2019 Annual Report of Accomplishments and Results

Guam
University of Guam

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)

Guam, an unincorporated Territory of the United States, is the largest of 16 islands in the Marianas in the Western Pacific. The estimated population of Guam in 2019 was 168,000. The most represented ethnic groups include Chamorros (37%), Filipinos (26%), Caucasian/Americans (7%), and Chuukese (7%). The University of Guam, an 1862 Land Grant institution includes the College of Natural and Applied Sciences (CNAS) which has three functions: research, Extension, and teaching. The CNAS Dean serves as Director of the Western Pacific Tropical Research Center (WPTRC) and Director of Cooperative Extension & Outreach (CE&O), with Associate Deans for each of three functions.

The Western Pacific Tropical Research Center (WPTRC) conducts research in agriculture, human nutrition, terrestrial ecology, ecophysiology, aquaculture, and natural resource conservation. Research at WPTRC is aimed to 1) sustain, protect, and restore the natural environment, 2) stimulate economic development though sustainable use of resources, and 3) improve quality of life in the Western Pacific. Some noteworthy research to preserve Guam's unique environment includes the Guam Plant Extinction Prevention Program, forest health on biotic and abiotic threats to native and introduced tree species, the Guam Forest Inventory Analysis, and extensive work to reduce chemical pollution, curtail sedimentation in coastal environments, conserve threatened taxa, and improve water quality by reducing application of synthetic fertilizers and disposal of animal waste. Research on socio-economic alternatives focuses on pathogen-free aquaculture, integrated small-scale farming systems involving simultaneous production of compost, fish, fruits, poultry, and vegetables; disease-free plant propagation, and widened availability of crop genetic resources. Projects emphasizing the enhancement of quality of life in the Western Pacific concentrate on human nutrition and child obesity, food safety and quality, and green roofs. In 2019, the eight full-time WPTRC research faculty co-authored 21 papers in peer-reviewed journals and offered numerous presentations in national and international meetings, and advised undergraduate and graduate students.

University of Guam Cooperative Extension and Outreach (CE&O) mission is to deliver research-based, unbiased information to citizens to incorporate into their daily lives. In turn, CE&O is the conduit back to the university research base about needs and concerns of the citizens that should drive the research cavities of the faculty. CE&O delivers education programs, materials, and activities that enhance and improve the lives of children, youth, families, businesses, villages, production agriculture, government agencies, non-profit agencies, service groups, and other island partners. CE&O is administered in the College of Natural and Applied Sciences, but the mission of Extension is to partner with all entities in the university to service the outreach function and philosophy. Partnerships are essential to conducting research and delivery of extension education. In the areas of nutrition education, child and youth activity, invasive species control, and youth engagement, CE&O faculty and professionals lead the research and engagement activities for the university, island, region, and international efforts for Micronesia. In FY 2019, CE&O faculty and professionals conducted workshops, learning events, and activities to engage citizens of Guam and the region to effectively engage people with the knowledge generated from research. In 2018, a new Associate Dean for Extension and Outreach joined in mid-year. During the remainder of the year several changes have been established to ensure extension operations continue to evolve to meet the needs of citizens. A peer reviewed publications process has been established for extension materials (print, on-line, etc.) to link to programming and national reporting systems. Publications are branded with university guidelines, meet basic standards for grammar, reading level, format, and learner style, as well as content base. A

strategic effort was launched for engaging stakeholders by asking their needs. Four strategic initiatives were launched to encourage transdisciplinary work through the entirety of Extension programs and audiences and connect across research efforts.

