2019 Annual Report of Accomplishments and Results

Oregon
Oregon State University

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

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.

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	Internal University Panel; Combined External and Internal University/External Non-University Panel; Expert Peer Review. 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. This year, OAES and OSUES faculty in the College of Agriculture Sciences (CAS) undertook a new strategic planning exercise to direct research and extension efforts in the future. What emerged were four key areas of distinction that encompass all the CAS's 13 on campus units and 11 BES across the state. These themes are as follows: 1) Marine conservation and food systems, 2) Argricultural competitiveness and resilience, 3) Markets and

	access in food and health innovations, and 4) Working and natural landscapes. These were developed based on input from the Dean's leadership team, unit leaders and all CAS faculty. Going forward, each unit will be evaluated annually as to the outcomes generated as a measure of success for meeting these four areas.
2. The Scientific Peer Review Process	All OAES projects funded via capacity grants or competitive grants are subjected to the peer review process. For capacity grants, collaborative projects are subjected to peer review by scientists at other land grant institutions with expertise within that particular discipline. Subsequent to the external peer review, collaborative projects are then submitted to NIFA via the REEport portal for final review by NIFA. Participation by faculty on multi-state projects are subject to similar review. The project is initially subject to review by the Multi-state Research Committee for each region and then NIFA for approval. Each participant on the project must create a REEport record outlining their contributions to the project and this record is reviewed by NIFA prior to acceptance for participation and funding. External grant applications are processed through internal and external peer review that is unique to each funding agency but relatively similar in most important aspects. All professional journals subject submitted manuscripts through their own editorial board and anonymous peer review process. Many other pass-through granting entities such as the Sea Grant and Sun Grant employ a scientific peer review process that reflects the requirements of the funding agency. Foundation grants (e.g., Agricultural Research Foundation) are peer reviewed internally before being submitted to the commodity group providing funding. Each commodity group enlists their own membership and outside expertise to make decisions regarding which submittal will be selected for funding. Please note these are commodity funded projects and no state or federal funds are involved.

III. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	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 groups Survey of selected individuals of the general public The Director, as well as Associate Directors, Assistant Director and the External Relations Director, travel throughout the state to interact at formal and informal stakeholder events. Events included field days, special commodity events, County and State fairs, faculty organized conferences and workshops. They also attended events organized by various industry, public and nonprofit entities to interact with stakeholders. Faculty also attended all events. Reviews of unit leaders and faculty are conducted periodically to assure that personnel are responding appropriately to relevant stakeholders, industry, and consumers. Each unit also has an advisory council of important stakeholders and the public at large that assist with setting strategic direction and allocation of resources.

2. Methods to identify individuals and groups and brief explanation.	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. As mentioned previously, CAS has undertaken a new strategic planning exercise that will change the focus of future scientific and extension activities around four areas of distinction. 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 date, 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.
3. Methods for collecting stakeholder input and brief explanation.	Use of Advisory Committees Use of Internal Focus Groups Use of External Focus Groups Open Listening Sessions Legislative Hearings and Requests for Information Meetings with State and Local Elected Officials Meet with agency representatives Meeting with Congressional members and staff Meetings with commodity groups Meetings with industry suppliers Meetings with consumer groups Needs Assessments

	User Surveys Other (blogs, fairs, social media, websites,) Extension, Station, and departmental faculty, as well as unit leadership provide information on critical stakeholders and groups. The deans and the External Relations Director also identify important clientele through their many contacts. The Director's advisory group is composed of industry and community leaders. They meet regularly to update the Station administrators about critical issues and developments around the state or in their industry. Every branch station enlists stakeholders to serve as an advisory council for station work planning and research emphasis.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	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 suggested a very modest increase of above continuing service levels but recent economic impacts of the pandemic, inflation, increasing cost of salary and benefits, and the need to replace aging infrastructure and equipment suggest declining budgets for the immediate future. 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. That document was replaced in 2019 in an ongoing process to describe key areas distinction where we demonstrate unique leadership that is recognized as an area of strength and opportunity. 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.

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	Impact of Environmental Chemicals: Br the Spectrum Of Environmental Toxicit Assessing Exposures, Distribution, And Molecular Mechanisms Of Effects of Chemicals	Dr. Tanguay's laboratory improved human health by exploiting the advantages of the zebrafish (Danio rerio) model and evaluated environmental biological effects o chemicals humans are constantly exposed to in air, water, and food The Tanguay continue to develop the zebrafish model as a powerful surrogate vertebrate mode complex biological assays of the effects of environmental chemicals, and the rang underlying inter-individual susceptibilities at the molecular level to these environm pollutants.	4
2.	Oregon State University researchers have developed a blood test to identify dairy cows are susceptible to bovine clinical mastitis.	Bovine clinical mastitis, a bacterial infection of the udder, is the most prevalent and costly disease in the dairy industry. Diagnosed shortly after calving, the disease strikes about 16.5 percent of U.S. dairy cows in the first 30 days of lactation. Clinical mastitis costs the dairy industry millions of dollars of lost milk income and loss of cows due to the disease. The OSU test can assist with prevention and early treatment intervention against clinical mastitis, thereby improving cow health and welfare. The researchers identified biomarkers in the cows' blood that could indicate which of them are at increased risk of a specific disease.	3
3.	Preventing Johne's Disease	Mycobacterial diseases of animals are serious program worldwide. In agriculture, *Mycobacterium avium subspecies paratuberculosis*, the cause of Johne's disease, and *Mycobacterium bovis*, the agent of bovine tuberculosis are associated with significant economic loss and health related issues for animals and humans. During the past 3 years we developed an in vitro cell-based model system for Johne's disease, that is now allowing us to answer many questions related to the infection. The model compares quite well with the response of animals to the infection. Using the model, specific proteins produced by the bovine host, during different phases of infections, have been identified. We also used the model to determine the bacterial proteins involved	3

