G2019 Annual Report of Accomplishments and Results

West Virginia
West Virginia University Extension (WVUES)
West Virginia University Agriculture and Forestry Experiment Station (WVAFES)
West Virginia State University Extension Service (WVSUES)
West Virginia State University Agriculture and Environmental Research Station (WVSUAERS)

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)

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	All WVUES specialists and county agents are appointed as faculty at West Virginia University. As such, they undergo the same faculty reviews as other university faculty and are recognized, rewarded and promoted under the same protocol. Each year, every faculty member submits a Plan of Work to her/his program unit director for approval. The plans are evaluated based on how they address Extension priority programs, meet the needs of West Virginia citizens, and produce measurable outcomes. In December of each year, every faculty member submits a faculty file which contains productivity charts, accomplishment narratives, and supporting documentation related to teaching, research, and service. Depending on years of service and whether the faculty member is applying for promotion, the files are evaluated by program unit peers, program director, an Extension-wide committee, Extension Dean and Director, and the WVU Provost (for decision years only).
2. The Scientific Peer Review Process	The scientific peer review process at WVUES includes blind, external reviews of new educational materials such as curricula, white papers, fact sheets and bulletins. The process begins when an Extension faculty member creates a new educational document that is intended to be used across the state. The faculty member submits the document to the program unit director or designee who recruits external reviewers with subject-matter expertise who are willing to review the document(s) and provide feedback. The feedback goes to program director and the faculty member. Together they decide what if any revisions are necessary before the document is disseminated. Journal articles and grant applications are reviewed using methods established by the publisher or the granting agency.

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	**No current updates**
2. Methods to identify individuals and groups and brief explanation.	**No current updates**
3. Methods for collecting stakeholder input and brief explanation.	**No current updates**
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	**No current updates**

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.	**Miscellaneous insect and insecticide studies. (WVAFES)**	A potential treatment for hemlock woolley adelgid (imidacloprid) does not negatively impact soil insect abundance.	Global Food Security and Hunger
	Proper sampling to determine nutritive, feed additive, and mycotoxin content of feed and indicators of thermal detriment to the nutritional value of pelleted feed. (WVAFES)	Two papers were published in Journal of Applied Poultry Research. JAPR 28:826-836 and JAPR 28:accepted.	Global Food Security and Hunger
	Plant-parasitic nematode management as a component of sustainable soil health programs in horticultural and field crop production systems. (WVAFES)	Several cultivars of quinoa showed resistance to some species of nematodes, but reduced plant growth in some cultivar x nematode groups were not associated with a reduced plant dry matter.	Global Food Security and Hunger
	Mycotoxins: Biosecurity, food safety and biofuels bioproducts. (WVAFES)	Fungal strains have been developed that have novel combinations of ergot alkaloid biosynthesis genes. Analyses of both grass and dung samples for levels of ergot alkaloids have supported the research of other investigators on the multistate project working to understand the biology and ecology of mycotoxigenic fungi. One paper was submitted for publication.	Global Food Security and Hunger
	Improving parasite resistance in Texel sheep. (WVAFES)	Semen was utilized from the UK to expand genetic diversity in the US Texel flock. The project submitted records accounting for 50% of the breed data in the NSIP data set and conducted fecal egg counts for other producers to expand that dataset. As a result NSIP expects to be able to release an EBV for fecal egg counts within the next year.	Global Food Security and Hunger

	Tissue-specific engineering of terpenes with activity against aphids in cultivated tomato. (WVAFES)	A total of 20 different tomato accessions have been assayed and grouped into 6 different terpene chemotypes. The six chemotypes have been assessed for their effect on aphid performance and behavior. Expression of terpene biosynthetic genes under the control of different tissue-specific promoters has begun by cloning the genes into PCR vectors using Gateway cloning. Incorporation of these genes into tomato tissues has allowed initial choice feeding experiments with aphids to determine impacts on performance and behavior.	Global Food Security and Hunger
	Identifying microbial allies in N retention with 15N quantitative stable isotope probing. (WVAFES)	Samples of soil were collected from several WV Agriculture and Forestry Experiment Station farms to assess soil respiration. Sequencing of the 16S rRNA from these soil samples has identified a distinct microbial population in the samples collected from the Organic Farm. These differences in microbial community composition will allow examination of how communities immobilize N in agricultural soils.	Global Food Security and Hunger
	Agribusiness Management, and Farm Entrepreneurship/Agripreneurship and Risk Management. (WVUES)	Higher demand for local foods has created new opportunities for WV producers, but points to information and experience gaps that continue to limit entry and business success for socially-disadvantaged producers in WV. Over the last decade, WV farmland has declined by 72% and agriculture's contribution to GDP fell by 25%. In 2019, agripreneurship and risk management lessons were integrated into current extension programming, including continued development of the WV Market Ready Curriculum. We then collaborated with other state agencies and NGOs to discuss a grant proposal for building a Beginning Farmer Program in WV. Our grant writing training has resulted in over 65 grants being funded to date and 10 pending. Overall, we have been able to build an 'entrepreneurial mindset' among our youths (WVU and High Schools) and state producers, leading to better overall business planning and risk management.	Global Food Security and Hunger
	WVU Small Ruminant Project. (WVUES)	The West Virginia Small Ruminant Project (WVSRP) is an outreach program of West Virginia University. The long-term goal of the Project is to help farmers realize a greater return to small ruminant production and to help revitalize this industry in West Virginia, ultimately helping farmers increase	Global Food Security and Hunger

		the economic efficiency and overall profitability of their small ruminant enterprises through sound research in production and marketing practices.Through our multi-disciplinary and inter-departmental collaborations (Davis College – Animal Science, and Extension), these projects continue to attract significant competitive funding to continue project efforts. Projects are being funded through several grants totaling more than $900,000 (Hatch, NESARE) since 2011. Our small ruminant project have had 2 completed and 5 ongoing independent research projects since 2011.	
	Horticulture. (WVUES)	In West Virginia, there is a strong demand for locally grown, fresh produce. In 2019, the West Virginia Legislature passed the West Virginia Fresh Food Act in which all state-funded institutions are required to purchase a minimum of 5% of their fresh produce, meat and poultry from in-state producers if available. This has provided a potentially strong market for the many specialty crops which can be grown year-round in West Virginia. In 2019, we expanded the reservoir of information available to specialty crop producers by conducting collaborative, state-wide trials with melons, sweet corn and beans in addition to 8 other crops. The focus has been on crops that can be processed into value-added products to achieve a higher profit potential. Twelve specialty crop meetings, reaching approximately 450 growers were conducted in 2019. Five updated research reports related to specialty crop production were created. A SARE Partnership Grant was received expanding our evaluation of heritage beans as a commercial market. Professional development training was conducted. A SARE Professional Development Grant was submitted which will address the issues of winter food crop production, grower leadership training, asset mapping and grower organization was submitted. Seed and plant material was provided or donated to growers and gardeners from across the state to showcase recommended varieties. Estimated food produced from the donations was approximately 18,000 lbs.	Global Food Security and Hunger

	WVU Plant Diagnostic Clinic. (WVUES)	The WVU Plant Diagnostic Clinic diagnosed plants from 610 commodity growers' fields, home owners' landscapes and lawns that were infected with disease causing pathogens and where plant health was compromised. Diagnosis of the problem was done through laboratory investigations. Results and recommendations for remedial measures were sent to the clienteles. Many of them followed recommendations and some accepted it for preventative measure in their next crop production cycle. Many crops were saved, especially fruits and vegetables, from ruin. Landscape trees and ornamental plants retained aesthetic values. Homeowners saved money that would otherwise be spent for replacing those plants and trees.	Global Food Security and Hunger
	WVU Extension Integrated Pest Management Implementation. (WVUES)	Tree fruit producers have been facing challenges in protecting their commodity from pests with lower cost and environmentally friendly methods. Growers were provided with pest scouting data, disease prediction capability and cutting edge technologies to combat these problems with an integrated pest management approach. Orchard owners better managed their commodities with lower cost. Higher yield resulted in higher income by $150,000.	Global Food Security and Hunger
	WVU Soil Testing Lab Committee. (WVUES)	WVU Extension service and WVU Davis College Faculty established a Soil Testing Lab Committee to explore changes to the extraction method and a revision of the recommendation system. WVU Extension faculty and information technology staff developed a completely new software system. This software provides a new soil sample submission method, new customer data management system, a new crop recommendation system and an email delivery process that links the customer to their county extension agent. The lab changed their soil extraction from M-1 to M-3. This allows farmers to track phosphorus saturation in soils and provides results that are like private labs in surrounding states. The WVU Soil Testing Lab has a customer list of over 12,000 names. Having a new extraction method that can provide additional soil nutrient information along with a revised crop recommendation system provides WV farmers and homeowners with better information to improve the productivity of their soils. Better plant growth	Global Food Security and Hunger