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	Strategies used in FY 19: Internal University Panel Combined External and Internal University Panel Cooperative Extension & Outreach (CE&O) of the University of Guam, have established programming and outreach efforts based on needs assessments and information gathering processes over the last five years. Identifying needs is an on-gong process to truly stay abreast of needs of stakeholders and link to the research base. Faculty and extension professionals plan and design programs based on those needs. The focus of the programs for production agriculture focus on small area (micro-plot) production (backyard farming). Large commercial producers are few, but effective. The greatest need is for self-sufficiency and micro-supply. Invasive species control is identified as a major issue for the island for the region. Not only insect, but reptile, bird, virus, fungus, fish, and other species not native or controlled by this environment are a concern for the natural, economic, and social environments of the island. Youth investment is another major thrust defined by multiple sectors of the island and region. With the compact of free association that allows in-migration from neighboring islands, youth new to the island are a target audience for involvement in youth development options to reduce risks in other areas. Youth leadership skills, as well as workforce skills, are the focus for community, school, club, and other youth active learning groups. Consumer skills are identified in financial strategies for families, work force skills, and basic transition to adult skills. Healthy aging has been identified as a strategy that has multiple components from other programs such as nutrition, physical activity, cybersecurity, family communication, and others aspects. Community development issues mirror consumer issues, but at a community level. Civil dialogue, community planning, access to accurate information, and assessment of impacts across society are essential to all communities. Both CE&O and WPTRC employed several stakeholder input methods including gathering input from local community groups, individual farmers, farmer's groups and other organizations, non-profit groups, businesses groups, service organizations, local agencies, federal partner agencies. In the relatively small area of Guam, personal interaction with stakeholders is very easy to do. Seeking information, concerns, and issues has been sought through formal meetings, as well as through informal and non-formal methods, such as social media and casual conversation. Periodically, stakeholders (farmers, golf course superintendents, owners of nurseries, and others) are invited to meet with faculty and professionals to discuss concerns, options, and research opportunities. At the end of 2018, CE&O held the first annual report to stakeholders meeting, where all stakeholders, partners,

	potential collaborators, and decision-makers were invited to attend and engage with Extension professionals about the impact of their programs on Guam citizens. In addition, a printed report of impacts was issued with the intent of being an annual report. The amount of funds available for projects within C-E&O is relatively small. As with all research approaches encourage the acquisition of outside funding by all faculty members and professional staff. Both extension and research faculty submit an annual plan of work called Comprehensive Faculty Evaluation System (CFES), that covers a range of activities that are within the University of Guam faculty portfolio. Non-faculty employees paid by Smith-Lever funds, use the same standard form developed by C-E&O for faculty, but their loads are project based. Each faculty and professional member is given $2,000-$3,500/yr to support basic work activities within their CFES and that work plan is discussed, modified (as necessary), and approved by the Associate Director/Dean and the Director/Dean prior to the faculty receiving their funds. A concerted effort has been exerted to capture, update, and publish previous materials in the extension system. Materials are being migrated to UOG main website: Uog.edu/extension. Additionally, scanning historical material to preserve and retain the immediate history of CE&O is a priority. Limited access has been dedicated tocapturing material, media accounts, and related materials across time for use in the future. For WPTRC, review of individual Plans of Work for Hatch, multi-state Hatch, and McIntireStennis projects are conducted by WPTRC Director and Associate Director). New research proposals are submitted to WPTRC Associate Director who checks them for completeness and format. There are few faculty at the university with expertise to review research proposals. Therefore, proposals may be submitted to external reviewers to assess significance, need, approach, new knowledge to be generated, potential for impact, and potential for success. WPTRC researchers post progress and final reports annually using NIFA's RReport site. The Associate Director then reviews and submit the reports. Reports contain outputs and short, medium, and long term outcomes.
2. The <u>Scientific Peer Review Process</u>	With all Extension programs, the foundation for all education is the peer-reviewed materials, accepted as legitimate, by the breadth of the research contributors. In addition, a continuous scan of the Extension materials used in other systems, as well as partnerships with other Extension professionals is primary to integrating research based materials from all disciplines into appropriate education processes for all learner groups. UOG CE&O relies on the integrity of other Extension systems to do the same, as well as disseminate research from the UOG system. Faculty and Extension professionals are expected to publish in peer reviewed journals.