		in the bacterial uptake by the intestinal mucosa. Surface bacterial antigens have been characterized and are currently being tested for use as vaccines aiming to prevent the infection of the young animal. In a different project, we recently we have developed an experimental vaccine against *M.bovis*, which has been shown effective in mice and is going to be tested in cattle.	
4.	Feeding Selenium fertilized hay to cattle to reduce parasite loading in weaned beef calves.	Cattle, unlike humans, do not receive passive immunity in utero (transfer of antibodies from mother to offspring) as antibodies do not cross the placenta; however, it is known that immunoglobulins in milk colostrum can convey passive immunity in newborn calves in the first 48 hours of life (transfer of antibodies from colostrum in gut to blood stream of calf). The period during which the intestine is permeable to antibodies varies but is highest immediately after birth and decreases to relatively low levels by 24 hours. Failure of passive transfer predisposes a calf to infection. Feeding Se-enriched hay to cows for 8 weeks prior to birth leads to significantly increased Se concentrations in colostrum and improves passive transfer leading to higher whole-blood immunoglobulin concentrations in newborn calves.	3
5.	Sustainable solutions to problems affecting bee health	Significantly higher honeybee colony losses have been reported for the past decade. Malnutrition is one among several factors attributed to these colony losses. Pollen is the primary source of protein for bees. There is a huge gap in knowledge regarding nutritional composition of pollens and other artificial bee diets. In this study key phytosterols and metabolites present across a spectrum of bee dietary sources, including some of the major bee-pollinated crop pollens in the western United States will be identified. Targeted sterol analysis and untargeted metabolomics will be conducted on commercially available crop pollens, bee-collected crop pollens and commonly used artificial protein supplements.	3
6.	Climate change negatively affects waterbirds in the American West	New research shows that recent climate change is having profound effects on wetlands across the American West – affecting birds that use these wetlands for breeding, migration and wintering. According to the study, higher temperatures and less precipitation have reduced waterbird habitat, resulting in fewer birds in the region and elsewhere. The study, which began in the mid-1990s, is the result of a research collaboration between scientists at Oregon State University, U.S. Geological Survey, University of California, Merced; and the Alliance for Global Water Adaptation.	2

7.	West Coast forest landowners will plant less Douglas-fir	West Coast forest landowners are expected to adapt to climate change by gradually switching from Douglas-fir to other types of trees such as hardwoods and ponderosa pine, according to a new Oregon State University study. The study, the first to estimate an economic model of forest-planting choices by landowners as a function of climate, finds evidence that Douglas-fir will be less productive in the Pacific Northwest under a warming climate, but those analyses haven't considered how landowners will respond, according to OSU scientists. The model shows a change in the forest landscapes will generate habitat losses for wildlife specialized to Douglas-fir and habitat gains for wildlife specialized to other forest types. Subsidizing carbon sequestration may create unintended changes in the composition of forests and wildlife habitat.	2
8.	Installing solar panels on agricultural lands maximizes their efficiency	The most productive places on Earth for solar power are farmlands, according to an Oregon State University study. The study finds that if less than 1% of agricultural land was converted to solar panels, it would be sufficient to fulfill global electric energy demand. The concept of co-developing the same area of land for both solar photovoltaic power and conventional agriculture is known as agrivoltaics. The results indicate that there's a huge potential for solar and agriculture to work together to provide reliable energy. The results have implications for the current practice of constructing large solar arrays in deserts. OSU researchers previously published research that shows that solar panels increase agricultural production on dry, unirrigated farmland. Those results indicated that locating solar panels on pasture or agricultural fields could increase crop yields.	6
9.	Optimizing Ground and Surface Water Resources for Agricultural Production, Drinking Water Quality, and Ecosystem Health in the Umatilla Basin, OR	Irrigation optimization is underway to facilitate the transition from center pivot irrigated onions to sub-surface drip irrigation. This transition has many benefits such as reduced water and nutrient losses, as well as increased onion yield and quality. Despite the benefits, growers of onions did not believe that sub-surface drip irrigation would be possible with the coarse soil of the Umatilla Basin. Our research has demonstrated that sub-surface irrigation is possible in coarse sandy soil, and we have developed a set of soil moisture recommendations to guide producers. Previous to this research, only 100 acres of onion in the Umatilla Basin were produced under sub-surface drip irrigation, now that area has expanded to 800 acres and is slated to be increased next season. Regional processing companies use fresh water to cool industrial facilities and wash produce. The water, after use, is recycled and stored in holding ponds. This water contains nitrogen and other nutrients that can support crop growth. A	3, 6

		small number of growers are permitted to pumping the re-use water to irrigate their crops, but the Oregon Department of Environmental Quality is issuing violations for improper use patterns. The violations are issued based on no supported research, and are restricting the potential of this resource. We have worked with a group of stakeholders to identify challenges and research needs, and then we wrote a proposal to help expand the potential of re-use water. The proposal was funded for five years as of 2020 for $456,825 to evaluate soil/plant/nutrient relationships with re-use water in the Lower Umatilla Basin. This project will help optimize the limited water resources in the Umatilla Basin, and establish in-depth nutrient recommendations to reduce nitrogen leaching and water losses.	
10.	Assessing Key Factors Influencing Farmers` Water Use and Irrigation Decisions on the U.S. West Coast	Agriculture is the largest water user in the United States, accounting for 80-90% of human water consumption in the arid west. Improving water resource management requires a deeper understanding of key factors influencing agricultural water use. The goal of this project is to address this need by identifying the key economic, biophysical, climate, and, institutional factors influencing farmers' water application rates and irrigation technology adoption on the U.S. West Coast (California, Oregon, and Washington). The specific objectives are: 1) Create a profile of water and climate variables affecting specific crops, including the timing dimensions of these variables and whether there are "upside" or "downside" risks; 2) Develop crop-specific databases on spatial and temporal variations of important climate variables affecting crop production on the West Coast; 3) Develop a database to characterize water availability, water supply institutions, irrigation technology, and water use across farms on the West Coast; 4) Develop a farm-level modeling system to understand how water availability, water supply institutions, climate, and extreme weather affect farmers' crop choice, water use and irrigation technology adoption for specialty crops, grain, and forage crops on the West Coast; 5) Use the modeling system to analyze how farmers would respond to changes in climate and water policy and to understand the barriers or disincentives to adopt efficient irrigation technologies; and 6) Communicate findings to inform policy on water resource management. Our approach will be to develop unique water and climate databases and construct water use and irrigation technology adoption models, capitalizing on the expertise of faculty in the PRISM Climate Group, Plant Science at UC Davis, and Applied Economics at Oregon State University. This project will provide value to society by supporting informed public and private decision making for managing water scarcity and climate variability on the U.S. West Coast. Preliminary results pending.	6, 3