		both in gardens and in agricultural fields is an economic benefit to all. This new soil testing method also provides an environmental signal to customers if their soils are excessive in certain nutrients that potentially can be lost to the environment.	
	Metagenomics and Nutrigenomics Study of Gut Microbiome and Metabolic Efficiency in Finfishes [WVSUAERS]	Studies conducted with rainbow trout and channel catfish, demonstrated a strong relationship between diet, temperature, strain/family types and mitochondrial function. Results also showed that in rainbow trout families with high FE, diet containing 42% crude protein (CP)/20% fat from either fish or vegetables was significantly better than those containing either 42% CP/10% fat or 42% CP/30% fat from either animal or plant oil in terms of growth performance characteristics. Thus, the popular belief that high fat diets (above 20% fat) are necessary for efficient production of fish was not supported by this study. Finally, the study also revealed changes in some of the selected mitochondrial genes in relation to growth and nutrient utilization efficiencies that could serve as marker(s) in breeding selection for genetic improvement of rainbow trout and channel catfish and possibly other aquaculture species.	Global Food Security and Hunger
	Characterization of phytochemicals in pepper germplasm for developing phenotypes with enhanced phytonutrients [WVSUAERS]	This study genetically characterized Ají peppers along with the American peppers for nutraceutical characterization for their role in reducing cancer and predisposition to cardiovascular diseases and transfer these value added traits into the American peppers using genomics driven plant breeding approach. Pepper pre-breeding lines with enhanced nutrients, already identified in this project, are expected to have better market value than the current market varieties. Furthermore, the study identified cultivars with very high β-carotene and vitamin C content. It also estimated the levels of carotenoids, flavonoids, vitamin C, and capsaicinoids at the immature and mature stages for 1000+ different collections belonging to *C. annuum, C. frutescens, C. baccatum and C. chinense.*	Global Food Security and Hunger

	Genomic Tools for Watermelon Improvement and Utilization [WVSUAERS]	This study identified various molecular mechanisms including mobile transcripts involved in different tissues of heterografted watermelon and bottle gourd plants. Grafting with bottle gourd rootstock increased the size and rind thickness of watermelon fruits under acidic soil conditions. In addition, Citrulline (cit), an non-protein amino acid, has been demonstrated of possessing health benefits that can cure cardiovascular diseases. To this end, we performed genetic analysis for citrulline content in a diversity panel containing 180 genotypes. The study identified suitable grafting methods that are more effective to growth in the acidic and heavy metal contaminated soils. The Cit content among the selected accessions ranged from 0.10 to 47.3 mg/g with an average of 10.0 ± .04 mg/g. Garrisonian, Cole's Early and PI 44282 had highest free Cit content in the flesh. Finally, the study identified two genes Ferrochelatase (FC) enzyme and Acetolactate synthase (ALS) gene to be responsible for citrulline variation in cultivars. These findings are useful to further develop high citrulline watermelon cultivars for the market.	Global Food Security and Hunger
	Breeding Fresh Market Tomatoes for Protected Culture Production [WVSUAERS]	Greater economic benefit can be obtained from growing vintage tomatoes over standard field-grown tomatoes, however their production is challenging because of the lack of pest resistance commonly found in modern tomato cultivars. The overall goal of this research was to incorporate the standard resistance genes using marker-assisted selection and speed vintage variety recovery using background selection coupled with phenotypic plant and fruit evaluations to create improved vintage types. Three vintage varieties, Brandywine, Cherokee Purple and Mortgage Lifter, were analyzed for phenotypic data on three plant and over thirty fruit characters and identified some variation between vintage varieties from different seed companies. Background genotypic variation within and between these varieties was analyzed with SNP markers. Genotypic variation found suggested that the same varieties from different companies are not homogenous and thus care should be taken in selecting a varietyto be used in a breeding program since varieties with the same name maynot	Global Food Security and Hunger

		have the same phenotypic and genotypic characters. Similar analysis was done with seven F1 hybrids between the vintage varieties and a donor parent. Reciprocal backcrosses were grown from three F1 hybrids. Seed germination was reduced when the vintage variety was used as the female parent in the backcross with each F1 hybrid. Backtracking, a similar reduction was seen in the success of crosses and seed generated from these crosses. Selection was done for resistance to tobacco mosaic virus resistance and a similar reduction in the number of plants with resistance was also seen in crosses where using the female as the vintage variety. No significant differences were observed in plant or fruit morphology in the different backcross populations. Using background selection, individual plants within each backcross population had a higher percentage of vintage variety marker types than was expected which will reduce the number of backcrosses necessary to retrieve the vintage variety type.	
	Extension Master Gardener Program/WVMG Association. (WVUES)	Extension Master Gardener Program offers an outlet for people interested in gardening to learn more about horticulture. The overall goal is to provide service to the communities throughout the state by offering the educational program that would fulfill the need for increased understanding and knowledge of horticulture, promote the science and prepare the public to be better stewards of the land, natural ecosystems and environment. This program trained volunteers in 46 counties through the West Virginia Extension Master Gardeners Association (WVEMGA) in coordination with the WVU Extension Service, help people better understand horticultural and environmental issues by community engagement through gardening and beautification projects at schools, parks, public institutions, community organizations, etc. This year, we had 201 new trainees in counties that submitted their reports. In 26 Counties, we had 568 volunteers that worked on 173 projects. They reported 24,748 service hours and 9,211 educational hours for a total of 33,957 hours. At $25.43/hr.(https://independentsector.org/value-of-volunteer-time-2018/), Master Gardeners' contribution to the WV state's economy was $863,527.	

	Fresh to Market: Cold Chain Support for Market Expansion (WVSUES)	West Virginia's small farms have difficulty marketing their products safely and effectively due to topography, distance to market centers, and limited resources. Nearly 90% of the state's farms gross less than $25,000 in annual sales (2017 Census of Agriculture). WVSUES targeted small-scale vegetable producers and capped gross income at $100,000 and capacity at 100 acres. Most participants earned less than $20,000 and had fewer than 10 acres in production. The program provided limited-resource producers with training in post-harvest handling and tools to implement an on-farm cold chain with storage and delivery capacity to improve product quality and safety. Tools included a CoolBot® device, coolers, harvesting knives, and produce packaging. WVSUES also provides and schedules a fleet of mobile cooling units seasonally among participants. A total of 77 producers participated in eight Cold Chain workshops with an additional five military veteran participants in two training sessions on Post-Harvest Handling. Over 75% of participants implemented precooling procedures and food safety measures resulting in improved produce quality and increased market share across the board. Participants further saw fewer restrictions on the variety of produce they could grow, which increased revenue potential[1] . Several, including berry producers and a pork farm, have significantly increased the availability of their product.	Global Food Security and Hunger
	Conservation Systems Training for Production Management (WVSUES)	Many West Virginia farmers who obtained and installed conservation systems through the USDA—Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP) lack basic knowledge to use them successfully, resulting in abandoned farm projects that reduce food security for the region. WVSUES partnered with the USDA NRCS and the West Virginia National Guard's (WVNG) Patriot Guardens Program to support sustainable agriculture through conservation-minded farming practices. The program targets producers and landholders enrolled in or interested in the NRCS EQIP program or who plan to independently implement conservation systems in	Global Food Security and Hunger

		their operation, budding agricultural entrepreneurs, and military veterans and members of socially disadvantaged or underrepresented populations seeking to start an agricultural venture. WVSUES established demonstration pollinator habitat and high tunnel facilities at WVNG sites and the WVSU Urban Agriculture Training Center in Charleston, WV. Agents distributed information on USDA programs at public outreach events and conducted workshops to assist new agripreneurs (producers and agricultural product manufacturers) with planning and obtaining USDA resources, provided training in sustainable production methods, including high tunnels and season extension, composting, pollinator support and rotational grazing. A total of 29 workshops drew 343 individual participants. WVSUES brought beginning and established farmers and food manufacturers and Extension and agency personnel together with beginning producers to orient them to available support, avoid common pitfalls, and to navigate marketing and regulation processes and offered hands-on training and material participant support in season extension techniques, high tunnel production, native pollinator support, and orchard maintenance.	
	Urban Farming for Socially Disadvantaged Farmers: Securing Food and Economic Opportunity (WVSUES)	High unemployment or underemployment rates discourage minority and economically depressed West Virginians from taking a risk to farm. State and local boards of education devote few resources to agricultural education, which leads to little exposure to agriculture. WVSUES activities targeted minority, veteran, disabled, and other historically underrepresented communities, while also providing private training sessions in urban farming for participants in an inpatient opioid recovery program. WVSUES educators developed an agricultural training and demonstration urban farm in Charleston, WV, and delivered workshops across the state to promote adoption of urban agriculture practices in urban, peri-urban, and rural settings with limited arable land to increase food security through self-reliance. Topics covered composting, hydroponics, urban orchards, raised-	Global Food Security and Hunger