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	In FY 2019, through strategic conversations for initiatives, CE&O professionals were asked to seek information about needs and potential strategies for programs from: • traditional stakeholder individuals • non-traditional groups • non-traditional individual • university potential or established partners/collaborators As the entity to implement the Ag Census, through multiple avenues, 250 farmers were identified as being classified in the NASS system (Commercial operations to micro-plot production). CE&O faculty and professionals are involved in a variety of stakeholder groups as resource experts, board members, advisory members, and a host of other roles. Identifying issues and partnerships is a daily activity.
2. Methods to identify individuals and groups and brief explanation.	• Invitation to stakeholder groups • Invitation to stakeholder individuals • Network to groups • Identify of non-traditional audiences • Media: social, print, digital, and other • Focus groups for target issues
3. Methods for collecting stakeholder input and brief explanation.	• Meet with stakeholder groups regularly. • Meet with stakeholder individuals. • Consultation with educational institutions on island in region. • Meet with non-traditional groups. Guam is a relatively small and close-knit community. Most UOG faculty work closely with stakeholders. These include community organizations, individual farmers, homeowners, school teachers, state legislature, and government agencies. Informal and formal input is provided to UOG on a regular basis during workshops, open houses, telephone calls, and letters. Several faculty members conducted research on stakeholders' farms. Some faculty and administrators were invited for informal or formal meetings, such as for example Guam Soil and Water Conservation District where UOG receives an input and feedback from stakeholder groups related to agriculture production. Because of the breadth of experience on other islands in the region, research and Extension professionals are able to identify, characterize and provide a rational method of management for invasive species, new disease outbreaks and other concerns on Guam. After identifying the challenges, researchers apply for funding for more in depth investigations. We also address the needs of non-

	agricultural clients. There are a variety of needs for information and education for youth, families, and the elderly on Guam.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	From the perspective of Cooperative Extension & Research, the need for science literacy and application to food security, environmental threats, and impacts to human populations is continuing to be part of the dialogue with agriculture producers, elected leaders, and consumers. Research-based information as a foundation of education and outreach is critical and needed for all programmatic efforts, but specifically for the Western Pacific in the areas of invasive species economic and environmental impact, food production, and water capture and use. In partnership with multiple youth focused agencies, career exploration and life skill development has been the foundation of 4H Program.

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.	Let's Talk HEIS COFA Ag Census	Four pilot workshops were conducted with fifty-one individuals. Participation was solicited through organizations involved with caregiving and hospice care, along with the general public. Evaluations were designed to measure specific topics around four areas: Comfort level, Communication, Awareness, and Intention to make decisions. Seventy-one percent of the participants indicated an increase in comfort level of topic and also took action at that event to communicate their wishes. This program was identified as being the beginning of family communication initiatives that transcend across age, social strata, cultural identity, and other influences that impact villages on a mezzo level. Community wide surveys regarding the Ag Census, Impact of Compact of Free Association for Micronesia, and Household Income & Expense Survey were conducted by Extension as principle investigator. As the leader for survey analysis, Extension continues to fulfill the role of research and analysis leader for all activities for information gathering on the island. The data collected is then provided to the provider, however Extension (and UG overall) then has access to data for other activities regulated under the Internal Review Board criteria. Data collected and protected within these surveys will be used for policy decisions at the local, reginal, national, and international level.	**Community Development**
2.	Food Safety & Security:	The frequency of foodborne illness on Guam is greater than that in the U.S. states. Each year about one of four residents experiences foodborne illness because of poor knowledge and practice in controlling temperatures in storage and cooking as well as avoiding unsafe food sources. In addition, ninety percent of foods are imported on Guam and value-added food products are lacking on the island. Workshops of food safety and home food processing using local produce were provided to the residents in the community of Guam. One-to-one assistance in food safety and food processing were also provided to meet the specific needs of individuals. Food safety lessons in 128 workshops in SNAP-Ed program, EFNEP program, and individual workshops were provided in the community. Through the educational activities, the target audiences improved their knowledge in food safety and food processing. Targeted audiences used food processing skills to make value-added food products using local fresh fruits and vegetables. There has been an increase in the number of food entrepreneurs who utilize the food label analysis before sending their product to market (26 labels). How to process breadfruit flour How to process use citrus powder	**Food Safety**

