty containers are available for the return shipment, shipment of small quantities of bulk materials can be affordable.

Public misconceptions regarding GMOs and transgenic breeding limits our effectiveness when producing new varieties or cultivars that are not GMOs but are perceived as such.

## V(K). Planned Program - Planned Evaluation Studies

### Description of Planned Evaluation Studies

Much of the research evaluation will be retrospective. Professional output from the program would qualify as scholarship implying a peer review process, validation and publication in journals. Publications and surveys to assess adoption will be utilized in evaluation.

Researchers need to address gaps in our existing knowledge if we are to create efficient ways to ensure food security for the broader population. The goals of this project are to develop comprehensive approaches to (i) improving productivity and (ii) controlling or mitigating losses. Better diagnosis of plant diseases as well as prevention and treatment measures are crucial for the productivity and sustainability of food systems as well as the establishment of safe food sources. This project provides important insights into the coordination of fundamental and applied research to achieve demonstrable advances in plant breeding to alleviate the impacts of biotic and abiotic stresses associated with climate change and an expanding human population.

Plant genetics, breeding, physiology and entomology are disciplines that directly impact every Oregonian, have stakeholders in multiple sectors of the state's economy, and have significant economic, environmental, and political impacts. Internationally and nationally, population growth and climate

change make providing nutritious, diverse, and abundant food an imperative. There is also a shortage of highly trained college graduates to address these challenges. Herein lies an opportunity for OSU to contribute to the PNW economy, to train the next generation of agriculture and food system scientists and producers, and to meet global challenges for food, fiber, and a healthy environment. Meeting the needs of our students and PNW growers will provide new information on how crops can be bred to deal with abiotic and biotic stressors. Many of the crops now grown in the Oregon and region were originally from elsewhere, and what we learn from improving the quality and quantity in the new growing region, i.e., the PNW, will provide the basis for advancing our basic understanding of plant biology and related issues. New genetic technologies will be instrumental in developing, and building on, our knowledge.

This project has two major priorities: 1) integrate basic and applied science to yield on-the-ground deliverables with high impacts in the state and the region; and 2) develop gene validation and expression genetics in economically important crop plants. This project will allow integration of these two priorities. Leadership in this integration aspect will be provided by the OSU Center for Genome Research and Biocomputing (CGRB), which provides services in the areas of Genomics, Functional Genomics, Biocomputing and Bioinformatics, and Imaging and Image Analysis. The plant breeding and genetics faculty at OSU are members of the CGRB and reside in two academic units: Crop and Soil Science (CSS) and Horticulture (HORT). Research and teaching functions are integrated in an emerging Plant Breeding and Genetics Program.

Establishment of food security involves many important aspects, from the source of the food to storage and transportation. We need to address gaps in our existing knowledge if we are expected to create efficient ways to ensure food security to the broader population. The goal of this project is to develop a comprehensive approach to address infectious diseases and toxins in food animals. We will study infectious conditions and toxins that have impact on food sources. Better diagnosis of diseases as well as prevention and treatment measures are crucial for the establishment of safe source of nutrients.

Appropriate stakeholder surveys will be conducted by Extension; industry trends and data on production practices in the industry will be monitored; input and equipment sales will be an indicator of adoption of some practices; case study measurements of soil and water quality will provide an indication of progress; producer surveys will also provide an indication of adoption.

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

### **Program # 4**

#### **1. Name of the Planned Program**

Food Safety

#### **2. Brief summary about Planned Program**

Our strengths in areas such as agricultural production systems, biotechnology, food processing and food safety systems, environmental toxicology and consumer marketing, trade, and economics position OAES and OSUES programs to further understand and develop the agriculture and food system in Oregon and the region. A combination of conventional, organic, and technology-based approaches will provide an array of strategies for sustainable, safe production of nutritional food. These food products will ensure a range of marketing niches for producers while providing the consumer with robust choices within a safe and secure food system. Expanded consumer education about the relationships of food, nutrition, and health will inform individual choices among an array of foods and food products.

Research will support producers and marketers in the safe production of certified organic and health-enhanced foods. Research will also provide analyses of health effects of agricultural and environmental chemicals as well as the use of foods and phytonutrients to maintain well-being. Expanded consumer education about the relationships of food, nutrition, and health will provide U.S. citizens with information for making individual choices among an array of foods and food products. Development, enhancement and adoption of technologies and strategies for food traceability will enhance food safety and agricultural competitiveness.