		bed-based production, soil management, urban poultry, and mushroom production. Educators also offered agribusiness training to encourage agricultural entrepreneurship, including topics on production planning, risk management, marketing, and regulations. Seventy workshops and seminars instructed 387 unique participants in agribusiness and alternative or urban farming techniques. WVSUES increased local accessibility to fresh produce by equipping participants with skills to grow food at home and by increasing the number of successful agricultural ventures in the region . WVSUES gave all harvests from the Charleston demonstration high tunnel site (100 lbs) to community volunteers, neighborhood residents, and local food banks at no charge .	
	Southern Ag Incubator: Strengthening WV's Agricultural Economy through Urban Agriculture and Agribusiness Support (WVSUES)	West Virginians disproportionately face hunger and food insecurity due to high unemployment and low median household income, limited access to arable land, and knowledge gaps in agricultural production and business. Some established farmers have a cultural avoidance of alternative technologies and growing strategies that characterize urban agriculture. Many West Virginians also have a historic distrust of government intervention or non-profit programs, particularly in the Southern Coalfields region of the state. WVSUES established an alternative agriculture demonstration facility at the Welch National Guard Armory showcasing hydroponics systems, scalable aquaponics, and raised beds, targeting peri-urban and rural households, limited income residents, displaced mine workers, and new farmers. Educators delivered workshops in related topics across the southern portion of the state and worked directly with producers to provide technical support, training, and one-on-one consultations in non-traditional methods tailored to small- to micro-scale agricultural production and agribusiness creation. Eighteen workshops trained 169 unique participants in alternative agriculture methods, mushroom production, and agribusiness. Notable agribusiness incubator successes include an Amish poultry farmer who now	Global Food Security and Hunger

		has regular urban clientele; an indoor gourmet mushroom farm that now hires local workers and markets direct to consumers via online sales, farmer's markets, and restaurants; and hydroponics support for an indoor urban farm to expand its capacity. WVSUES donated all harvests (200 lbs) from the Welch demonstration high tunnel site to community volunteers and residents.	
	Sprouting Farms Training Series: Grass Root Agricultural Development (WVSUES)	Sprouting Farms is a non-profit farm in Summers County, WV, that aims to strengthen the local farm community through shared educational resources and collective marketing through the Turnrow Appalachian Farm Collective. Sprouting Farms is a grass roots movement to build an agriculture community by encouraging new farmers within the region for economic benefit in the agriculture sector in the absence of traditional industry options. Sprouting Farms recruited WVSUES to train new farmers from the Summers County vicinity in sustainable production methods . WVSUES offered hands-on training and participant support in cold chain and post-harvest handling, high tunnel production, hydroponics, soils, and transplanting. WVSUES trained 44 attendees (38 individual participants) through five workshops in sustainable production for Sprouting Farms . Sprouting Farms has increased knowledgeable staff and the number of new effective producers to enable them to implement pop up markets and support a new agriculture collective with online purchasing capabilities.	Global Food Security and Hunger
	VA Farms Project-Based Learning Pilot Program: Agribusiness Development for Veterans (WVSUES)	The Veteran's Administration Office of Mental Health and Suicide Prevention (OMHSP) reports that rural veterans have a 20% higher suicide rate than others due to lower income, higher unemployment rates, and reduced social connection. OMHSP created the Veterans Affairs Farming and Recovery Mental Health Services (VA FARMS) program to support Veterans through agritherapy—integrating behavioral health care services with agricultural vocational training to overcome these effects.	Global Food Security and Hunger

		WVSUES, retained through the WV Department of Agriculture, worked with military veterans enrolled in the VA FARMS program to support the VA FARMS Project Based Learning Pilot Program through curriculum development assistance and content delivery. The program consisted of six cycles of six-week immersive training events, followed by a two-week set-aside for voluntary internship opportunities and ran from April through mid-December. Each cycle focused on a specific implementation project and engaged participants with educators four days per week in four-hour combinations of lecture, lab, and activity-based instruction. Extension agents offered training in cold chain, hydroponics, irrigation and water management, mushroom production, production planning, and planting seedlings for production transplants. WVSUES delivered 16 workshops through September to 20 enrolled participants and two guests. While largely intended as therapy, the program equipped participants with skills to grow their own produce and potentially start their own agricultural enterprises. Nearly all of the participants expressed increased interest in agriculture and plan to continue production on their own.	
	Sustainable Agriculture Professional Development Program. (WVUES)	Social agripreneurship is gaining much traction in West Virginia (WV) and the US because of increasing social awareness around food issues referred to as the 'good food movement'. This business model is based on the premise of 'creating economic value by creating social value', and aligns well with sustainable agriculture by integrating profitability, food security, environmental stewardship, community connections, and advocacy. In 2019, we developed an 'Agribusiness Asset Mapping Tool' to identify and prioritize farm-to-table enterprises and related assets based on 'farm-to-table readiness', and to digitally map these assets for future product and market development initiatives. We are currently using these Asset Maps and GIS spatial analysis techniques to identify gaps in 'farm-to-table readiness'; potential business linkages between agribusiness based on their complementarity; and potential 'agribusiness cluster' opportunities in	Global Food Security and Hunger

		production and/or marketing. This analysis will enable ASPs and producers to determine agribusiness sites and regional areas for additional training and technical support efforts, and for regional agribusiness 'cluster' development, such as the 2019-2020 Mountain State Maple Days Clusters	
	West Virginia Urban Agriculture Conference and Community Expo (WVSUES)	West Virginians disproportionately face hunger and food insecurity due to high unemployment and low median household income, limited access to arable land, and knowledge gaps in agricultural production and business. To address this issue, the annual West Virginia Urban Agriculture Conference, hosted by WVSUES each May, brings together agency partners (e.g., NRCS and Conservation Districts, WVDA, Forestry Service, Farm Bureau) and Extension personnel with successful local producers to share their knowledge with the general public, advertise agency programs, and promote adoption of urban farming, urban forestry, and alternative agricultural techniques. Sessions targeted small-scale producers, limited-resource households, socially disadvantaged populations (including racial and ethnic minorities and individuals with disabilities), and military veterans in urban and rural communities. Hands-on workshops are geared toward producers with limited space, financial resources, and time. Thirty-one workshops and seminars addressed local food security with more than 100 local participants and 36 vendors. Workshops contributed to food security by helping producers mitigate risks, incorporate sustainable techniques, increase productivity, connect with nonprofits and cooperatives, and safely preserve foods.	Global Food Security and Hunger
	WV Agritourism Initiative. (WVUES)	WV farmers are exploring agritourism as an emerging agribusiness opportunity - Post-evaluations from Annie's Project and other extension programs, combined with WV tourism data on total visitor spending ($5.1 billion-2012) and trending tourism niches (inter-generational travel, local foods/culinary tourism, last minute trips), indicate that new/additional agritourism/farm-based educational enterprises are in demand because of	Global Food Security and Hunger

		their flexibility, and income-diversification and inter-generational potential for small operations. We have worked to build the WVU Agritourism Initiative Team, which is a multi-agency team consisting of personnel from WVUES, WVU Law School, WV Department of Agriculture, WV Division of Tourism, and Local CVBs and Insurance Agencies . Over $30,000 in grant funding was secured for this program; 200 graduates successfully completed one of 4 rigorous short-courses in WV to date; 40 in 2019. Post-project evaluations in 2019 show: 100% of post-survey respondents (75 participants) have implemented at least two risk management tools/practices in their current or planned Agritourism operations that contribute to farm viability; 70 participants have made significant improvements to their current/planned operations; 35 have launched a new/improved agritourism/farm-based educational enterprise; 42 participants have already reported improved farm viability/profitability as a result of changes based on workshop and technical assistance; 27 participants have already reported an increase in quality of life indicators (changes in personal time/personal satisfaction); and 100% of participants indicated an intent to expand or maintain the size of their current operation.	
2.	**Soil survey work in West Virginia. (WVAFES)**	This project has increased geospatial knowledge regarding soil resources of the US at local, regional and continental scales. By advancing our understanding of soil management guides decision making.	Climate Change and Environmental Quality
	Preliminary investigations in soils. (WVAFES)	Evaluations to test the suitability of new fertilizer and by-products as soil amendments for crop production. Two journal articles were published from this project.	Climate Change and Environmental Quality
	Hydropedology of vernal pool systems. (WVAFES)	Vernal pools are one of the most ecologically valued inland wetlands, providing habitat for numerous rare and endangered plants and animals. This project collected data from an instrumented section of the Monongahela National Forest including field work, laboratory analysis and geospatial modeling. The project developed a better understanding of the	Climate Change and Environmental Quality

		processes that occur in these systems. This information was shared with students and regional soil scientists.	
	Sustainability of Central Appalachian fresh water resources: Implications of climate and environmental change on water quantity and water quality. (WVAFES)	This project provided critical insight into how environmental and climate change have impacted freshwater resources in greater Appalachia and West Virginia, in particular. Several water and energy balance datasets were generated which can be used by researchers, educators and decision makers. The project also produced five peer-reviewed journal articles.	Climate Change and Environmental Quality
	The green corridor potential of Appalachian stream buffers: access, ecological restoration and management strategies. (WVAFES)	This project seeks to examine historical greenspace, implement measures to mitigate soil erosion from stormwater and identify gaps in community greenspace networks. The project makes heavy use of students to collect data, creating an integrated audience and developing an appreciation for research amongst students. Significant planning for greenspaces has been accomplished, including identifying important features like historic 'Big Trees' and old growth beech stands potentially 350 years old. The trail design has benefited the local community and resulted in manuscripts submitted for peer-reviewed publication.	Climate Change and Environmental Quality
	Conservation genetics of fish and wildlife populations. (WVAFES)	Genetic tools are developed to better understand wildlife populations to aid managers in decision making. During this year genetic markers were established to delineate the structure of lake sturgeon populations across the Great Lakes and to determine the success of stocking in the St. Louis river. Similar approaches were used to assess hybridization between variegate and candy darter. This project resulted in 5 peer-reviewed publications.	Climate Change and Environmental Quality
	Natural resource integrity: water and energy systems. (WVAFES)	This project assesses water and energy systems at a regional level with implications for national decision making. During this year the project determined that natural gas substitution for coal in the generation of electricity is heterogeneous in the region, and has led to improved technical efficiency and reduced CO2 generation. The project also evaluated the installation of solar energy generation at commercial sites and found that installation was impacted by state-level factors like solar intensity as well as	Climate Change and Environmental Quality