		Drying your fruits and vegetables Canning and drying of local produces Food fun & food safety basics Additional imbedded: Multiple programs within EFNEP and SNAP Ed programs Nutrition label creation Direct Contacts Adults 1662 Indirect Contacts Adults 210 Direct Contacts Youth 1359 Indirect Contacts Youth 25	
3.	**Youth Engagement**	In 2019, Guam 4-H Youth Development conducted four hundred and thirty-six (436) workshops that reached 9,560 youth through public and private school classrooms, 4-H community clubs, and afterschool programs. UOG 4-H College and Career Path project expanded and connected STEM knowledge and applied life skills to support academic achievement, college readiness, and career aspirations for all youth. The project targeted at-risk youth populations to discover successful pathways through hands-on learning activities, strategies to apply science concepts to daily living, and interactions with adult mentors. Participants were able to connect with researched based curriculum materials, life skill activities, experiential learning models, college learning environment, and practical experiences such as successful high school completion and career aspirations. 94% of participants' reported increased knowledge of STEM-related fields in college and career options. 68% of the participants' reported increased knowledge of specific STEM subject matter from workshop participation. Direct Contacts Adults 3873 Indirect Contacts Adults 6262 Direct Contacts Youth 9560 Indirect Contacts Youth 15273	**4-H and Youth Development**
4.	**Children's Healthy Living Project**	From pre-/post-assessments completed from direct nutrition and behavior education, results indicated that approximately half of all participants had improved, at least, one behavior/knowledge in healthy food/diet, food safety, food resource management, physical activity, and/or chronic disease prevention. Program evaluations reveal areas of improvement to include store field trips, more contact hours, alternative dietary practices or meal patterns (e.g. vegetarian, plant-based, disease management), and cooking examples (e.g. recipes, videos, and demonstrations), as well as adaptations to be more relevant with cultural practices and recipes, food planning for different family sizes, locally-sourced food options (convenience and non- or minimally-processed). Community-based program evaluations revealed more community programs ingrained in the villages are welcomed as to support physical and social environments to promote physical activity and access to healthy foods. However, multi-lesson workshops or programs are challenging due to lack of transportation and competing family/work obligations underscoring cultural and economic challenges. The CHL Program Community Reports are the most recent data available on Guam to	**Childhood Obesity**

		demonstrate that children do not meet the recommended fruit and vegetable servings and physical activity minutes; in addition to having a frequent consumption of sugar-sweetened beverages. As a result of the social marketing campaign of 5-2-1-Almost None, three elementary schools continued to implement scheduled "Fit Days," where all children participate in physical activity, and four new elementary schools adopted the schoolwide activity;" six food stores continued and seven new stores have pledged to promote the healthy campaign messages throughout the store and modify the food environment to identify school-approved Smart Snacks; and two mayor's office that has supported 5-2-1-Almost None activities. The data from the 5-2-1-Almost None pre/post school survey show gains being made in children's healthy habits that families perceived easier than anticipated. Future focus of social marketing and community approaches should be on healthy habit changes that can be easily integrated into everyday life. Three hundred seventy-two direct contact hours were achieved through research activities. Coupling childhood obesity prevention outreach and education with research recruitment has helped to connect consumers with evidence-based information. Child measurements are ongoing and will be able to provide new prevalence data for Guam and the Pacific when combined with data from other institutions to inform the development of programs and educational material. A comparison of data from Guam and other Pacific islands will also help to better understand the burden of obesity and chronic disease in the absence of a monitoring system (124 participants)	
5.	**Walk-to-Wellness/Nutrition**	More than half of older adults met or exceeded the recommended physical activity minutes and improved their readiness to change. Extension products, like webpage content posted on websites (e.g. Walk-A-Mile Maps), and local publications have been developed to ensure exposure to place-based physical activity opportunities are far reaching. Direct contact hours recorded for collaborative efforts for this outcome were 1,584 hours using multiple approaches. Partnerships with community stakeholders and extension programs have been maintained. Contact hours measured 1,044 in this program area. (417 participants)	**Childhood Obesity**
6.	**Nutrition (Obesity prevention)**	Pre-/post-test, formative and outcome evaluations, and/or alternative assessments were administered to measure improvements in healthy behaviors, such as improvements in intake, physical activity, and meal planning. The community-based program has provided a model for sustainable community-owned programs. Community relationships have been strengthened and more partners have been added to programs to support policy, system, and environmental change in different communities. Another measure of impact is the 6,553 indirect/non-formal/self-directed learners contacted/communicated with these program efforts. Specific to direct contacts, 9,106 contact hours were logged. (1,867 direct contacts – adult and youth) TOTAL ACROSS ALL EFFORTS Direct Contacts Adults:1228 Indirect Contacts Adults: 1746 Direct Contacts Youth: 1180 Indirect Contacts Youth: 4912	**Childhood Obesity (All ages/family)**