Additionally, individuals, families, and communities require education relating to numerous aspects of food safety, such as food handling and hygiene, prevention of food-borne diseases, and correct methods of food preservation. The OSUES Family and Community Health program has expertise and experience in developing and delivering effective educational programs to individuals and families.

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

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

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

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



**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
133	Pollution Prevention and Mitigation	0%		5%	
204	Plant Product Quality and Utility (Preharvest)	0%		5%	
306	Environmental Stress in Animals	0%		5%	
308	Improved Animal Products (Before Harvest)	0%		5%	
311	Animal Diseases	2%		5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		5%	
501	New and Improved Food Processing Technologies	12%		10%	
502	New and Improved Food Products	11%		10%	
602	Business Management, Finance, and Taxation	0%		5%	
603	Market Economics	0%		5%	
606	International Trade and Development Economics	0%		5%	
607	Consumer Economics	0%		5%	
701	Nutrient Composition of Food	12%		0%	
702	Requirements and Function of Nutrients and Other Food Components	0%		5%	
703	Nutrition Education and Behavior	15%		5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	12%		5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		5%	
723	Hazards to Human Health and Safety	10%		5%	
724	Healthy Lifestyle	8%		5%	
903	Communication, Education, and Information Delivery	8%		0%	
	<b>Total</b>	100%		100%	

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

## 1. Situation and priorities

Consumer demand for safe as well as high quality or value-added products has been increasing rapidly. Food processors seek ideas, inputs and support for developing innovations in packaging, processing, for the enhancement of product quality and safety, and the creation of approaches to develop novel products that meet specific market needs. The food processing industry is a critical, established Northwest sector, which generates over \$6.1 billion annual sales and employs more than 31,000 workers in Oregon alone. The support needs of the food industry equally affect large and small producers, and the urban and rural communities in which they are located.

Value-added processing or further manufacturing and marketing of agricultural-based products offer considerable potential for expansion, economic growth and job creation in the region, but businesses need information to tackle perceived high risk. For example, dairy, livestock and poultry producers are interested in finding natural products that meet the public's interest in healthy foods and enhances animal health without having to rely on antibiotics or other pharmaceuticals. Enrichment of fresh fruits with calcium, zinc, vitamin E or other PACs may increase the intake of these nutrients, thereby decreasing the need for nutritional supplements. Knowledge of the chemical constituents, pharmacokinetics, and metabolic pathways will augment and enhance our ability to prevent chronic disease and extend health-span. Conversely, an understanding of which food components are degraded or enhanced during processing will enable delivery of more potent forms of natural foods and food ingredients.

Foodborne disease outbreaks traced to seafood consumption and that of fresh fruits and vegetables is of continuing concern in the U.S. Advocated as part of a healthy diet, coupled with a growing consumer preference for minimally handled and processed food, results in a need to develop new and more product-specific technologies designed to curtail microbial contamination and decomposition with these foods. Strategies and technologies for tracing food as it moves through the food system is of increasing importance. Beside identifying or tracking microbial activity, use of agricultural chemicals, one of many tools used to ensure an abundant food supply, demands practical knowledge of their fate and effects in agricultural and natural ecosystems. Effective Integrated Pest Management seeks to minimize impacts on human and environmental health while assuring effective pest limitation.

The implementation of the Food Safety and Modernization Act (FSMA) will have a major impact on agriculture, especially small farms throughout the U.S. It requires new harvest and post-harvest handling practices and record keeping that minimize the risk of food-borne disease hazards. Small farms are artisanal in nature, have 1-5 employees and lack the capital (human and financial) to adopt such a system on their own. A critical need exists for development of a cost effective and simple-to-implement Food Traceability System (FTS) for small producers and processors. This project will model several small scale food production systems: berries, tree nuts, seafood and meats in order to identify and report both common and unique barriers to FTS implementation. The team will evaluate current technology in the context of how it's able to be implemented and recommend solutions for FTS implementation for small scale systems. The solutions we suggest to overcome barriers to FTS implementation will enable small scale systems to fully integrate a FTS system that will allow them to be proactive and prevent or minimize microbial outbreaks by integrating food safety and harvesting practices.