		state level policies like carve outs and tax breaks. The project also determined that populations are willing to pay for improved trails and other amenities in urban forests. Three peer-reviewed articles were published from this project.	
	Investigating hydrology and water quality of mixed-land-use watersheds of West Virginia. (WVAFES)	This project seeks to provide data from the West Run Watershed as an example of a 303d impaired stream in the Appalachian region for use in distributed models. A number of permanent instruments evaluating stream flows and water quality have been installed and data collection continues so that sufficient datasets can be made available for distributed modeling. In addition, the project is developing partnerships at the national level to assess and advise on best management practices in both the Chesapeake Bay Watershed and Mississippi River Basin. The project resulted in eight peer-reviewed journal articles and a book chapter.	Climate Change and Environmental Quality
	Evaluation of strategies to mitigate and adapt to a changing climate that ensure the long-term health of the environment, food and energy production. (WVAFES)	This project developed marginal cost curves of soil organic carbon sequestration to help identify the costs of changing management to increase soil organic carbon stocks. The project determined that practices could increase soil carbon at a cost of less than $20/Mg CO2. This project resulted in two peer-reviewed articles.	Climate Change and Environmental Quality
	Seeing green in our woodlands: Promoting plant education to improve forest health, economics and conservation. (WVAFES)	Both in person and webinars were provided to share the science of forest resiliency for forest professionals, land managers and landowners.	Climate Change and Environmental Quality
	Spatial decision support: Optimizing drone data acquisition for natural resource management. (WVAFES)	This project approached its goal of optimizing (minimizing negative factors and maximizing positive factors) drone use in natural resource management to provide rapid detailed information to track runoff at a gas well pad and use that data to strategically deploy mitigation, resulting in one peer-reviewed journal article.	Climate Change and Environmental Quality
	Nutrient Management Recordkeeping. (WVUES)	As we learned more about water quality in the Chesapeake Bay, much focus from the U.S. Department of Environmental Protection has been placed on reducing pollutant runoff into waterways that drain into the Bay. Agriculture is the sector that has been defined as the greatest source of nutrient and	Climate Change and Environmental Quality

		sediment pollution that enters the Bay. Typically, nutrient management plans are the most common best management practice used among agriculture professionals and farmers to display their production practices are not reducing pollutants into waterways. The eight-county Eastern Panhandle region of West Virginia is the only portion of the state included in the Chesapeake Bay's watershed. Of the six states with watersheds that drain into the Bay, West Virginia is the only state that does not have any legislation that mandates certain or all farmers to have a nutrient management plan. Since all farmers with nutrient management plans in West Virginia have one on a purely voluntary basis, no record keeping system of inputs is defined. As a means to better capture the positive effect West Virginia producers have on water quality, this research study utilized a cell phone application, the Ohio Nutrient Management Record Keeper (ONMRK), to capture nutrient management application data in real time from producers within our Eastern Panhandle that have a nutrient management plan.	
	Evaluating the Impact of Reforestation of Surface Mining Operations on Soil Water Quality [WVSUAERS]	The study focused on the impact of different reclamation practices on soil biogeochemical processes and water quality. Several vulnerabilities were found during the study. Results pointed to redox-promote dissolution processes as a dominant factor controlling soluble salts levels, especially during episodes where soluble salts concentration exceeded regulatory thresholds. Results also pointed to inherent limitations associated with the newly developed soils to regulate redox fluctuation and to possible role of the management practices to mitigate it. The second part of the study evaluated temporal and spatial changes in soil water quality of mine sites under different reclamation practices. The study revealed several biogeochemical processes governing the impact of reclamation practice on soil water quality, allowing better understanding of the system, and for further refinement of reforestation practices to assure sustainable recovery of ecosystem services. This knowledge is critical and a key for further	Climate Change and Environmental Quality

		development, evaluation, and adaptation of Proper reclamation practices of surface mining operations to assure cost-effective, sustainable, and robust recovery of ecosystem services, such as site productivity and clean water.	
	Conservation Systems Training for Farm Sustainability (WVSUES)	Increased seasonal rainfall combined with warmer-than-average winter temperatures and extended periods of heat challenge West Virginia's producers to adopt new production schedules and methods, change plant varieties and pest mitigation strategies, and maintain habitat for native pollinators in order to successfully navigate vagaries in regional and local microclimates. WVSUES is addressing this issue through programs targeting range land holders and agricultural producers, with outreach aimed towards limited-resource and underrepresented populations, disabled veterans, and new or beginning farmers. Workshops and seminars focused on conservation systems to enhance environmental quality and productive capacity. These highlighted differences between protected culture (high and low-tunnel season extension) and traditional row cropping and introduced producers to concepts of basic soil science, composting at garden- and farm-scales for sustainable nutrient management, the importance of native pollinators to cropping systems, positive and negative aspects of climate change for the region, and other ecological considerations for farmers and land managers (e.g., snake remediation and identification, conservation of warblers and butterflies). WVSUES reached 109 individuals through 15 workshops and seminars covering season extension methods and passive environmental control systems, soil and water conservation strategies, and pollinator support to improve sustainability through better management decisions. Participants learned how to construct low-cost season extension solutions to take advantage of milder winters and protect cool-weather crops in warmer months.	Climate Change and Environmental Quality

	Sustainable Production Methods for Socially Disadvantaged Farmers (WVSUES)	The negative impacts of climate change disproportionately affect those with limited resources. Many avenues for improvements toward environmental quality are ranked as low priority as food security, substance abuse, and income inequality take precedence. WVSUES activities targeted minority, veteran, disabled, and other historically underrepresented communities, providing private training sessions in urban farming for participants in a local inpatient opioid recovery program. Participants typically have little to no agricultural experience. Workshops have been held on composting, edible plant walks, high tunnels, hydroponics, shrimp, irrigation and water management, mushroom production, tree care and orchard maintenance, pollinator support, season extension, soil lab, transplanting, urban farming and raised bed production. WVSUES promoted sustainable ways to offset effects of climate change by hosting 44 workshops that included 285 unique participants.	Climate Change and Environmental Quality
	Southern Ag Incubator: Alternative Agriculture for Resource Conservation (WVSUES)	The Southern Coalfields region of West Virginia needs to diversity income streams as the decreased demand for and mechanization of coal production negatively affects the economic viability of these rural communities. With a strong connection to the land, the residents of this region need support to decrease dependence on extractive industries, improve water and stream quality and build better ecosystems in their immediate environs. To address this issue, WVSUES targeted peri-urban and rural households in the Southern Coalfields, limited income residents, displaced mine workers, and new farmers with workshops addressing climate change through promotion of conservation measures including composting at garden- and farm-scale, indoor hydroponics and shrimp farming, mushroom production, construction and monitoring of native bee houses and pollinator gardens, season extension techniques, urban beekeeping, and organic urban garden maintenance. Twenty-one workshops introduced 146 unique participants to ways they can apply alternative agriculture, such as aquaponics as a renewable nutrient	Climate Change and Environmental Quality

		source, conserve and improve soils through basic soil science, and to engage in naturally sustainable production management practices.	
	Renewable Forest Resources and Sustainable Orchards (WVSUES)	Increased seasonal rainfall combined with warmer-than-average winter temperatures and extended periods of heat challenge West Virginia's forest owners and orchardists to adopt new tree species, production schedules, and pest mitigation while maintaining habitat for native pollinators in order to successfully navigate vagaries in regional and local microclimates. WVSUES provided workshops and technical advice targeting forest land holders, producers, farmers, NGOs, and urban growers, with outreach aimed towards limited-resource and underrepresented populations, disabled veterans, and new or beginning farmers. Topics included soil management, alternative agriculture practices, tree care, forest knowledge, mushroom production, pollinator habitats, and environmental awareness. More than 175 individuals participated in 19 workshops focusing on urban areas (Charleston and Teays Valley regions) where the built environment constrains tree planting and care. These involved detailing the planning and development of small orchards and grafting of fruit trees to rootstock suitable for our region's climate, planting trees on campus and private property, in addition to a donation of more than 20 fruit trees to area nonprofits, and forest forays to raise public awareness of native forest products, ecology, and conservation practices.	Climate Change and Environmental Quality
	USFA Climate Hub: Farm Resilience through Climate Adaptation (WVSUES)	Climate changes have resulted in a need for West Virginia's producers to adapt to increased rainfall, warmer than normal temperatures, and killing frosts that decimate harvests from fruit varieties forced into early bloom. Increased production loss from northward migrating pests and increased fungal growth requires changes in observation patterns and mitigative applications to achieve sustainable harvests. WVSUES provided training and technical support to small-scale producers with minimal profit margins, high tunnel producers, gardeners and homeowners.	Climate Change and Environmental Quality