11.	Soil, Water, and Environmental Physics to Sustain Agriculture and Natural Resources	Agricultural scientists have been charged with finding ways to double productivity on the same soil footprint, while using the same or even decreasing resources, in an era of fluctuating climate patterns. To this end, advancements in irrigation technology have permitted incredible agricultural productivity in soils that would not otherwise be useful. Sandy loams in semi-arid climates are one example. On one hand, low clay content, poor aggregation and dry hot climate make these soils ideal for growing root crops, but on the other hand, these same attributes make these soils exceedingly difficult and challenging from an environmental perspective. Their high hydraulic conductivity may lead to high throughput of nitrates to aquifers, their poor aggregation lead to soil losses by erosion, and their low clay content lead to poor water retention that requires increased irrigation frequency. Still, any agriculturally viable land can no longer be ignored. This project directly addresses one sector of this very important charge by investigating a new way of soil management that encourages the use of native microbial biofilms and other organic matter to improve soil function. It is hypothesized that biofilms can take on many of the roles of clay by increasing aggregation, decreasing conductivity and increasing moisture retention. Furthermore, this approach is in line with sustainable agricultural practices that foster soil health and preserve our soil resources for future generations. Preliminary results are pending.	6
12.	Packaging insecticides in tiny capsules may make them more toxic	Encasing insecticides in microscopic plastic capsules – a common formulation for many pest sprays on the market – could lead to unintended consequences, according to a new study from Oregon State University. Scientists found that a common insecticide in its “capsule suspension” formulation – with molecules of the active ingredient encapsulated in tiny, inert plastic pellets – was more toxic than the same amount of active ingredient delivered straight up in water. They exposed a species of water flea (Ceriodaphnia dubia) to five doses of the pesticide’s active ingredient. One group got it in micron-sized capsules, and another group got the same dose in nanometer-sized capsules. As a control, a third group got the same dose of active ingredient, but it was not encapsulated. The team found toxicity for the water fleas increased in the nanometer-sized capsules. The crustaceans were immobilized, leading to their death. The species lives in freshwater lakes, ponds and marshes and, due to its sensitivity to pollutants, is used in toxicity testing of waterways.	4
13.	Development of Bio-Enabled Nano-Plasmonic Sensing Technology For Rapid Detection Of Histamine And Aquaculture Drugs In Seafood	This project targeted portable biosensing technique for rapid, reproducible, in-situ detection of multiplex contaminants in seafood, which can also be readily applied to other food testing applications. In this study, we have developed a quantitative TLC-SERS sensing method to detect histamine from artificial and real spoiled tuna samples with SVR analysis. The diatomaceous earth TLC	4

		plates used herein not only separate histamine from complex tuna meat matrix, but also serve as ultra-sensitive SERS substrates to enhance the detection limit down to 10 ppm, which is far below the 50 ppm safety level set by US FDA. In addition, we applied the TLC-SERS sensing techniques to detect histamine from real spoiled tuna samples. Using the PCA-SVR algorithm to analyze the SERS spectra, we are able to build an accurate quantitative model to evaluate the histamine level with respect to the spoilage time in real tuna samples. Considering that TLC is one of the low cost analytical chemistry methods and the affordability of portable Raman spectrometers, the reported SVR-enabled TLC-SERS sensor would enable a rapid, cost-effective, and quantitative on-site detection technique for histamine in seafood.	
14.	**Novel immunomodulatory and antimicrobial peptides within the infant intestine**	Most current therapeutics for inflammatory disorders and microbial dysbiosis have generic actions and numerous side effects. Novel bioactive molecules with more specific effects are critically needed. Milk proteins co-evolved with infants to protect the immature immune system from microbial and immune threats. Digestion of milk proteins in the infant gut releases an array of bioactive peptides. There is a critical need to identify the milk peptides released in the infant gut and determine their antimicrobial and immunomodulatory actions. The overall objective of this proposal is to identify which peptides are released from milk proteins in the infant intestinal tract and that survive to infant stool and apply in vitro testing, iterative fractionation and bioinformatics to determine their functions. We have demonstrated that the milk peptides from in vitro intestinal digestion have antimicrobial actions against E. coli and S. aureus. We identified one main fraction that is antimicrobial. We have identified that the pool of peptides from the in vitro digest has anti-inflammatory actions when incubated with macrophages. We now need to test the isolated fractions of these peptides to determine which has the specific effect.	5
15.	Extending Food Safety Training to Frontline Communicators with Seafood Harvesters	The purpose of this project is to support the expansion of a newly developed and successful food safety and quality training program, the OSU Better Seafood Processing School (BSPS), to an often overlooked group of individuals at primary processors: Fleet managers, Dock managers, and Buyers. These individuals have critical connections, interactions and communications with seafood harvesters (fishermen). They, essentially, serve as the frontline communicators for food safety to seafood harvesters. This group of individuals, however, is often overlooked when it comes to professional development and training in the area of food safety. Primary processors often focus scarce training resources on individuals in quality assurance and quality control. However, fleet managers, dock managers and buyer are a group of individuals at primary processing plants that can be very influential in communication of food safety and best practices with regard to sanitation to harvesters. The training modules and outreach of this project will provide a solid foundation based on	4

		scientific and best available knowledge for seafood safety, sanitation and quality best practices that support FSMA. Enhancement of seafood safety and quality awareness among this targeted audience can significantly improve integration of food safety practices in product chain of custody from harvesters to processors.	
16.	Economic benefits of endangered species	A new study provides evidence that increasing the abundance of a threatened or endangered species can deliver large benefits to the citizens of the Pacific Northwest. The study finds that a two-thirds increase in the average annual number of returning coho salmon to the Oregon coast would generate up to $518 million per year in non-market economic benefits to residents of the region. The study comes the same week that the U.S. Department of Interior announced that it will implement a new rule that stipulates that economic impacts for listing a species be considered under the U.S. Endangered Species Act (ESA). The benefits of protecting threatened species are difficult to estimate since they are considered to be non-market and arise from the public's values for things like the existence of abundant salmon in the wild. This study gives us a way to evaluate the benefits.	3
17.	Pollen diversity and nutrition of honeybee colonies	A new study provides valuable insights into pollen abundance and diversity available to honeybee colonies employed in five major pollinator-dependent crops in Oregon and California, including California's massive almond industry. The study, a collaboration between OSU and Texas A&M University, found that almond, cherry and meadowfoam provide ample pollen to honeybees, but highbush blueberry and hybrid carrot seed crops may not. In addition, California almonds don't provide as much pollen diversity as other crops, according to the findings, published in the Journal of Economic Entomology. The western honeybee is the major pollinator of fruit, nut, vegetable and seed crops that depend on bee pollination for high quality and yield. The findings are important because both pollen abundance and diversity are critical for colony growth and survival of the western honeybee. A diet low in pollen diversity hurts a colony's defense system, which consequently increases disease susceptibility and pesticide sensitivity. Some cropping systems may put bees at risk for temporary nutritional deficiency if the crop plant's pollen is deficient in certain nutrients and bees are unable to find an alternative source of these nutrients.	3
18.	Diet and Microbiome Interactions During Age-Related Inflammation	Aging of the immune system, or immunosenescence, is characterized by a gradual decline in both cellular and humoral immune responses, resulting in increased susceptibility to infectious diseases and compromised vaccination efficacy in the elderly. Aging is also associated with a low-grade, systemic chronic inflammation, which is a significant predictor of morbidity and mortality in aged individuals. The mechanisms leading to age-related chronic inflammation	5