Existing strengths in agricultural production systems, food processing and food safety, biotechnology and genomics, environmental toxicology and consumer marketing, trade, and economics position the OAES and OSUES programs to further develop regional agricultural and food systems. Expanded consumer education about the relationships of food, nutrition, and health will inform individual choices among an array of foods and food products. Educational programs will result in safe food handling and safe methods of food preservation and preparation to reduce the prevalence of food-borne illnesses.

## 2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research

- Multistate Extension
- Integrated Research and Extension
- Multistate Integrated Research and Extension

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

### **1. Assumptions made for the Program**

Faculty members will effectively collaborate with professional peers throughout OSU campuses and field offices, as well as with university and governmental scientists in the state, region and the country, and with peers internationally. They work with commodity commission and grower association leaders. They will converse directly with growers, participants at various levels of the supply chain, and with consumers. They are members of successful regional and national competitive grant consortia. Through this array of contacts they have a keen awareness of local, state, regional, national and international outreach needs and opportunities in post-harvest handling and related food safety practices.

How Oregon's resources are managed to assure food is available, affordable, safe, and produced in a manner that sustains the health of people and the environment depends, in part, on improved understanding of the potential for adverse impacts of practices employed in agriculture and related industries. Oregon and other states of the Northwest produce have a particularly diversified agricultural production base with few crops that can be produced efficiently for the commodity market. This situation drives a need for value-added and niche market products to accomplish economic sustainability for agricultural producers and food processors. The development and adaptation of new food technologies requires today broader and deeper knowledge of food properties and accurate estimations of the response of quality attributes in foods to conventional and new non-thermal processes. The Oregon industry alone cannot respond to these demands, as new and improved technologies generate new engineering challenges requiring further research. Advances in these areas may optimally be achieved by OSU researchers working independently and also in collaboration with other research institutions in the U.S., and with the food processing industry.

An emerging issue, particularly for small growers, is the implementation of FSMA. OSU researchers and extension faculty will test a variety of small-scale food production systems: berries, tree nuts, seafood and meats in order to identify and report both common and unique barriers to FTS implementation. The team will evaluate current technology in the context of how it's able to be implemented and recommend solutions for FTS implementation for small-scale systems.

There is growing interest in identifying the specific chemoprotective constituents and their mechanisms of action, such as zinc's role in protecting cells from oxidation and damage to DNA. There may be other important minerals and foods that provide protection. We assume development of this knowledge will enable citizens and policy makers to make informed decisions and management choices that allow sustainable use of natural resources.

Interest among Oregonians in learning about food preservation continues to grow. Audiences across the state are increasingly interested in educational programs that focus on food preservation topics, especially using foods from gardens or local commercial sources. Evidence-based educational programs result in behavioral changes that increase the safe handling of food in the home, thereby decreasing food-borne illnesses. Extension faculty have the knowledge base, educational expertise, and programming skills to deliver up to date, scientifically accurate, and well received programs on a variety of food safety / food preservation topics.

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

The goal of this program is to develop a secure, high value/ high quality and safe food supply that yields successful and profitable Northwest producers and processing industries. Long-term objectives within this program include:

- To ensure Consumers have greater choice of safe, quality foods in a secure U.S. food supply chain
- To advance fundamental knowledge about food, nutrition, and health, including the effects of microbial and environmental chemical sources.
  - To enhance human and animal health, well-being, and survivability with the use of nutrition and nutrigenomics and development of organic production.
  - To improve the success and profitability of Northwest food producing, marketing and processing industries through research and education in consumer economics, sensory and consumer preferences, and value-added product development.
  - To reduce Human health risks from pest management practices (includes risks to applicators, non-applicators, food consumers, and non-target areas). Education of Spanish speaking workers will reduce health risks and improve effective use of Integrated Pest Management practices in the agricultural workforce.
  - To inform the public and policy makers about risks and benefits of agricultural and emerging chemical uses. This entails robust analyses of data deriving from research of these investigators and that available from work within the broader scientific community.
  - To increase the use of best practices relating to food safety principles by food preparers and servers in a variety of public and private settings. Education of food preparers will reduce the prevalence of diseases related to improper food handling and preparation.
    - Identify current traceability practices by small producers and processors.
    - Identification of Critical Tracking Events (CTEs) and Key Data Elements (KDEs).
    - Identification of benefits and costs to implementing FTS.
    - Training on FTS implementation for stakeholders.