		Outreach to growers with climate-related concerns was achieved through dissemination of related materials through social media, listservs, and as announcements at workshop events where the information was related and relevant. WVSUES disseminated notices of bovine diseases released through the office of the State Veterinarian to alert ranchers of new disease vectors identified within the state. WVSUES is developing a high tunnel at its urban garden location in the capital city that will utilize rainwater and solar energy to demonstrate renewable energy use and application in a production environment as a means to decrease the carbon footprint of producers.	
3.	**Improving the Versatility and Adaptability of Thermophilic Anaerobic Digestion & Microbiome Functional Diversity Driving Plant Biomass Decomposition in Engineered Environments [WVSUAERS]**	The study focused on two complementary, engineered environments where the decomposition of plant biomass is important: anaerobic digestion (AD) and restored mine site soils. The obtained metagenomes showed that the digester microbiomes were enriched in carbohydrate metabolism genes and pathways. In particular, the categories of monosaccharides, di- and oligosaccharides, and polysaccharides metabolism were enriched. Within the monosaccharides group, the most enriched subgroups were pathways for xylose, glucuronate, arabinose and mannose utilization. All of these are found in plant cell walls and show the functional specialization of this anaerobic microbiome for plant biomass decomposition. A second major objective was to analyze soil microbiomes from disturbed and restored mine site soils. Analysis of metagenomes was done for a chronosequence of restored soils following Mountain Top Mining (MTM) in West Virginia. Results showed that the oldest restored soils (30 years post-MTM) were much more similar to the control forest soils compared to recently restored land. Our analysis has shown that important carbon biogeochemical cycling processes do recover over time in damaged soils.	Sustainable Energy
	Molecular Mechanism of Seed Storage Compounds Regulation in Plants [WVSUAERS]	This study developed advanced molecular techniques to manipulate the genes involved in the production and accumulation of seed storage compounds such as oils – using the model plant Arabidopsis thaliana. Analysis of a subset of storage compound synthesis genes during the seed germination revealed that some set of genes are dramatically down during	Sustainable Energy

		seedling establishment, indicating the role of these genes in seed filling. The study also selected an uncharacterized gene for subsequent functional characterization. Based on the Arabidopsis studies, the best gene combination which is known to involve in enhancing sugar supply to oil synthesis was identified. This research is also generating transgenic plants using Agrobacterium-mediated flower dip transformation by use of binary vectors consisting of herbicide selection marker/DsRED protein and hygromycin alone or in combination.	
4.			
	WV Mentoring Program. (WVUES)	The 4-H National Mentoring Program's goals are to improve outcomes for at-risk, high-risk, or underserved youth and reduce negative outcomes, including juvenile delinquency and gang participation, improve academic performance, and reduce school drop-out rates through mentoring. This program provided mentoring programs for 120 at-risk, high risk, or underserved youth while addressing factors that can lead to or serve as a catalyst for delinquency or other problem behaviors in underserved youth for a minimum of 12 months. Our audience included youth suffering from family opioid/substance abuse problems in Huntington, WV. This is the ninth consecutive year for the program	Childhood Obesity, Nutrition and Health
	Changing the health trajectory for older adults through effective diet and activity modifications. (WVAFES)	This project is attempting to determine the effectiveness of novel interventions to achieve healthy weights and to identify biomarkers of successful aging. The project resulted in two peer-reviewed journal articles.	Childhood Obesity, Nutrition and Health
	Using behavioral and environmental tools to identify weight related factors associated with health in communities of young adults. (WVAFES)	This project is focused on developing approaches to reach young adults on college campuses and in low income communities and impact their lifestyles using behavioral and environmental tools. This project resulted in 16 peer-reviewed journal articles over its 5-year period.	Childhood Obesity, Nutrition and Health
	WV Health Rocks Program. (WVUES)	WV remains one of the statistically largest per capita users of tobacco products and illegal drugs. Curriculum from the National 4-H Center and a grant funded from Altria provided 10 hours of instruction in prevention for	Childhood Obesity, Nutrition and Health

		tobacco and alcohol and other drug use along with a health and decision-making program. The WV Health Rocks program has served over 12,000 WV youth with instruction on substance abuse prevention at statewide 4-H camping, through the West Virginia Statewide Afterschool Network (WVSAN), and the 4-H Health Ambassadors to broadcast the instruction across the regions of our state	
	Family Nutrition Program. (WVUES)	People who participate in Drug Court and recovery programs throughout the state often lack basic skills in food preparation, food safety, meal planning, grocery shopping and food resource management. Eleven Adult Nutrition Outreach Instructors and Health Educators in thirteen counties throughout the state partnered with Drug Court and Recovery programs to bring Eating Smart, Being Active (a nine-week course focusing on shopping and cooking healthy meals on a budget) to 294 program participants and residents. Participants showed improvements in all core areas of the program; diet quality, physical activity, food safety and food resource management.	Childhood Obesity, Nutrition and Health
5.	**Control of Salmonella spp. in poultry products by physical and chemical treatments. (WVAFES)**	Contaminated poultry meat represents the greatest public health impact among foods and is responsible for an estimated $2.4 billion in disease burden. This project has evaluated the economic feasibility of several different antimicrobial approaches to reducing microbial load on poultry products. Both electrospray and immersion approaches were effective, but on small scales the immersion approach was more economical. This project resulted in one peer-reviewed journal article.	Food Safety
	Evaluation of the safety and health benefits of apple pomace and development into food products for human consumption. (WVAFES)	Apples are the most abundant fruit crop world-wide and the US is the number 2 producer. Processed apples generate pomace and the goal of the project is to test inclusion in diets. Inclusion improved indicators of health without negatively impacting kidney or bone health. The project resulted in two peer-reviewed journal articles.	Food Safety
	Value-added ingredients from repurposed underutilized resources. (WVAFES)	With more than 800 million people undernourished each year, recovering valuable nutrients (protein and energy) for low value sources could have great societal impact. This project determined the biochemical properties	Food Safety

		for nutrient extraction and the potential yields of effective processes from insect powders.	
	WV Food Safety Training Team	Recently enacted food safety policies such as the Food Safety Modernization Act (FSMA) and increased manufacturing and retail emphasis on the Global Food Safety Initiative (GFSI) compliance have left local food system participants unsure of the regulatory requirements and liability exposure for different market channels. Specifically, small producers participating in local food systems may be uncertain about the impact of new food safety regulatory frameworks on their cost structure, profitability, and market access. We developed a multidisciplinary, collaborative effort from several institutions and organizations, to develop and deliver a continuous, comprehensive food safety education and technical assistance program - in effect, creating a 'one-stop-shop' for food-safety education, resources and producer support, aimed at reducing the risk of contamination of fresh and fresh cut fruits and vegetables. The intention of this program is to begin building long-term infrastructure that will support a state-wide culture of food safety through continuous food safety education and training, and provide significant compliance assistance through follow-up mentoring, partnerships and networking opportunities. The WVUES continues to build long-term infrastructure that will support a state-wide culture of food safety through continuous food safety education and training, and provide significant compliance assistance through follow-up mentoring, partnerships and networking opportunities. This program has already interacted with and trained 1000 producers.	Food Safety
	Fresh to Market: **SafePost-Harvest Handling (WVSUES)**	Topography, distance to consumer centers, and lack of an established on-farm cold chain challenge West Virginia's vegetable producers' ability to market products effectively and safely, and they limit the variety of produce grown and revenue potential. WVSUES targeted small-scale vegetable producers and capped gross income at $100,000 and capacity at 100 acres. Most participants earned less than $20,000 and had fewer than 10 acres in production.	Food Safety

		The program provided limited-resource producers with training in post-harvest handling and tools to implement an on-farm cold chain with storage and delivery capacity to improve product quality and safety. Tools included a CoolBot® device, coolers, harvesting knives, and produce packaging. WVSUES also provides and schedules a fleet of mobile cooling units seasonally among participants. A total of 77 producers participated in eight cold-chain workshops, with an additional five military veteran participants in two training sessions on post-harvest handling. Over 75% of participants implemented precooling procedures and food safety measures resulting in improved produce quality and increased market share across the board. Participants further saw fewer restrictions on the variety of produce they could grow, which increased revenue potential. Several, including berry producers and a pork farm, have significantly increased the availability of their product.	
	Agripreneurship and Food Manufacturing Series: Food Quality, Safety, and Marketing (WVSUES)	A successful agricultural enterprise must have the ability to ensure, to the extent possible, the safety of its product for consumers. Knowledge gaps in disease prevention, good agricultural practices, post-harvest handling, and temperature control of products prior to market sales reduce product quality, safety, and market share. WVSUES brought agency partners and successful producers together with new agricultural entrepreneurs to discuss strategies for risk reduction for produce, meat, and poultry through production, harvesting, processing or manufacturing, and market storage. Efforts targeted producers and landholders enrolled in or interested in the Natural Resources Conservation Service's EQIP program or who plan to independently implement conservation systems in their operation, budding agricultural entrepreneurs, military veterans, and members of socially disadvantaged or underrepresented populations seeking to start an agricultural venture. WVSUES served more than 113 participants through 10 workshops and seminars. Participant feedback indicated 98% of participants considered the	Food Safety