		must be resolved in order to develop strategies to improve the healthspan of older individuals. Increasing evidence indicates that the interaction among gut microbiota, the immune system, and diet contributes to age-related inflammation. Gut microbiota are essential for development and homeostasis of immune function throughout life and changes in its composition are linked to inflammatory disorders. Older individuals have distinct compositions relative to younger individuals; these differences could contribute to age-related changes in both intestinal function and dysregulation of the immune system. Age correlated with overall microbial composition in the gut, according to a PERMANOVA test and a permutation test, regardless of zinc status. Generalized linear models developed for each genus were used to identify significant correlations for zinc status, age and specific taxa. A significant interaction between age and MZD diets was found; no similar interactions were found with ZS diets. Conclusion: Zinc deficiency elicits a varied effect on the microbiome that is dependent upon host age. Conversely, zinc supplementation elicits smaller changes on the microbiome, and the changes identified are comparable regardless of age.	
19.	Maintaining Forest Health in an Uncertain Climate	As the local climate conditions in southwest Oregon change, bringing warmer temperatures, longer fire seasons, and erratic precipitation patterns, forest landowners are left wondering how best to adapt their forests to the changes. Landowners are looking for guidance not just to keep their forests healthy for today, but to continue to have healthy forests in the decades to come. A workshop series has been developed to help landowners address this climate variability. The 6-part series is being held in 5 counties: Coos, Curry, Douglas, Jackson and Josephine throughout 2019 and 2020. The workshop consists of a half day in-class, where participants learn about overarching climate trends and some of the strategies they can employ to ready their forests. Discussions about how to make these management activities financially feasible are included in these presentations. The second half of the workshop consists of a field tour where participants see examples of adaptive practices, review opportunities for improvement at the site, and learn how to develop their own Climate Change Risk Assessment and Action Plan. As a result, participants developed Climate Change Risk Assessment and Action plans in Jackson and Coos Counties.	2
20.	Northwest Plan Evaluations	The over-riding goal of all subsequent trials has been to develop fully drought-tolerant, hardy shrubs, especially groundcovers, for use in "low-input" Northwest landscapes. Development of genuinely low-input landscapes for western Oregon will require use of drought-tolerant, evergreen groundcovers, few of which are currently used in local landscapes because data on their adaptability to local conditions are not available. As a result, landscapers tend not to request these	1,2

		plants and nurseries do not grow them in the absence of these data. Instead, better known but poorly adapted species are used which tend not to thrive without significant inputs of water, fertilizer, pesticides and labor. Local evaluations of drought-tolerant, evergreen groundcovers would provide gardeners and landscapers with data on plant adaptability to this region and provide nurseries with access to plants for propagation. Specific cultivars of these genera identified in these evaluations have been utilized with suitable companion plants in a variety of un-irrigated landscape projects around Marion and Polk Counties. We have installed landscapes at the St. Francis Shelter in Salem (2007), the Oregon Garden in Silverton (2007), the Willamette Valley Humane Society in Salem (2008), Rotary Park in the City of Dallas (2008) and most recently in several sites in collaboration with the City of Monmouth, including Madrona Park in September 2017 and the OSU Linn County Extension office in November 2017. The program aims to introduce new cultivars into the nursery trade at both the retail and wholesale level in order to encourage landscape use of the plants. As of 2019, 7 retail and 8 wholesale nurseries in Oregon, Washington and California have taken cuttings from these evaluations to date and are known to be growing and marketing these cultivars. The nurseries are each growing and selling an average of 11 *Hebe* cultivars, 14 *Cistus*, 4 *Halimium* and specifically derived from the evaluation trials. A nursery (Xera Plants, Sherwood, OR) named and is selling a *Grevillea* selected from one of my trials as a new cultivar 'Neil Bell'. Cuttings from the manzanita evaluation have been shared with 4 wholesale and 2 retail nurseries in the Valley in 2017-18 as well as the McMenamins group.	
21.	Master Woodland Manager Volunteers Improve Forest Stewardship in SW Oregon	Oregon's Master Woodland Manager (MWM) program trains woodland owners and managers in technical forestry topics, ensuring enhanced management of family forestlands. MWM also provides a venue for networking and collaboration, as well as excellent leadership training, all of which facilitate development of the necessary social and political capital that create a sense of community and place. In turn MWMs work to foster forest landowner networks in their local communities by educating other woodland owners, taking on leadership roles in forest landowner organizations, educating non-woodland owners, participating in citizen science projects, and much more. Volunteers in Jackson and Josephine Counties reported more than 1,000 contacts and 400 hours of unique activities with the public, family forestland owners, youth, watershed councils, and various other organizations in 2019. They reported being better able to manage 580 acres of forestland. Volunteers contributed through their communities via leadership, interactions with the general public, woodland owner education, and citizen science projects.	1