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

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	6.0	0.0	25.0	0.0
2017	6.0	0.0	25.0	0.0
2018	6.0	0.0	25.0	0.0
2019	0.0	0.0	25.0	0.0
2020	0.0	0.0	25.0	0.0

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

**1. Activity for the Program**

This program will result in multiple outputs as a result of the following proposed activities:

- Conducting laboratory, pilot-plant experiments and data collection

- Conducting research experiments
- Developing quality monitoring protocols
- Developing and applying new technology of food processing systems
- Developing products, curriculum, resources
- Developing services
- Presenting seminars and professional talks
- Conducting workshops and training sessions
- Publishing scientific findings
- Partnering
- Providing community education classes
- Maintaining a statewide food safety hotline
- Working with and supervising volunteers to deliver high quality information and programming about food safety topics

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

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>• Education Class</li> <li>• Workshop</li> <li>• Group Discussion</li> <li>• One-on-One Intervention</li> <li>• Demonstrations</li> <li>• Other 1 (case studies)</li> <li>• Other 2 (statewide food safety hotline)</li> </ul>	<ul style="list-style-type: none"> <li>• Public Service Announcement</li> <li>• Newsletters</li> <li>• TV Media Programs</li> <li>• Web sites other than eXtension</li> <li>• Other 1 (radio media programs)</li> <li>• Other 2 (publications)</li> </ul>

**3. Description of targeted audience**

There are diverse audiences for the information this program generates. They can be classified into five general groups: (1) the general public and food consumers; (2) state and federal food regulatory agencies; (3) the research community including scientists working in government, industry, and academic sectors; (4) the commercial food processing industry and commodity groups; and (5) professional food handlers in organizations such as schools and other institutions, as well as restaurants.

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

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

#### **1. Output Measure**

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

O. No	Outcome Name
1	Understand nutritional relationships to health and food safety, such as: a) mechanisms behind the health benefits of fruits and vegetables, b) novel dietary modifications to reduce the incidence of disease, c) role of antioxidants from berries in preventing health disease
2	Improve animal food production systems that impact food safety by a) improving diets to produce safer foods and human benefits, b) enhancing efficacy and safety of vaccination programs, c) developing diagnostic methods
3	Characterize and model pathogens and toxins in food and food systems, including: * agents and mechanisms * toxicity to animals or humans * mechanisms behind immune suppression
4	Improved food handling and regulations, including: * food production and handling practices * intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses
5	Improved animal husbandry that reduces food safety issues
6	Number of specialty food and mainstream food processors accessing and applying science based information to produce and distribute safe, nutritious, high-quality foods
7	Number of individuals improving their practices of safe food handling, food preparation, and food preservation
8	Number of technologies and control strategies that improve food safety
9	Ability to detect incidences and trace pathways of food borne illnesses
10	Number of policy makers and managers informed about safe food handling and processing
11	Identify Current traceability practices by small producers and processors
12	Identification of Critical Tracking Events (CTEs) and Key Data Elements (KDEs)
13	Identification of benefits and costs to implementing FTS
14	Training for Stakeholders

## **Outcome # 1**

### **1. Outcome Target**

Understand nutritional relationships to health and food safety, such as: a) mechanisms behind the health benefits of fruits and vegetables, b) novel dietary modifications to reduce the incidence of disease, c) role of antioxidants from berries in preventing health disease

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

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

- 133 - Pollution Prevention and Mitigation
- 502 - New and Improved Food Products
- 701 - Nutrient Composition of Food
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle

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

- 1862 Extension
- 1862 Research

## **Outcome # 2**

### **1. Outcome Target**

Improve animal food production systems that impact food safety by a) improving diets to produce safer foods and human benefits, b) enhancing efficacy and safety of vaccination programs, c) developing diagnostic methods

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

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

- 308 - Improved Animal Products (Before Harvest)
- 311 - Animal Diseases
- 502 - New and Improved Food Products

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

- 1862 Extension
- 1862 Research



### **Outcome # 3**

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

Characterize and model pathogens and toxins in food and food systems, including:

- \* agents and mechanisms
- \* toxicity to animals or humans
- \* mechanisms behind immune suppression

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

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

- 501 - New and Improved Food Processing Technologies
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety

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

- 1862 Extension
- 1862 Research

### **Outcome # 4**

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

Improved food handling and regulations, including:

- \* food production and handling practices
- \* intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses

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

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

- 204 - Plant Product Quality and Utility (Preharvest)
- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 501 - New and Improved Food Processing Technologies
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety

- 724 - Healthy Lifestyle

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

- 1862 Extension
- 1862 Research

**Outcome # 5**

**1. Outcome Target**

Improved animal husbandry that reduces food safety issues

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

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

- 306 - Environmental Stress in Animals
- 308 - Improved Animal Products (Before Harvest)
- 311 - Animal Diseases
- 502 - New and Improved Food Products
- 701 - Nutrient Composition of Food
- 702 - Requirements and Function of Nutrients and Other Food Components
- 724 - Healthy Lifestyle

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

- 1862 Extension
- 1862 Research

**Outcome # 6**

**1. Outcome Target**

Number of specialty food and mainstream food processors accessing and applying science based information to produce and distribute safe, nutritious, high-quality foods

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

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

- 133 - Pollution Prevention and Mitigation
- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products

- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 7**

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

Number of individuals improving their practices of safe food handling, food preparation, and food preservation

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

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

- 501 - New and Improved Food Processing Technologies
- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 8**

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

Number of technologies and control strategies that improve food safety

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

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

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle

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

- 1862 Extension
- 1862 Research

**Outcome # 9**

**1. Outcome Target**

Ability to detect incidences and trace pathways of food borne illnesses

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

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

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 607 - Consumer Economics
- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle

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

- 1862 Extension
- 1862 Research

**Outcome # 10**

**1. Outcome Target**

Number of policy makers and managers informed about safe food handling and processing

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

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

- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 11**

**1. Outcome Target**

Identify Current traceability practices by small producers and processors

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

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

- 204 - Plant Product Quality and Utility (Preharvest)
- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics

- 607 - Consumer Economics
- 701 - Nutrient Composition of Food
- 702 - Requirements and Function of Nutrients and Other Food Components
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 12**

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

Identification of Critical Tracking Events (CTEs) and Key Data Elements (KDEs)

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

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

- 204 - Plant Product Quality and Utility (Preharvest)
- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 13**

**1. Outcome Target**

Identification of benefits and costs to implementing FTS

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

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

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 607 - Consumer Economics
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 14**

**1. Outcome Target**

Training for Stakeholders

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

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

- 703 - Nutrition Education and Behavior
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

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

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

#### **Description**

This program focuses in part on increasing understanding and knowledge, as well as disseminating information of food product development, that is, food processing technologies (edible coatings, vacuum infusion and high pressure processing), microbial detection methods for research/food production, food chemistry, and sensory quality. Multiple external factors inform decisions regarding priorities for research and extension activities. Recent food recall incidents, media exposure, or current "hot topics" can drive the food research agenda and OSUES activities. Agricultural commodity groups, state natural resource agencies, the major food processing industry, and consumer interest groups influence allocation of state and federal funds through the legislative process. They also sponsor research directly.

Scientific peer review panels are especially important in directing federal support for research and extension. Public opinion is also a powerful force in determining both state and federal resource commitments necessary to sustain this program.

The program focuses on educating individuals, families, and organizations about best practices related to food safety, resulting in positive behavior changes and, ultimately, reduced incidence of food-borne illnesses. Therefore our evaluation of these educational programs will include attention to a variety of significant outcomes, particularly changes that are being produced in participants' knowledge, attitudes, skills, and behaviors.

"Note on "Appropriations": These projections are based on an assumption that budget will remain level across the five years in the plan."

### **V(K). Planned Program - Planned Evaluation Studies**

#### **Description of Planned Evaluation Studies**

Most of the program evaluation will be retrospective. Efforts will be evaluated based on the stated objectives, and the entire programmatic project will undergo periodic evaluation. The evaluation process will assess project planning, project implementation and project outcomes. Publications, surveys to assess adoption, and Digital Measures will be utilized in evaluation. Numbers of manuscripts and theses



will be tabulated for the Program. Reactions of peer review panels to grant applications is another means for evaluation of research initiatives. Faculty departments record each submission and our accounting system tracks awards. Reviews of total intramural and extramural funding occurs on a semi-annual basis. Data collection will occur as appropriate in accordance with the expected outcomes.