		training impactful in terms of skills learned, applicability to their personal situation, and overall value of information obtained.	
	Food Risk Reduction Strategies for Socially Disadvantaged Farmers (WVSUES)	Lack of resources and information both hamper producers' ability to ensure the safety and quality of agricultural products and contribute to negative perceptions of fresh products among disadvantaged urban populations in terms of effort and value. WVSUES activities targeted minority, veteran, disabled, and other historically underrepresented communities and provided private training sessions in urban farming for participants in a local inpatient opioid recovery program. Participants typically have little to no agricultural experience. WVSUES brought agency partners and successful producers together with new agricultural entrepreneurs to discuss strategies for risk reduction for produce, meat, and poultry through production, harvesting, processing or manufacturing, and market storage. Canning workshops and forest walks introduced urban participants to traditional food storage and foraging techniques, covering their risks and benefits. More than 137 individuals participated in 21 workshops intended to increase participants' awareness of fresh and healthy food options, cost saving strategies, ways to prevent spoilage and food waste, and how to build safe food handling into a farm plan or value-added business model.	Food Safety
6.	**Community Engagement Lab. (WVUES)**	Faculty and students worked to design and visualize positive community change to impact local economies and public health through landscape change.	Community, Economic, Workforce Development
	Mason County Development Authority Project. (WVUES)	A report (plan) was developed after work sessions with the county development authority and research. Actions were taken on several issues in-line with plan recommendations. County secured $75,000 in federal grant funding to expand broadband internet to the most underserved areas of the county. The project is estimated to improve connectivity for more than 26,000 households and businesses. Also, the county entered into a	Community, Economic, Workforce Development

		partnership with Marshall University, Appalachian Transportation Institute to conduct countywide planning initiatives.	
	Risk analyses for energy, agriculture and natural resource protection. (WVAFES)	Given the last two decades of enormous price volatility in agricultural and energy commodities, research is needed to improve forecasting approaches. This project has developed several manuscripts to address these issues for publication.	Community, Economic, Workforce Development
	Renewable energies: New uses for former mine lands in West Virginia. Design Principles and recommendations for minimizing landscape impacts. (WVAFES)	Use of former extraction industry sites for locating renewable energy infrastructure has focused primarily on availability and feasibility, but not the implications for communities and their landscapes. This project has been analyzing bordering geographic regions to former mine sites and determining the potential negative impacts of renewable energy facilities on the communities and landscapes. This project has resulted in a peer-reviewed journal article and an installation depicting the past, present and future of Kayford Mountain.	Community, Economic, Workforce Development
	Trans-disciplinary approach to community planning and development for heritage and recreation tourism. (WVAFES)	This project seeks to use a transdisciplinary approach, often associated with STEM research, to community engagement. This project resulted in two book chapters being published.	Community, Economic, Workforce Development
	Assessing the potential of evidence-based design to improve the delivery of health care in rural settings. (WVAFES)	This project focuses on using evidence based approach to inform design decisions in rural, resource-limited health care facilities. Work is expanding to collecting data from targeted sub-populations in the rural health care landscape and has resulted in one peer-reviewed journal article.	Community, Economic, Workforce Development
	Community Engagement Lab. (WVUES)	Faculty and students worked to design and visualize positive community change to impact local economies and public health through landscape change. We provided a vision for communities and stakeholders and created physical changes in the landscape to improve quality of life that impacted 1000 people.	Community, Economic, Workforce Development
	Business Development in Southern West Virginia (WVSUES)	With depressed economies and changing industries, many small businesses in West Virginia lack the skills and capacity for sustainability. With the lack of general or specialized business assistance, many businesses have been	Community, Economic, Workforce Development

		forced to shut their doors with no hope of growth. West Virginia continues to adapt to rapidly changing local economies. The primary economic drivers of many local communities have traditionally been based on the coal industry or other extraction industries. As the coal industry continues a rapid decline, there is an increase in displaced workers, who are unemployed due to layoffs, shutdowns or other industry-related changes and who are actively seeking new employment or other entrepreneurial opportunities. These individuals lack the skills and resources required to start a new business or to enter emerging, alternative industries such as tourism development. One-on-one support services were delivered to local, existing businesses who support the tourism industry in Mingo, Logan, Wyoming, McDowell and Mercer counties. The support services included general business assistance, marketing services, community involvement services, technical assistance and funding opportunities. Educational workshops were held throughout a multi-county footprint that WVSUES serves through a partnership with the Hatfield McCoy Regional Recreation Authority. The training opportunities were geared toward strengthening existing and potential new businesses within the tourism industry. During the past year, 160 businesses have taken advantage of these trainings.	
7.	**Biological improvement of Chestnut through technologies that address management of the species and its pathogens and pests. (WVAFES)**	This project seeks to evaluate and deploy, in orchard and forest settings, biological control of Chestnut blight. Engineered mycoviruses have been developed to overcome vegetative incompatibility barriers. This project resulted in a peer-reviewed journal publication.	Production/Sustainable Forestry
	Blue spruce network. (WVUES)	Colorado blue spruce (Picea pungens) also known simply as blue spruce is a popular tree used by many homeowners in their residential landscapes throughout the State of WV. Rhizosphaera needle cast is caused by the fungal pathogen Rhizosphaera kalkhoffi, and as it causes the needles to turn purplish-brown and drop off, it seriously affects the aesthetic value and health of these valuable trees. Repeated needle loss can result in branch death after 3 to 4 years and, in some cases, eventually cause tree death. This disease is very widespread in the state of WV. A community based approach	Production/Sustainable Forestry

		was taken to control the disease more effectively, which eliminated the chance of disease spread from one site to another. Preventative measures taken by 125 homeowners saved money, time and efforts to replace diseased spruce trees that would cost thousands of dollars to homeowners.	
	Serving Fruit Industry/Cider Apple and Hard Cider Apple Production. (WVUES)	Engaging in cider apple production and/or hard cider production is a good opportunity for farm diversification with high potential for further market expansion and economic success. We are expecting that through our efforts we will be in position to make solid recommendations about which varieties and rootstocks will perform best in our growing conditions and which varieties will be best suited for cider making based on their sensory characteristics that constitute the taste. That will give us an advantage in producing high quality cider recognizable as unique for the Appalachian Region.This "Feasibility Study for the West Virginia Economic Development Initiative in Cider Apple and Cider Production", provides the craft cider industry with economic and market analysis information that will enable them to make informed decisions on future strategic directions for the industry. Development of these markets will be positive for the apple industry, and for the state of WV.	Production/Sustainable Forestry
	Service to the Green Industry/West Virginia Nursery and Landscape Association (WVNLA). (WVUES)	Maintain close collaboration with the "Green Industry" by providing technical support and outreach through participation in the industry-sponsored events like WVNLA Winter Symposium. The goal of my presentation was to educate people on identification and management of common landscape diseases. Topics covered include alternative methods to spray applications. There were 128 attendees that learned about diseases on common landscape standbys like sycamores, oaks, dogwoods, pines, pears and apples, cedars, hawthorns, etc. This knowledge will help them in choosing right treatment materials ensuring a high success rate and more satisfied customers. This year, very few of the attendees use the microinjection system as a method of product delivery in their operations.	Production/Sustainable Forestry

		Once hearing about it for the first time, expressed interest in learning more about it and consider adding it into their services.	
	Orchard and Forest Resource Management (WVSUES)	Competing land uses and increased urbanization, introduction of invasive forest pests and disease (both exotic and native), and wildfire risks provide challenges to West Virginia's forests and woodlands. Urban canopies struggle as a result of limited funding and a need for individual training in basic tree care. To address these issues, WVSUES targeted small-scale producers and woodland foragers across the state, small orchards and community urban orchards operated and maintained by WVSUES and other NGOs. Underrepresented and underserved producers and farmers, veterans and new and beginning agripreneurs were recruited for training. WVSUES upgraded its orchard and tree management practices to incorporate digital graphic information system (GIS) format to document and manage trees by species, condition, and needs. Extension educators delivered 18 hands-on workshops covering tree care and orchard planning, native pollinator support, and edible forest products to more than 226 participants. WVSUES also provided forest resource field days and training on log-type mushroom production for both shiitake and oyster varieties. These hands-on workshops provided training for log selection, proper inoculation and management techniques to improve harvests and yields. Sixty-two individuals were trained on forest composition, resources and management including wild mushroom resources. More than 300 individuals were trained and provided hands-on technical assistance in mushroom production ranging from commercial indoor production, log production and raised-bed innoculation for improved soil condition and production. Participants were provided with technology and material support to continue on-farm production resulting in additional revenue streams through increased product diversity.	Production/Sustainable Forestry