22.	Olive Orchard Establishment	Olives are a high value specialty crop cultivated to a limited extent in Oregon, mainly due to climatic and environmental conditions that directly affect field establishment and plant survival. The principal limitations to growing olives in Oregon are low winter temperatures that affect tree development at planting (with a lack of known tolerance to winter injury in available cultivars) and a relatively short season to ripen fruit in addition to a lack of research based knowledge of best production practices for the region. Cultivars that are sufficiently resistant and produce quality fruit in Oregon's shorter ripening season must be identified and growing techniques refined to adapt the crop to these conditions and assist with orchard survival. An additional goal is to reduce the cost of orchard establishment by providing information on propagation to facilitate local availability of adapted cultivars and for growers to be able to propagate their own plants, as well as implement best management practices that improve tree survival at planting. The industry has continued to grow and expand as we are learning and sharing our experience with growers. Olive propagation. The second year of propagation trials involved the replication of the 2018 hormone trial and completing the substrate trial. Our first collaborator has increased his rooting success following our techniques and has expanded his propagation operation. High rooting success encouraged our second collaborator to build an open window structure against a building which is south facing. A third grower asked to be added to our propagation trial, to evaluate and improve their current protocols for larger scale production. Following our guide for larger trays they have achieved high rooting success and automation of the system with minimum supervision in the fall. Cold hardiness of olive cultivars. A total of 152 accessions were planted for use in 2020 for the cold hardiness evaluation. The effort to document cold injury to olive cultivars at grower sites includes 5 collaborator farms in the Willamette Valley and one in the Umpqua Valley. Temperature data will be collected from these sites throughout the winter season and correlated to evaluations of cold injury to cultivars undertaken in late spring 2019. Transplanting and up-potting practices. We received over 200 trees from the nursery supplying research plants. We planted 240 trees in our four different fields (NWREC and Woodhall.) In the fall, we up-potted 240 trees and moved them to a winter greenhouse with heat for nights with temperatures below threshold. We did not lose trees in the winter, and are continuing to reduce losses in summer and at the time of transplant. Multiple growers have learned and applied our techniques and and learning and sharing with us all their experiences and challenges.	2, 4

23.	Land Steward Training Makes a Break Out: Helping Land Owners Manage their Resources in More Regions	More than 40% of land in Oregon is held by private land owners. These private land owners have a significant collective influence on natural resources issues ranging from wildfire to invasive weeds, yet many land owners are new and inexperienced. Land Steward Training has helped 382 new and experienced land owners in southern Oregon manage their more than 12,000 acres of private land in southern Oregon since 2009.Until recently, this effective program was only offered in Jackson County. A new instructor-led online hybrid PACE version of the program is helping to get this impactful education to landowners in other parts of the state by making it easier for agents and specialists to deliver. The hybrid also makes the program more accessible to participants with 9-5 work schedules or who live far away from extension offices. The short course is a hybrid of online and in-person instruction offered on evenings and weekends, making it more accessible to the target audience and a lighter coordination lift. This new hybrid training design has allowed the program to burst its county boundaries as two new counties are now offering the program to land owners and managers. For the 2019 Hybrid course, by the end of the 9 week course the 8 respondents (72% response rate of those completing) reported 100% of 213 acres reported on in the survey either had completed improved practices or planned improved practices. 100% said the program had provided them with new knowledge and improved their awareness of the topics covered. 80% said they had gained new knowledge or the program had modified their opinions. 80% said they were more connected to professional and technical resources. 100% said they would implement something they learned in the program in the next year. 60% reported the new format of the training made it possible for them to attend, fulfilling one of the goals of the new design to reach new audiences. 73% of those finishing the course completed a management plan for their property. 100% of those surveys said that creating the management plan during the course was very effective in helping them develop and meet their land stewardship goals.	2
24.	Food Hero at the Farmer's Market	Food Hero at the Farmers Market series had two avenues of behavior change. First, SNAP-Ed rationale discusses how increasing exposures for youth increases likelihood of behavior change, along with policy, system and environment changes. The creation of this project filled a community driven need that provided summer nutrition education to more youth and changed the environment at farmers' markets to engage youth in the process of picking fresh fruits and vegetables. Second, the Deschutes County WIC program offers their participants summer fruit and vegetable vouchers. The challenge for WIC is having a high voucher redemption rate. OSU Nutrition Education Program Food Hero at the Farmers Market offered an eight-week program for youth at farmers market designed to encourage	4,5

		participants to eat more fruits and vegetables and to increase families shopping at farmers market. OSU Extension collaborated with the Redmond Farmers' Market and Deschutes County WIC program to host an activity booth and incentive program for youth ages three and up. Kids participating in the program received a Food Hero passport. Students completed an activity, then received a stamp on their passports and a two dollar ($2) voucher that could be used to purchase fresh fruits and vegetables at the market. For both years, 2018 and 2019, 105 (95 WIC recipients) people toured the market. Eighty-eight percent strongly agree or agree that they gained knowledge and skills that they can use to purchase fresh fruits and vegetables at the best prices, properly store them at home and prepare them in ways their family enjoys. Ninety-two percent strongly agree or agree that they are confident they will return to the market to purchase more fruits and vegetables with their vouchers.	
25.	Mechanical Weed Cultivation Education in Organic Vegetables	Farm profitability, and labor cost and availability are key challenges that fresh vegetable growers identified in interviews of 16 organic annual crop producers (Andrews, unpublished). Weed management was also a top priority, in part because of its' impact on the cost of production, and labor requirements, especially in Organic vegetables. Discussions with key-informants have identified mechanical weed cultivation as a top priority for education and applied research. On August 29th, 2019 the second OSU Mechanical Cultivation Field Day was held at the North Willamette Research and Extension Center in Aurora. The day-long event was attended by over 100 people, many of the participants were farmers. In 2019 participants had a very positive experience: 88% said the demonstrations were very useful or extremely useful; 96% said they gained new information to improve weed management in their crops; and 80% said they planned to use new cultivation equipment on their farm. Comments included, "Tractor tool demos were very useful for me. Talking to the company reps was a quick way to get questions answered", and "What was most useful was seeing the tools demonstrated, and having an opportunity to operate them."	4
26.	Expanding the Beef Quality Assurance Program to Cattle Producers Statewide	The BQA Program is a nationwide, educational effort, developed and coordinated by the National Cattlemen's Beef Association (NCBA), to promote the production of safe and wholesome beef. It is implemented through the OSU Extension Service, which promotes BQA-approved best management practices. The Program provides BQA certification to Cow-Calf Operators, Stocker Operations, Feedyards, and cattle transporters who participate in BQA workshops and pass a BQA exam. As of January 1, 2019, three major beef packers required BQA certification from feedyards. Beginning January 1, 2020, all transporters hauling cattle to some major packers in our region must be BQA-Transportation certified. Currently, there is a strong demand within the Oregon	3,4