7.	**Tree, Vegetable, and Fruit Production (micro- to macro-level)**	Workshops, training sessions, demonstration, and site visits are the main activities used to teach vegetable gardening. Instruction on container, raised gardening, and in-ground. Follow up visits are often necessary to supplement topics covered, such as pest managements and plant nutrition. Engagement utilizes in-person as well as digital connection. Multi-year research conducted by WPTRC and research faculty has provided a wealth of information on promising plant species and varieties for Guam. Seeds of crops adapted to humid tropical environment for improvement of agricultural diversity in Guam were collected, tested, and conserved, in alignment with USDA Germplasm conservation program. This included *Moringa oleifera*, local chili pepper, lettuce, microgreens, bok choi, zucchini, bell peppers, Chinese cabbage, edamame soybean, tomatoes, and roselle. Mizuna was found to be the best microgreen species to grow in the aquaponics in Guam. In other studies, varieties of several varieties of kale and zucchini were evaluated and performed well proving to be good varieties for Guam. Fact sheets contained information on each crop about origin, climate preference, growing recommendations, common pests and diseases, harvesting and post-harvesting methods. Workshops were conducted educating participants on highlighted crops, and Best Management Practices of growing and storing produce were developed. Both kale and zucchini projects were also highlighted in a published WPTRC report. Multi-year research led to selecting varieties of iron wood (Casuarina spp.) resistant to dieback caused by bacterial and fungal agents. These varieties are being subjected to large scale test at the Ija Research Station. Research studies contribute to identify cucumber varieties that are resistant to anthracnose which cause 2-50% of crop yield losses. It was confirmed that *Colletotrichum* species are responsible for cucumber anthracnose disease on Guam. The variety trial results were presented at a Cucumber Anthracnose Workshop at the University of Guam. TOTAL ACROSS ALL EFFORTS Direct Contacts Adults 3374 Indirect Contacts Adults 11350 Direct Contacts Youth 727 Indirect Contacts Youth 2730	**Plant Health and Pest Management**
8.	**Micro-plot production/Consumer and Commercial production**	Two on-campus microplot agroforestry demonstration sites are utilized for the hands-on portions of our New Farmer workshops. These incorporate recommended soil and water conservation practices. They are often use for school and youth tours as well. TOTAL PROGRAM CONTACTS 2019 Direct Contacts Adults 2027 Indirect Contacts Adults 2239 Direct Contacts Youth 1476	**Global Food Security and Hunger**