8.	**Genetic modification of ergot alkaloid profiles in agriculturally important fungi. (WVAFES)**	Many important forage and turf grasses are infected by symbiotic fungi that often produce toxins that have profound negative effects on herbivores, parasites or competitors that interact with these plants. This project seeks to better understand the synthesis of the toxins and exploit that understanding to mitigate the negative impact of the toxins produced. Work focused on the enzymes involved in differential ergot production, successfully altering fungal ergot production. This work resulted in a peer-reviewed journal article.	Fundamental Plant and Animal Systems
	Phylogenetic organization of microbial biodiversity and activity in response to nutrient availability within natural and agricultural soils. (WVAFES)	Soil microbes contribute significantly to carbon and other nutrient storage and cycling, yet many microbes remain uncharacterized and therefore their contribution to carbon and nutrient cycling is poorly understood. This project investigates the impact of both agricultural and land use practices on soil microbial phylogenetic structure and function of the microbial communities. This project resulted in one peer-reviewed journal article.	Fundamental Plant and Animal Systems
	Elucidating the link between the soil microbiome and the fate of soil organic matter. (WVAFES)	Soil is one of the major reservoirs of carbon and nitrogen on earth. Understanding the complex network of microbes and their contribution to soil organic matter is critical to efforts to predict and manage natural resources. This project investigates the impacts of pasture management, mine reclamation techniques and changing environment conditions in forests on soil microbial communities. This project resulted in two peer-reviewed journal articles.	Fundamental Plant and Animal Systems
	Influence of ovary, uterus and embryo on pregnancy success in ruminants. (WVAFES)	Early embryonic loss is a major contributing factor to reduced fertility in livestock. This project seeks to improve our understanding genes and gene products that control early embryo development. Work focuses on long noncoding RNAs, agouti signaling protein and a zinc finger imprinted gene, all of which they have found are highly expressed in oocytes and early embryos. This project resulted in one peer-reviewed journal article.	Fundamental Plant and Animal Systems
	Genetic and developmental underpinnings of the morphological diversification of evolutionary novelties in insects. (WVAFES)	This project uses dung beetles to study the genes controlling development, specifically of beetle horns. They have identified 4 genes involved in determining horn size. A peer-reviewed manuscript is in preparation to describe this work.	Fundamental Plant and Animal Systems

	Feed manufacture effects on pellet quality, hygenics and nutrient availability. (WVAFES)	This project focuses on the impact of parameters of feed manufacturing (conditioner time and temprature, throughput and ambient conditions) on feed pellet quality, pathogen load and nutrient availability. The project resulted in one peer-reviewed journal article.	Fundamental Plant and Animal Systems
9.	**CYFAR PROSPER Project. (WVUES)**	West Virginia University Extension and Iowa State University have jointly implemented the PROSPER program for the past five years over the period of September 2014 to August 2019. The Partnerships to Enhance Resilience Model (PROSPER) was implemented in two West Virginia (WV) communities and two Iowa (IA) communities. CYFAR supported community educational programs for 508 at-risk children, youth, and families which were based on locally identified needs, soundly grounded in research, and which led to the accomplishment of one of four CYFAR National Outcomes; and Integrated CYFAR programming into ongoing Extension programs for children, youth, and families – insuring that at-risk, low income children, youth, and families continued to be part of Extension/4-H programs and continue access to resources and educational opportunities.	Strengthening Families
	Healthy Grandfamilies (WVSUES)	The prevalence of grandfamilies -- households in which grandparents are providing fulltime care for one or more of their grandchildren -- is on the rise throughout the United States. While the reasons behind this growing issue are multiple, research points to the issues such as the rising rates of opioid addiction as being one of the leading factors behind how grandparents come into custody of their grandchildren. Often called Ground Zero of the opioid epidemic, West Virginia ranks second in the nation for the number of grandfamily households. Studies have shown that as many as 1 in 14 children is being raised by a grandparent, and the overwhelming majority of cases in the state are the result of one or both parents being impacted by opioid addiction. While grandparents are rising to the challenge of once again becoming fulltime caregivers, they have reported feeling overwhelmed with the issues and challenges they face as 21st century parents, including changes in education, behavior, technology, and so on.	Strengthening Families

		To address this issue, the WVSU Healthy Grandfamilies program provided programming through discussion sessions and social work services to grandparents raising their grandchildren. Topics included navigating the school system, communications, social media, family relationships, healthy lifestyles/managing stress, family response to addiction, parenting, legal issues, nutrition, and health literacy/self-care. Curriculum modules were developed specifically through this project to address the above mentioned topics. The program provided education to 90 grandparents in Kanawha and surrounding. After completing their participation in discussion groups, grandparents reported statistically significant improvement [MB2] in awareness, knowledge, and comfort level related to the session topics. Grandparents also reported fewer challenges at six months than at baseline related to financial burden, less time for self, less privacy, feeling "tied down," lack of sleep, and fear of losing custody. Learning activities were provided to 198 social work students in the classroom environment. The services which saw the greatest increases in use were information about services, assistance in accessing services, assistance with the school system, and legal assistance. A website healthygrandfamilies.com was developed and launched. In 2019, the West Virginia Legislature, recognizing the vital need for this type of programming, appropriated $300,000 to expand the program statewide and to develop a Center of Excellence for Grandfamilies on the campus of WVSU. Four hundred and seventy-five community social service members attended trainings in 25 counties trainings during this reporting period and most have begun implementation.	
10.	**4-H Healthy Habits. (WVUES)**	To address the concerns of health and nutrition in the rural, economically disadvantaged state of West Virginia the West Virginia University Extension Service (WVUES) expanded the 4-H Healthy Lifestyles Program. This program trains 4-H teens to serve as Health Ambassadors and provides them	Youth Development

		opportunities to serve in school, afterschool, and summer learning environments to implement health and nutrition programs. 4-H Health Ambassadors are being trained to select, implement and advocate for health, anti-substance abuse, and nutrition curriculum in using tools such as Up For the Challenge, Afterschool Energizers, and Rethink Your Drink. A total of 4000 youth were reached with the program and 100 Health Ambassadors were trained. In addition to many county 4-H camps, the program was also implemented at State 4-H Dance Weekend, Teen Leader Weekend, and Alpha II state 4-H camps.	
	2019 STEM Team. (WVUES)	Through these efforts (2019 Camp Science Experiment, STEM Ambassador Program, 4H Code Camp, STEM Camp, and AgriSTEM camp) , 25,000 of WV youth engaged in hands-on science activities while at camp and extension professionals were trained on working with volunteers to include more STEM activities in their counties.	Youth Development
	Building scientific inquiry through the use of cross curricular project based learning in agriculture to developing students in the mountains of Appalachia. (WVAFES)	This project is deploying a cross curricular project to study the impact on developing workforce ready high school graduates, with a focus on agricultural projects and engagement with extension faculty. This project has begun its implementation phase and preliminary data have been presented at several conferences.	Youth Development
	Energy Express. (WVUES)	Energy Express is a nationally recognized, award winning summer program that has provided services for children in low income, rural communities throughout West Virginia for the past 24 years. The program strives to improve literacy skills of children while creating a fun and engaging learning environment. In addition, Energy Express sites provide 58% of daily nutritional requirements of children through the delivery of two meals each day. In the communities where sites are located, there is little opportunity for summer recreation, nutrition, socialization or extended school programs. Energy Express provides services at no cost, as well as providing opportunities for family members to get involved by volunteering in a non-traditional educational environment. In 2019, Energy Express was	Youth Development

		successfully implemented in 79 WV communities and had 3,192 children participate.	
	4-H Unit STEM Team. (WVUES)	West Virginia youth need more positive interactions with science, technology, engineering, and mathematics (STEM) so that they may become life-long STEM learners and problem solvers, prepared for STEM careers in the future. The STEM team conducted many STEM events to spark interest in STEM. The STEM team reached all 55 counties in some way in 2019 to reach a total of 13,979 youth.	Youth Development
	Reality Store - Financial Literacy for Middle School Youth. (WVUES)	The Reality Store program is a financial simulation for youth in middle school and high school. Presently, the program has only been delivered to middle school students in Wayne County. The goals of the program are to: Provide youth an idea of what their future might be like, help youth become aware of their need for basic skills in financial planning, goal setting, decision-making, and career planning, aid youth to examine their attitudes about their futures and their career aspirations, provide students a greater awareness of whether the career they are considering would support the lifestyle they would like as an adult, and motivate students to stay in school. In 2019, the program was delivered at five out six middle schools middle schools. Combined these reality store programs reached 770 youth and involved 119 adults.	Youth Development
	Rocket Girls (WVSUES)	Research has shown that girls tend to lose interest and confidence in science, technology, engineering and mathematics (STEM) by the time they reach middle school. To address this issue, WVSU 4-H developed a "Rocket Girls" five-day non-residential camp program designed to increase the number of women going into STEM fields. The instruction introduced girls to aerospace engineering using an immersive rocketry curriculum model, allowing girls to get creative while applying engineering and design concepts to real-world applications by designing their own rocket. Eighteen girls participated in the program. The "Rocket Girls" saw a 40% increase in rocket	Youth Development