		cattle industry to get BQA certification and the OSU Extension Service has the opportunity to fulfill this critical niche. In 2019, 80 cow-calf operators and 12 feedyard operators--six in English and six in Spanish were certified. Furthermore, with an industry partner, Beef Northwest, 22 feedyard workers had Spanish curriculum for BQA certification. The certified feedyard operators have a certification that allows them to fulfill the requirement to sell fed cattle to food packers—like Tyson, National Beef, and Cargill. Feedyards getting certified with new curriculum represent operations with a daily capacity of 100,000 fed cattle. Furthermore, eight OSU Extension Service faculty, one local veterinarian, one allied-industry representative, and two feedyard employees to become Oregon BQA Trainers.	
27.	Fine Fuels Management Dormant Season Grazing Project on the Three Fingers Allotment	Approximately 72% of Malheur County lands are publicly owned and federally managed. Cow-calf producers with public land grazing permits rely on the use of these rangelands. The greatest threat to southeastern Oregon sagebrush rangelands includes annual grass invasion and wildfire resulting from an abundance of fine fuels on the landscape. In the last seven years, approximately two million acres of rangelands burned in fires with perimeters within Malheur County. These wildfires devastate the landscape and the associated natural resources. Previous research from EOARC-Burns and the University of Nevada-Reno highlight that grazing when perennial grasses are dormant can be an effective tool to mitigate wildfire and recuperate rangeland health and function. Furthermore, there is a push for a landscape-scale focus with broad-based support from public agencies, non-profit organizations, and private landowners. A four institution, tri-state, collaborative team conducted a dormant season grazing research & extension project on 25,000 acres of public lands for the next decade. A formal MOU between OSU and the BLM was established. In 2019, grazing during the non-traditional dormant season saved five grazing operators $130,000 on winter feed costs, which removed 500 tons of fine fuels to mitigate wildfire. Efforts led to a $300,000 USDA-NIFA grant, that started fall 2019, and will continue project extension and research components for three more years.	1, 2
28.	Children Youth and Families at Risk Benton Program	The overall percentage of Oregon children aged 10-17 who are overweight or obese is 26.5%, while the rate for Latino children rate is 41.3%. Oregon also ranks 16 on the State Rank for Latino Origin Disparity. Both Benton and Linn County have large Latino low-income populations. Results of an informal needs assessment, determined a lack of programming focusing on healthy diets and physical activity for this population in either county. The 4-H Food + Fun Program was implemented to provide a program that targets Latino youth in Benton and Linn Counties early in their schooling (middle school grades) to help them develop knowledge, skills, attitudes, and behaviors that will contribute to healthier diets and increase physical activity.	5

		This program features a core healthy living curriculum that focuses on food, nutrition, and physical activity with teamwork as a learning strategy with a unique strategy to empower youth to explore all their food and physical activity options through culturally relevant healthy Living 4-H programming. Since its start, the program has benefited more than 450 Middle School Students who have demonstrated a change of attitude towards healthy foods and physical activity. The impact of this program extends beyond the in-school and after school programs at the middle schools to OSU students engagement and the recruitment of new audiences to 4-H.	
29.	Physical Activity Programming Gains More Traction with New Curriculum and Collaborations	In the United States, approximately 1 out of every 3 children and teens is overweight or obese. In the prevention of childhood obesity, the CDC recommends that children get at least 1 hour of moderate to vigorous activity daily. Studies of rural Oregon schools show that children in elementary schools get an average of about 20 minutes of moderate to vigorous activity during the school day. In the newly created North Willamette Region, we joined forces to promote a newly redesigned curriculum designed at OSU that the ODE has approved to fill in for PE minutes with classroom activity. Our partners in nutrition education, particularly in the after school setting, needed physical activity programs and were able to use the kits as well. We received support from Providence through a grant to fund purchasing the kits and other items for kids and families already connected with our partners, and began to implement trainings and see kids with more activity options by the end of 2019. Our impact by the end of 2019 had only reached about 50 people, but we are expecting to reach about 2,000 by the end of 2020.	5
30.	Fire Science Education within OELP	Community school-aged kids need forestry and fire science education just as much as adults do. There are not many opportunities for kids to get out and receive quality education about natural resources and fire. I have directly participated and/or directed events designed to bring forestry, natural resource, and fire science education to elementary, middle school, and high school-aged kids. We have continued to bring this education to adults as well. The outcome to this effort is consistent with our RREA project outcomes. And that is, for Oregon's K-12 students: *To have a document that guides Oregon educators, formal and non-formal, through Fire content that is developmentally appropriate, tied to Oregon Fire Marshal Guidelines and Oregon Department of Education Standards and reinforce Oregon Environmental Literacy Strands (1. Systems Thinking; 2. Physical, Living, and Human Systems; 3. Interconnectedness of People and the Environment; 4. Personal and Civic Responsibility; and 5. Investigate, Plan, and Create a Sustainable Future.* The fire science core curriculum and RREA outcomes fit within this structured	2

		organization and presents an opportunity to integrate fire science into the OELP strands.	
31.	Extension Education Results in More Efficient and Effective Pesticide Use	Cranberry growers have been struggling financially for several years as a result of poor market prices. More than ever they are in need of tools to inform on-farm pest management prioritization in order to minimize unnecessary pest management expenditures. A collaborative, grower-focused needs assessment was conducted in 2017, which resulted in the Integrated Pest Management Strategic Plan for Cranberries in Oregon and Washington (Section C). This document prioritized growers' perceived need for education, research, and policymaking. One of the top priority educational needs defined was that of pesticide resistance management and prevention. As a result of the PRM workshop, growers reported a 28% increase in their confidence in making pesticide choices that properly rotate mode of action classes. When surveyed, 81% of the growers indicated they would factor in the rotation of mode of action class into future pesticide selections, and 65% of responders intended to share the pesticide resistance management information they learned with others. When surveyed, 84% of growers reported rotating chemistries, while 85% reported scouting for pests as part of their pest management program, and 100% reported an increase in knowledge and/or skills as a result our training program.	1, 2, 4
32.	Rural Living Day: A Gateway to Extension Programming and Practice Implementation	Rural landowners in western Oregon have diversified land uses even on small acreages. Managing woodlands, wildlife, livestock, pastures, and home gardens all take specialized skills and knowledge that rural landowners are seeking. Questions and requests posed to small farms and forestry Extension professionals are common, and sharing basic information which often includes fundamentals on soil, water, and weed science with individuals is repetitive and time consuming. Educational events like Oregon Small Farm Conference in Corvallis and Small Farms School in Clackamas County are beneficial for commercial farms, and Tree School offers opportunities for those interested in managing woodlands and forests. However, an educational event for rural landowners who have many interests and in some cases a steep learning curve, is needed. Longitudinal survey data collected from RLD participants nearly two years (2018) or 9 months (2019) after attending the event indicate that the program positively impacted rural landowners and increased their awareness of OSU Extension Service programming.	1, 2, 4
33.	Food Safety and Preservation Programs have wide reach and impact on Health of Oregonians	Reducing food waste is currently a topic of great media attention. Added to the desire to utilize seasonal, local produce; prepare for emergencies; increased interest in home gardening and locally grown foods; and an increased desire to	