		Indirect Contacts Youth 838	
9.	**New/Veteran Farmer Program**	The New and Veteran Farmer Program has promoted an integrated approach to address the different aspects of food security and hunger in Guam and Micronesia; e.g., community development, agricultural and aquaculture systems, human nutrition, youth development, and environmental conservation. Demonstration plots maintained for variety of teaching and research activities. Farmers have been adopting soil conservation strategies, such as use of compost and recycled paper researched and disseminated by CE&O & WPTRC. Portfolio expanded to variety of crop species and varieties that include hybrid and natural-pollinated plants. Traditional agroforestry systems enhanced with modern soil and water conservation practices are demonstrated. Direct Contacts Adults: 536 participants	**Global Food Security and Hunger**
10.	**Global Food Security partnerships**	Global Food Security efforts develop curriculum, educational materials, conducts workshop, capacity building meetings, maintains field demonstrations for training use, and facilitates multi-agency project planning to support and enable agricultural professionals in their efforts to address the identified local and regional needs. The agricultural professionals supported include those from the University of Guam and other regional land grants, the Chamorro Land Trust Commission (CLTC), the Guam DoAG, USDA FSA & NRCS, Micronesian Chef's association, non-profits like Guahan Sustainable Culture, Haya Foundation and local agricultural consultants. Three farmers groups are involved in setting priorities of trainings are, the Northern and Southern Soil and Water Conservation District Boards, and Guam Farmers' Cooperative Association Board of Directors. 11 partnerships	**Global Food Security and Hunger**
11.	**WSARE**	Curriculum on grant writing, livestock waste management with dry litter, composting, sheet mulching, and plant propagation were utilized in programs of the COM FSM. Local NGO's have use our sheet mulching curriculum, and teachers on island have utilized a large number of our gardening curriculum modules. After the regional meeting was convened in Guam in May 2019, WSARE state coordinators visited the Marshall Islands, FSM, and CNMI to conduct workshops and disseminate research. Knowledge generated by research studies was effectively transferred to targeted audiences, and increased interest in producing local fruits and vegetables. Direct Contacts Adults: 201 participants	**Global Food Security and Hunger**
12.	**Aquaculture**	UOG has traditionally led aquaculture research in Guam at the biosecure Fadian Hatchery. New knowledge was generated on husbandry methods and bred for shrimp, tilapia, and freshwater prawn. Also, quality and quantity of larvae and postlarvae production was increased by determining the best feeding regimes and larval rearing conditions. In all, there were 33 families of freshwater prawn (*Macrobrachium rosenbergii*) and 46 families of shrimp (*Penaeus vannamei*) produced during 2019. The average shrimp weight was 30 g and the biggest shrimp reached 92 g. The shrimp/prawn stock have been under strict health surveillance and monitoring regimes for species specific diseases, and remain specific	**Global Food Security and Hunger**

		pathogen free status for all the OIE listed pathogens and known emerging diseases from the Asia, the world center of aquaculture. WPTRC participates in the Aquaculture Task Force to reinvigorate efforts to develop aquaculture industry according to the executive order signed by Governor Leon Guerrero. There was also participation on the Micronesian Association in Sustainable Aquaculture Regional and the Pacific Community Groups meetings and established collaboration with the Palau Community College on mangrove crab larval rearing project. Peer-review manuscripts: 1 TOTAL PROGRAM CONTACTS 2019 Direct Contacts Adults 18	
13.	**Invasive species**	Little fire ant (LFA) was detected on Guam in 2011 and continues to spread in Guam. The treatment of LFA infestations in a GovGuam Conservation Forest that includes planted acacia trees interspersed with shrubs and bushes was turned over to GovGuam Biosecurity personnel. Delimiting surveys and treatment of LFA infested areas occurred on Department of Defense installations on northern and southern Guam. These areas were treated with pesticides that contain the insect growth regulator s-methoprene, and a chitinase inhibitor, metaflumizone. Following the application of the pesticides, the worker ants ingest a sublethal dose of the active ingredient of either pesticide, feed it to the queen upon returning to the main colony. Once the queen dies, the workers and ultimately the entire colony gradually dies out. Results indicate that LFA numbers decreased to undetectable levels following eight treatments spaced six weeks apart. Education programs (Extension) are developed to share information with various audiences (agency personnel, landowners, general public). Uncontrolled outbreaks of Coconut Rhino Beetle-Guam is a major emergent problem for Pacific islands. Outbreaks of this highly invasive biotype are damaging and killing palms in Guam, Rota, Hawaii, Palau, Papua New Guinea, and the Solomon Islands. Without effective control of these outbreaks, the problem will spread to other Pacific islands, resulting in a human tragedy when it reaches atolls were islanders still rely on coconut palm as the tree of life. Project resources, time and effort were used to facilitate communication among an ad hoc collaboration of entomologists working on the CRB-G problem throughout the Pacific. Faculty and staff (CE&O / WPTRC) provide service and training on invasive species identification, serve in the Guam Invasive Species Advisory Committee, the Guam Invasive Species Council, the Micronesian Regional Invasive Species Committee and other committees. Direct Contacts Adults 663 Indirect Contacts Adults 27935 Direct Contacts Youth 604 Indirect Contacts Youth 1446	**Sustain, Protect, and Manage the Environment and Natural Resources of Guam and Micronesia**