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

### **Program # 5**

#### **1. Name of the Planned Program**

Childhood Obesity

#### **2. Brief summary about Planned Program**

Obesity results from complex interactions between physiological, behavioral, social, and environmental variables. While obesity has been increasing among adults, it is also becoming more prevalent in children. Currently, about 32% of children and adolescents aged 2-19 years of age are overweight, while 17% are obese. The increasing number of youth experiencing weight problems is troubling, since it puts them at risk for one or more chronic diseases earlier in life. OAES and OSUES will study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as increase acceptability. We also will determine if the greater exposure and familiarity with whole grains, vegetables and fruits increases the selection and incorporation of these foods into typical dietary patterns at home and in school lunches as well as among seniors in residential retirement communities. The program will examine what environmental and social factors predict how groups (e.g. communities, schools, families) and/or individuals (e.g. mothers, family food providers, etc.) make long-term positive changes in dietary patterns, healthy eating and physical activity (PA) behaviors for obesity prevention and reduction of chronic disease risk. Finally, we are interested in the impact of diet (types of foods) and levels of PA intensity on appetite, food selection and weight management.

The program will include a wide variety of educational strategies and activities with focus on:

- promoting healthy eating by children and their families, and
- increasing children's levels of physical activity

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

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

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

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

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
610	Domestic Policy Analysis	0%		10%	
703	Nutrition Education and Behavior	30%		20%	
704	Nutrition and Hunger in the Population	10%		10%	
724	Healthy Lifestyle	10%		20%	
802	Human Development and Family Well-Being	5%		10%	
806	Youth Development	20%		20%	
901	Program and Project Design, and Statistics	10%		0%	
903	Communication, Education, and Information Delivery	15%		10%	
	<b>Total</b>	100%		100%	

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

## 1. Situation and priorities

Childhood obesity is a national epidemic and the problem is quite significant in Oregon. The increasing number of youth experiencing weight problems is troubling, since it puts them at risk for one or more chronic diseases earlier in life. Currently, approximately 32% of children and adolescents aged 2-19 years of age are overweight, while 17% are obese. Research has demonstrated that childhood obesity is linked to numerous factors including, e.g., low availability and high cost of healthy foods, low levels of physical activity in children, extensive advertising of high-calorie, high-fat fast food chains, and lack of awareness on the part of families about multiple aspects of a healthy diet. The problem is more severe in low-income or rural areas where options, and frequently, family resources, are limited.

This program will study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as increase acceptability. The project will examine what environmental and social factors predict how groups (e.g. communities, schools, families) and/or individuals (e.g. mothers, family food providers, etc.) make long-term positive changes in dietary patterns, healthy eating and physical activity (PA) behaviors for obesity prevention and reduction of chronic disease risk. We are interested in the impact of diet (types of foods), familiarity with the food, food sensory attributes, and levels of PA intensity on appetite, food selection and weight management.

The outcomes of our studies will have a tremendous impact on populations of great need, i.e., rural populations who face on-going challenges of health and well-being, families and individuals who live in poverty, and families of Latino and underrepresented groups in Oregon. The project activities will yield important knowledge about the factors that positively or negatively affect physical activity behavior, as well as, how much daily physical activity is critical in maintaining adequate energy balance/energy expenditure issues that affect obesity.

We also have a unique opportunity to learn how community conditions and public policy affect the food, lifestyle, work and residence choices of rural versus urban households. Availability of four decades of panel data on household work and migration decisions allow new data sets - particularly the Local Employment Dynamics (LED) data available from the Department of Labor and U.S. Bureau of the Census

- allow analysis of household decisions about work and place of residence that were unimaginable a decade ago. Statistical tools for econometric analysis - including tools for spatial analysis and analysis of panel data - have been developed and new statistical software makes these tools widely accessible.

OSUES is in a good position to provide educational programs to address behavioral factors related to childhood obesity through innovative, effective programs at the individual, family and community levels.