		control ingredients means interest and activity in home food preservation is widespread in Oregon. 44,448 Oregonians had direct contact with extension representatives regarding food preservation. 4817 called their local office or the toll-free Food Safety and preservation hotline. 5127 Oregonians attended one of 309 workshops or demonstrations; 28,804 stopped by an information booth. 293 queries came through Ask-an-Expert. 1568 pressure canner gauges were tested for accuracy at Extension office or events. Master Food Preserver volunteers dramatically extend the reach of Extension programs. Of the 324 active volunteers, 257 were returning from previous years and 67 were newly trained in 2019. Together they contributed 17,279 hours of time toward ensuring Oregonians stay safe and healthy as a result of preserving food.	
34.	Malheur Youth (MY) Health Science Day: Inspiring Future Health Professionals	Historically, Malheur County is by far one of the most disadvantaged counties in the state. Malheur County's child poverty rate is 37% compared to Oregon's 19%. This poverty results in a corresponding higher rate of unwed pregnant teens (teen pregnancy rate of 13.6; Oregon is 10.1%), high contact with the law enforcement, court and jail/prison systems, and a loss of the value these young men and women could add to Oregon's social and economic base. One of the causes of poverty is our failure to train our Opportunity Youth for jobs readily available in our community, and in not using or developing resources that we have in abundance within Malheur County. An estimated 779 of these Opportunity Youth live in Malheur County; while the Opportunity Youth rate for the nation is 14.6%, Oregon is higher at 15.5%, and Malheur County is a shocking 20%. In addition, there continues to be a national shortage of professionals entering the health science career fields according to U.S. Bureau of Labor Statistics. Eighty-seven percent of the students who have participated in the program completed a post-evaluation. Because of the program, students reported in their evaluations a significant increase in interest and aspirations related to Health Science/STEM careers. Frequencies of participants "Agreeing" or "Strongly Agreeing" with Interest and Aspiration Items (N = 1098) Gender: Boys=97.4%, Girls 92.9%, 9.7% prefer not to state. 93% increased their interest and aspiration in Health Science/STEM 67% increased their interest in a Health Science Career 73% want to take more STEM/Health Science classes 98 % learned new STEM/Health Science related content	5

35.	Threemile Canyon Farms Heifer Project	Morrow County is the largest region for dairy production and boasts the 2nd largest dairy in the state with over 100,000 cows. As a result, the Threemile Heifer Project was a 2019 trial program developed between Morrow County 4-H staff and the dairy division of Threemile Canyon Farms. The purpose of the project is to provide educational experiences and in-depth understanding of the dairy industry through a hands-on, experiential learning professional setting. This project teaches youth to take responsibility for an animal not their own, make decisions, solve problems, interact with their peers and professional veterinarian staff, and to follow strict feeding and caring rules. The participation included eight 4-H members and their families. This was the first program and partnership of its kind anywhere in the state. 94% of the participants had never raised a large dairy animal and the dairy presence at the county fair increased 600%. The response by youth and their families was overwhelming and the friendships that fostered with one another and the Threemile staff is life-lasting.	4
36.	Developing and maintaining community learning gardens on the Warm Springs Indian Reservation	Health issues due to recent history of poor nutrition caused by Tribal relocation policies negatively impacting traditional food gathering practices and access and availability of nutritious foods. Warm Springs could be identified as a food desert in that there is limited or minimal access to affordable, nutritious foods such as fresh fruits and vegetables. The implementation of sustainable food systems would be a key remedy for this situation. Living in a food desert contributes to food insecurity so exploring where food comes from and making this vital connection to sustenance in the living soils can be addressed in a Learning Garden environment promoting positive youth development by creating hands on activities that promote sustainability and resilience for the people of Warm Springs. Another issue/situation that has been addressed lack of fresh and affordable produce for the Warm Springs Children's Protective Services Group Home. Warm Springs OSU is working with CPS management to bring fresh produce to the Children's Protective Services Group Home. The Group Home is locate next to Learning Garden #2. Using the Learning Garden as a therapeutic milieu has also been discussed. It is the intention of this endeavor/program to establish sustainable food systems for the people of Warm Springs to address the many diet related health issues as well as spark youth and community interest in utilizing local resources (land and water) to foster health and prosperity on the reservation. The Warm Springs Oregon State University Extension Office now has three Learning Gardens to continue teaching sense of place, gardening, food origins, food sovereignty, and a mechanism for establishing food security in Warm Springs to address issues with food insecurity and living in a food desert. Through the Warm Springs/OSU Learning Gardens our office was able to	4, 5

		implement and utilize a STEM Summer Grant to offer STEAM in the Garden classes. The STEAM In the Garden Program included 30 tribal youth participants and held six classes. STEAM summer activities allowed 3rd to 8th-grade youth from the Boys and Girls Club to engage in the garden and activities relating to nutrition, community water issues, Traditional Ecological Knowledge, learning environment and Art. All activities were focused on exploration to spark interest, foster curiosity, inquiry, investigation and hands-on learning. Youth learned about plant parts, pollinators and food crops that can be grown in the garden. Snacks were provided for taste testing of fruits and vegetables that were growing in the garden or could be grown in a garden. They participated in Art activities part of STEAM, such as making tie-dye t-shirts which allowed them to investigate collaboratively to produce tie-dye shirts as evidence to test the prediction of the design outcome-based on pattern or color dye combinations. The group explored community water issues, identifying problems, impact on the people, and animals in the community. Discussions relating to the water system repairs being done and how we as community members need to take care of waters. Interest in the gardens and the plants growing in them was greatly demonstrated by the youth. Youth harvested approximately 25 pounds of blueberries, blackberries, raspberries and grapes.	
37.	OSU Extension's Master Gardener Program: Volunteer Support of Sustainable Gardening & Community Food Production Initiatives in Oregon	OSU Extension Service Master GardenerTM volunteers expand Oregon State University's ability to reach and assist the citizens of Oregon. After receiving extensive training from OSU Extension Service faculty, Master Gardeners are certified to provide objective, science based information to citizens who are seeking advice or information on a plant, garden or home horticultural issue. The title "Master Gardener" (which was trademarked by Oregon State University in 2001) is recognized by Oregonians to identify a knowledgeable advisor who represents Extension and Oregon State University. For many Oregonians, the Master Gardener program provides a window to the services and activities of Extension and Oregon State University. **A Substantial Volunteer Labor Force:** In 2019, 2,849 Master Gardeners volunteered 221,423 hours, which is equal to $5.6 million and 106 FTE equivalents to Oregon State University. Volunteers reached and taught 139,242 Oregonians as they taught classes, answered gardening questions, or provided garden consults. A total of 444 new Master Gardeners were certified in 2019, out of the 660 who enrolled. This equals a 67% completion rate. Of the 2,189 continuing Master Gardeners, 69% completed their recertification requirements (10 hours of continuing education units and 20 hours of volunteer service). **Ask an Expert:** In 2019, a total of 6,321 questions were submitted to OSU Extension through eXtension's Ask an Expert Service. Of these, 4,925, or 78%, were related to home gardening, insect identification, urban forestry, or other questions commonly fielded by Master Gardeners. Of the 4,925 Ask an Expert questions that were related to home gardening, Master Gardener volunteers	2, 4