14.	**Plant inventory and monitoring/ Climate change mitigation**	Agriculture and forest lands are affected by climate change. Plant inventories of urban landscapes have continued. Propagated and out-planted Guam rare plant species are established in protected sites. Endangered native orchids were re-established at the Anderson Air Force base with 87% success rate in partnerships with the U.S. Department of Defense. Plants are monitored and maintained using adaptive management until they are established. Monitoring included documenting pest problems. The Forest Inventory Analysis (FIA) cooperative agreement will continue until 2021. Technicians trained in FIA measurement practices are now conducting field work in Guam, other Micronesia islands, and Hawaii. The Arborist Certification program for Guam is housed at UOG. A beta testing version of the Raspberry Pi software and computers for the Arborist Certification training were given to the Guam Department of Agriculture Forest and Soil Resources to test. Cooperative Agriculture Pest Survey (CAPS) program aimed to conducting national and state surveys targeted to plant pests, diseases, and weeds identified as threats to agriculture and the environment. Native Plant Education Program that focuses on development of native plant fact sheets that provide educational information to the general public continues with the addition of conducting a series of workshops where each workshop focuses on featured native plants. Workshops included basic plant identification methods, plant propagation, planting appropriately and in proper places, and overall plant care. Pesticide safety education program (PSEP). Through funding from eXtension Foundation, update PowerPoint presentations for PSEP courses. Another is being used to update a pesticide applicator's guide for Guam. Direct Contacts Adults 703 Indirect Contacts Adults 23000 (approximate) Direct Contacts Youth 298 Indirect Contacts Youth 350 (approximate)	Sustain, Protect, and Manage the Environment and Natural Resources of Guam and Micronesia
15.	**Soil conservation and management**	Research on soil quality improvements to increase sustainable food production while reducing negative effects on lands and coastal environments has shown trends to increase crop yields and decrease CO2 emissions after applying biochar and conservation agriculture practices. Findings have been shared with farmers, school students, and federal, territorial, and regional government agencies and NGO's promoting public awareness on soil conservation in Micronesia. The Guam Legislature has passed bills to promote soil and water conservation based on UOG research efforts. Surveys of vesicular-arbuscular mycorrhizae (VAM) communities associated to three native plant species were conducted at ten sites across Guam with the goal of finding beneficial	**Sustain, Protect, and Manage the Environment and Natural Resources of Guam and Micronesia**

		organisms that would reduce pesticides and fertilizer use. This research involved seven high school, undergraduate, and graduate students. Species identification was obtained by genetic sequencing of collected fungal spores. Related projects included VA use to improve nursery production of larval hostplants for the endangered Marianas eight-spot butterfly, VAM fungi in native orchids, and VAM density gradients in badlands. Peer-review manuscripts, media articles and presentation to technical and scientific meetings: 21 Direct contacts adults: 20	
16.	Turf management	Turf management has been a focus of research at WPTRC for many years. A workshop and field day on the updated turf management was conducted in conjunction with WERA-11 regional project including representatives from eight western states. In addition, educational seminars for superintendents, assistant superintendents, other golf course employees, commercial landscape company employees and selected landscape suppliers were conducted by four certificated instructors. Instruction was approved and certified by Golf Course Superintendent Association of America. Main topics were selection of pre-emergence and post-emergence herbicides for strategic weed control, pesticide equipment calibration for safe, effective and economical weed, disease and pest control; and management practices for turfgrass water conservation. Direct contacts adults: 67	**Sustain, Protect, and Manage the Environment and Natural Resources of Guam and Micronesia**

	Extension	Research
	Smith-Lever 3b & 3c	**Hatch**
Actual Formula	1303005	1415775
Actual Matching	838576	783486
Total Actual Expended	2141581	2199261
FTE Actual	30.97	25.02