## **2. Scope of the Program**

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

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

### **1. Assumptions made for the Program**

The key assumptions of this research project are that:

- Federal, state and local policymakers seek to understand how individual economic opportunity is affected by local economic and social context,
  - Such understanding will be useful in designing federal, state, and local policy to support state and local efforts to increase local community capacity
  - Underlying challenges and interactions of public assistance and public policy affect the quality of life of families and individuals who live in poverty
  - Daily physical activity is critical in maintaining adequate energy balance/energy expenditure issues that affect obesity
  - Obesity, especially childhood obesity, is a health and social issue that is responsive to improvement through Oregonians' behavioral and lifestyle changes
  - Delivering educational programs for children and parents, in multiple forms depending on audience characteristics, program goals, etc., can be an effective strategy for combating childhood obesity
  - Significant and durable change is best supported by "systems-based" or "contextual approaches" to addressing childhood obesity, that is, programs which target individual behavior change must be augmented by programs that change environments in which young people live (families, schools, communities, and policies)

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

This program will produce important insights about urban, rural and underrepresented populations who face on-going challenges of health, well-being, and economic opportunities. Research and extension efforts fall into two subareas:

1. Factors affecting the health and economic opportunities of Oregon's people and the economic and social vitality of its communities.
2. Strategies and policy affecting individual opportunities for urban, rural and underrepresented people, and their economic and social conditions.

#### **Program objectives**

1. To demonstrate the benefits of human nutrition and interaction of healthy behavioral choices, including healthy diet and physical activity
  - To identify food compounds, dietary patterns, and educational strategies that promote healthy lifestyles and weights
  - To provide strategies which prevent or reduce obesity in high risk families and improve weight maintenance
  - To identify strategies and activities that result in children, youth, and families practicing healthy eating and engaging in healthy levels of physical activity.
2. To examine perceptions of and barriers to physical activity
  - To identify individual attributes and family processes associated with specific patterns of physical activity among youth within the context of a community.
  - To identify specific resources, opportunities, and barriers within the social and physical environment that either positively or negatively affect patterns of physical activity among youth
  - To examine how individual attributes, family processes, and characteristics of place shape the capacity of youth to develop and maintain healthy patterns of physical activity.
3. To understand the links between quality of life for individual families and wider community and public policy influences

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

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

Year	Extension		Research	
	1862	1890	1862	1890
2016	6.0	0.0	2.0	0.0
2017	6.0	0.0	2.0	0.0
2018	6.0	0.0	2.0	0.0
2019	0.0	0.0	2.0	0.0
2020	0.0	0.0	2.0	0.0

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

**1. Activity for the Program**

We will determine factors that drive the decisions of individuals and householders to adopt and maintain healthy lifestyle choices. Further, we will use a social-ecological framework to study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as acceptability.

We will also:

- Conduct evidence-based educational programs and activities that are directed at parents, children, professionals, partner agencies, and other audiences.
- Develop or select new 4-H foods curricula that focus on the youth learning to prepare healthy, local foods.
- Develop a curriculum designed to help older youth become local advocates for healthy eating and physical activity in their communities. The curriculum will help young people learn how to conduct

community assessments and lead community change efforts that focus on education, system building, and policy development.

In summary, we will:

- Conduct surveys
- Conduct data analyses
- Conduct mixed-methods longitudinal research (interviews,
- Conduct Research Experiments
- Develop models
- Develop Products, Curriculum, Resources
- Provide Training.
- Assessments.
- Partnering
- Partnering.

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

**Extension**

Direct Methods	Indirect Methods
<ul style="list-style-type: none"> <li>● Education Class</li> <li>● Workshop</li> <li>● Group Discussion</li> <li>● One-on-One Intervention</li> <li>● Demonstrations</li> <li>● Other 1 (professional journals)</li> <li>● Other 2 (policy briefs)</li> </ul>	<ul style="list-style-type: none"> <li>● Newsletters</li> <li>● Web sites other than eXtension</li> <li>● Other 1 (Newspaper articles)</li> </ul>

**3. Description of targeted audience**

- children, youth, and families across Oregon
- schools and others youth educators
- elderly residents
- urban and rural residents
- Latino populations
- economists.
- policy makers and agency personnel who work with children and families .