		fielded and answered 3,650 questions, or 58% of all of OSU Extension's Ask an Expert questions in 2019. Master Gardener volunteers are vetted for their ability to provide high quality answers to Ask an Expert questions, and are supported and supervised by OSU's Home Horticulture according to the successful 'Train the Trainer' model employed by the Master Gardener Program since the mid-1970's.	
38.	Alternative Crops bring Sustainability to Willamette Valley Farms	Farmers within the Willamette Valley region of Oregon face many challenges to maintain profitability: labor is in short supply and labor costs are high; food safety regulations place increasing management and liability costs on producers; and imported products frequently provide lower consumer prices. Farmers need to have new options in crop production as industries and consumer preferences have changed (reduction in acreages of processed vegetable production, for example). In an effort to provide local growers with alternative crops, my field research over the past two summers included a planting date and variety trial for quinoa seed production. Additionally, I am coordinating efforts across disciplines and with industry to form a working group around meeting the market needs for Asian vegetables and traditional Chinese medicinal herb within the region. The Portland metro area hosts a thriving Asian-Pacific Islander (API) community with market options that rely almost completely on imported produce. Many of these crops can be grown locally with the development of farm to market connections. Additionally, high value medicinal herbs are sought for both medical practitioners and consumers. In cooperation with researchers at Oregon College for Oriental Medicine and the international marketing office at Oregon Department of Agriculture, we are beginning to connect farmers with potential new crops for production and marketing within Oregon.	1, 2, 3, 4
39.	Systems Approach to Pest Control: Managing Cabbage Maggots in Root Vegetables	Cabbage maggots can feed on all brassica crops but are perhaps cause most economic damage on root vegetables. The adult fly, *Delia radicum*, will lay eggs on any *Brassicaceae* crop species. However, many crops like broccoli or cauliflower can withstand some damage with minimal yield reduction or can be planted around the peak activity times of early spring and late fall. Root vegetables have zero market tolerance from insect damage and their crop cycle often overlaps with peak pest populations. This pest has been managed previously with the insecticide chlorpyrifos which is likely to be phased out due to toxicity concerns. We have the efficacy data for 16 new treatments (new active ingredients and/or delivery methods) for this pest which will allow for rotation of products. We have used the outcomes of these two trials to further the integration of products and systems based on grower inputs.	4

40.	Technology integration: Unmanned Aerial Systems (UAS) Scouting for Plant Health	Many seed crops overwinter in the Willamette Valley. The winter rains make portions of the fields impassible on foot for portions of the growing season. Many of these seed crops are Brassicas and have been observed with high rates of infection from the foliar disease Black leg. Early scouting and fungicide applications can minimize crop damage and secondary spore movement within the valley. Aerial imagery may be an effective method to scout fields during winter months. With the preliminary data, we received funding from OSU's Agricultural Research Foundation to accomplish a wider base of preliminary studies on grower farms for Black leg incidence in 2019 and 2020. In 2019, we scouted more than 10 fields, collecting infected residue and aerial images. These techniques and image analysis is currently a part of a student M.S. program to narrow the spectrum of light that is effective for early detection of disease. Additionally, the system has provided other OSU Extension programs (field crops and orchards) with vital support for image gathering on projects presented at 6 extension events (regional and international) with over 1,600 stakeholders to demonstrate potential uses of technology on farms.	4
41.	Connecting recreational boaters to the impacts they can have on water quality	Recreational boaters play a role in preventing water pollution. One source of pollution can be human waste generated while boating and fishing. The disposal of untreated sewage is prohibited in waterways unless the vessel is over 3 miles seaward (Federal Clean Water Act; ORS Vol. 11, Ch. 468B). The Clean Vessel Act is a federal grant program that supports the installation of waste disposal facilities, as well as education and outreach with boaters to improve awareness and understanding of use of pumpout, portable toilet dump stations, and floating restrooms. Since January 2016, 95 outreach events have taken place allowing for one-on-one conversations with approximately 3,550 boaters, fishermen, and their families on the CVA program. Approximately 325 pumpout adapter kits and close to 1,600 waste disposal location cards have been distributed to alert boaters to facilities near them.	2
42.	Cooking Matters at Any Age	No child should grow up hungry but many are in Klamath and Lake Counties. Over 22% percent of children (under 18 years of age) live in households that experienced food insecurity compared to 18.9% statewide. Children who are food insecure are more likely to be hospitalized and may be at higher risk for developing chronic diseases such as obesity as a result in lower quality diet, anemia and asthma. In addition, food-insecure children may also be at higher risk for behavioral and social issues including fighting, hyperactivity, anxiety and bullying. In the last two years, Cooking Matters has expanded to new audiences with innovative delivery strategies. This includes a 12 week in-school cooking series	5

		taught by junior high science teacher that was so well received it has been expanded to 24 weeks. Medical students, Extension nutrition educators and volunteers support the program as guest speakers, shoppers, cooking assistants and more. Nationwide, Cooking Matters programs have been shown to improve people's attitudes about cooking and decrease barriers to preparing healthy, affordable meals. We have realized the same results in Klamath and Lake Counties. In our cooking class for teens, there was a trend toward increased frequency in consumption of fruits, vegetables, and green leafy vegetables.	