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

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

### **1. Output Measure**

Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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

O. No	Outcome Name
1	Conceptual model will guide research to understand the factors & processes that account for physical activity and the associated health outcomes among youth across ethnic and class boundaries in the context of changing communities
2	Knowledge gained to develop strategies for maximizing physical activity and physical and mental health of youths and adults
3	Improved outreach, education, and professional practice to serve the needs of low-income families, including programmatic interventions that reduce physical inactivity and promote the well-being of lower-income and ethnic minority youth across America
4	Develop understanding of human health and nutritional behaviors * obesity intervention strategies * bio-behavioral markers * key parent-child relationships * family interactions * peer interactions * personal choices
5	Improved nutrition * schools offer/encourage healthful foods * more effective programs and student experiences * markers and strategies become the standards of methods and measurement of childhood overweight and resiliency
6	Identify tactics, strategies and factors that provide families, children, and youth access to healthy foods
7	Children practice healthy eating as defined by the current U.S. Dietary Guidelines for Americans (Percent of target audience indicating positive change in measured outcome)
8	Children engage in healthy levels of physical activity as defined by national physical activity guidelines (Percent of target audience indicating positive change in measured outcome)
9	Increases in positive levels of Knowledge, Attitude, Skills and Aspiration (KASA) outcomes, as per Bennett & Rockwell, 1995, related to goals of reducing obesity (Percent of target audience indicating positive change in measured outcome)



### **Outcome # 1**

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

Conceptual model will guide research to understand the factors & processes that account for physical activity and the associated health outcomes among youth across ethnic and class boundaries in the context of changing communities

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

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

- 610 - Domestic Policy Analysis
- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 2**

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

Knowledge gained to develop strategies for maximizing physical activity and physical and mental health of youths and adults

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

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

- 610 - Domestic Policy Analysis
- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 3**

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

Improved outreach, education, and professional practice to serve the needs of low-income families, including programmatic interventions that reduce physical inactivity and promote the well-being of lower-income and ethnic minority youth across America

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

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

- 610 - Domestic Policy Analysis
- 802 - Human Development and Family Well-Being
- 901 - Program and Project Design, and Statistics
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

### **Outcome # 4**

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

Develop understanding of human health and nutritional behaviors

- \* obesity intervention strategies
- \* bio-behavioral markers
- \* key parent-child relationships
- \* family interactions
- \* peer interactions
- \* personal choices

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

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

- 703 - Nutrition Education and Behavior
- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 806 - Youth Development
- 901 - Program and Project Design, and Statistics
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 5**

**1. Outcome Target**

Improved nutrition

- \* schools offer/encourage healthful foods
- \* more effective programs and student experiences
- \* markers and strategies become the standards of methods and measurement of childhood overweight and resiliency

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

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

- 610 - Domestic Policy Analysis
- 703 - Nutrition Education and Behavior
- 704 - Nutrition and Hunger in the Population
- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

**Outcome # 6**

**1. Outcome Target**

Identify tactics, strategies and factors that provide families, children, and youth access to healthy foods

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

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

- 610 - Domestic Policy Analysis
- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

#### **Outcome # 7**

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

Children practice healthy eating as defined by the current U.S. Dietary Guidelines for Americans (Percent of target audience indicating positive change in measured outcome)

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

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

- 703 - Nutrition Education and Behavior
- 704 - Nutrition and Hunger in the Population
- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

#### **Outcome # 8**

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

Children engage in healthy levels of physical activity as defined by national physical activity guidelines (Percent of target audience indicating positive change in measured outcome)

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

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

- 724 - Healthy Lifestyle
- 802 - Human Development and Family Well-Being
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

#### **Outcome # 9**

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

Increases in positive levels of Knowledge, Attitude, Skills and Aspiration (KASA) outcomes, as per Bennett & Rockwell, 1995, related to goals of reducing obesity (Percent of target audience indicating positive change in measured outcome)

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

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

- 703 - Nutrition Education and Behavior
- 724 - Healthy Lifestyle
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

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

- 1862 Extension
- 1862 Research

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

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

##### **Description**

Childhood obesity is a multi-component, complex issue, and all of the above indicated factors can potentially affect its prevalence in Oregon.

Note on "Appropriations": These projections are based on an assumption that budget will remain

level across the five years in the plan.

## **V(K). Planned Program - Planned Evaluation Studies**

### **Description of Planned Evaluation Studies**

Evaluation studies include During, Before-After and After-Only evaluations, and in some instances, case studies and time series. The most prevalent data collection methodologies are the sampling, observation, on-site survey, structured and unstructured interviews.

Annual performance monitoring data will be collected from participating counties to develop aggregate measures of program participants who have gained knowledge related to diet or physical activity.