		science knowledge and a 94% increase in confidence on the subject of rocketry.	
	STEM Days (WVSUES)	The percentage of West Virginia public school students scoring at least "proficient" in reading and math only marginally increased last school year from the year before, while science proficiency dropped, which is measured by statewide standardized test data released by the state Department of Education on Thursday. In order to improve STEM interest and knowledge in the local school systems WVSUES created STEM Days, which are in-school, after-school, or community events targeting pre-k through 12th grade public school students, particularly in Title I schools. Through STEM Days, students have learned about astronomy via a portable planetarium, dissected dinosaur coprolite, investigated dry ice, genetics ,robotics, inventing with Rube Goldberg,foam rockets, straw rockets, boat builds, Lego Simple Machines, nano rovers, Junk Drawer Robotics, Rube Goldberg online games, Robotic and Renewable Cars, Wind Turbine, "Does the Monkey Fit?" Challenge and Challenge Rock-eta, and model rocketry. Each activity was designed to create positive experiences, encourage logic and critical thinking skills, and otherwise align with science standards. Over 1900 students were reached across six counties.	Youth Development
	Hands-On Spanish (WVSUES)	Spanish is the second most spoken language in West Virginia and is important in global industries and education. Spanish language classes were offered to the local community targeting home-school students ranging from 9 to 17 years old, with the goal of introducing them to a language that can open several opportunities for personal and professional growth. The program reached 34 students and promoted diversity through the learning of interesting facts about Spanish-speaking countries and their cultures. Assessment scores, through pre- and post-tests, showed that 75% of the participants in the first set improved beyond 50% in knowledge, whereas in the second set, 83% of the participants increased beyond 50% in knowledge. Students in both courses recognized the importance of speaking	Youth Development

		a foreign language and gained more confidence and enthusiasm to continue with their Spanish language learning.	
	Sowing Young Sprouts (WVSUES)	The southern coalfields region of West Virginia is stricken with high rates of poverty, food insecurity, and health-related disease. According to the Appalachian Regional Commission, the poverty rate is consistently higher in both Appalachian mining counties and non-mining counties compared with the rest of the U.S. The poverty rate has increased everywhere in the U.S. However, while the poverty rate in both Appalachia non-mining counties and the rest of the U.S. started declining in 2011, it is not the case in Appalachia mining counties. In addition, the data show that mining counties in Appalachia have substantially higher mortality rates than those for non-mining counties and the rest of the U.S. Youth raised in these environments, are likely to fall into the same trends as their families. To address these issues for a youth audience, WVSU 4-H launched the Sowing Young Sprouts program, designed to mitigate the effects of poverty and health-related diseases by intervening with children in grades K-8. Efforts targeted low-income students in Raleigh County, WV. The program teaches children to garden, cook their produce, and sustain the garden by selling produce and value-added products to the community. Over the course of the year, 100 students were reached, and three garden sites were constructed at participating elementary schools.	Youth Development
	National Summer Transportation Institute (WVSUES)	WVSU 4-H partnered with the WV Department of Transportation to host the National Summer Transportation Institute summer camp, targeting students in grades 6-8 in underserved and underrepresented populations. Participating students were introduced to careers in transportation through field trips and guest speakers and learned about the skills needed to excel in those fields by engaging in an engineering design curriculum. Twenty-nine students participated, with all reporting an increased interest in both science and engineering.	Youth Development

	Logan STEAM (WVSUES)	Logan County is located in the southern coalfields region of West Virginia, a rural area that has seen declining population and wealth alongside the decline of the coal industry. As such, the available resources for students are limited. To address this issue, WVSU 4-H launched the Logan STEAM program to support teachers with resources and provide direct programming to K-8 students as a collaboration with the schools in the areas of science, technology, engineering, art and mathematics. Area high school students act as volunteer assistants and gain from their experience as well by being able to teach youth about science, it improves their own understanding about the concepts. Through this program, 800 students have been provided with STEM enrichment.	Youth Development
	Little Growers (WVSUES)	According to the Annie Casey Foundation, West Virginia ranks 43rd nationally in education. The report notes that high-quality preschool programs for 3- to 4-year-olds help set the stage for future skill development, well-being and learning, particularly for those from low-income households. To address this issue, WVU 4-H developed the Little Growers summer program targeting underserved 3-6 year olds and their parents in Kanawha County, WV. The program engages young students in hands-on science and art content to which the families may otherwise not have access. During the program, families learn how to engage their children with sensory activities that will help their children develop language and comprehension skills. Ten families and 32 youths participated in the program. Parents reported that their children had an increased interest in science after attending the program, as well as being more engaged with the topics that they were introduced to in camp, outside of the classroom	Youth Development
	Cultivating Young Agriprenuers (WVSUES)	Access to fresh local produce is disproportionate across urban locations. To address this issue, WVSU 4-H developed the Cultivating Young Agripreneurs project to enhance the quality of life in challenged urban neighborhoods by focusing on their most valuable resource - their youth. The program delivers not only the framework for a positive entrepreneurial exercise in economically depressed areas but delivers the STEM training and science-	Youth Development

		based agricultural and food nutrition practices that perform in non-rural applications. This program targets children in elementary and middle schools that are socially and economically disadvantaged as well as adults with various learning disabilities. Participants were first introduced to gardening through the Junior Master Gardener (JMG) curriculum. Garden sites were then constructed and maintained at two community sites. The 76 participants have reported that by studying the natural sciences, they have gained a better appreciation for the environment around them.	
	Growth on the Go (WVSUES)	In a 2013 study by Horizon Research, Inc., researchers aimed to assess K-5th grade educators' preparedness to begin teaching the Next Generation Science Standards (NGSS), and found that while more teachers felt prepared to teach life and Earth science than physical science, still only 1⁄3 of them felt "very well prepared;" furthermore, 7 in 10 teachers did not feel adequately prepared to teach chemistry. These numbers correlate directly to the coursework received as pre-service teachers: "Roughly 90% of elementary science teachers had college coursework in life science, and approximately 65% had coursework in Earth science," while"fewer than half of elementary school teachers had at least one college course in either chemistry." To address this issue, WVSU 4-H launched the Growth on the Go program, an innovative approach to the dual problems of preschool and primary school educators having low confidence in science content knowledge and their ability to teach science, agriculture and other STEM subjects. The program offers support and education to create change in knowledge and confidence for both in-service and pre-service teachers to build a network of educators throughout West Virginia that are prepared and excited to engage with STEM in the classroom and the garden. As a result, 18 pre-service teachers have been trained in STEM content delivery in an after-school setting.	Youth Development
	Homeschool STEM Classes (WVSUES)	West Virginia has a large homeschool population, mostly consisting of rural and low-income students. In 2017, a pre-interest survey was conducted to	Youth Development

		see if there was a need in the local community to offer special-topic STEM classes. Fifty parents participated in that survey, and 91.84% reported that they would be interested in attending those sessions. WVSU 4-H developed a series of 5-6 week classes targeted at West Virginia homeschool students typically enrolled in middle and high school. The goals of these classes are to introduce students to hands-on STEM subjects that they would not necessarily have access to and to acquaint homeschool students with classroom behaviors in order to prepare them for high school or college courses. Classes have been offered on physics, chemistry, astronomy, and web design. Activities in the classes ranged from planetarium lectures in the star lab to coding personal websites and drawing refraction bright-line spectra for various metal salts in a flame test. Each class enrolled between 14 to 50 homeschoolers per class, for a total of 106 students in grades 6-11. Students were given identical pre- and post-tests to gauge the knowledge gained through the course of the class. In chemistry, students averaged a 45% increase; for astronomy, students averaged a 23% increase; and for web Design, students averaged a 35% increase on their post-test scores. Each of the classes saw, on average, a 60% increase in subject interest and 16% improved interest in going into STEM fields.	
	Health Sciences and Technology Academy (WVSUES)	The Health Sciences & Technology Academy, known as HSTA, is a one-of-a-kind mentoring program in the state of West Virginia that helps underrepresented high school students enter and succeed in STEM-based undergraduate and graduate degree programs. A total of 73 students participated in the program. Every participant stated that they enjoyed their experience; 42% stated that the experience helped to prepare them to conduct their community research; and 75% stated that the experience increased their interest in STEM careers.	Youth Development
	STEM Scholars Academy (WVSUES)	According to the Annie Casey Foundation, students who graduate from high school on time have many more choices in young adulthood. In addition,	Youth Development

		they are more likely to pursue post-secondary education and training, make healthier decisions, and engage in less risky behaviors. To support these efforts, the WVSU STEM Scholars Academy sought to achieve two main goals: 1) expose high school juniors to opportunities in STEM fields and increase interest in attending college to study STEM, and 2) prepare students to succeed by providing purposefully structured resources and mentorship to address students' needs. These components were designed to increase the number of underrepresented individuals including minority, low-income and/or first-generation students completing degrees and entering careers in lucrative STEM fields. This program is not an early intervention but specifically geared toward facilitating the transition to college for underprivileged students that already have interest and potential in STEM. As a result, 19 high school students were paired with 18 undergraduate mentors. During the program, participants reported an increase in their ability to set goals for themselves, and 88% of students reported being enthusiastic about pursuing a career in STEM.	
	4-H Youth and Families with Promise Mentoring Program (WVSUES)	Overall, about one in five West Virginians — 18.5%— live in poverty. For a family of four, with two adults, one preschooler and one school-age child in Kanawha County, WV, WorkForce West Virginia estimates a self-sufficiency standard of $47,145, more than double the poverty line. To address this issue, the WVSU 4-H Youth and Families with Promise mentoring program trains mentors to help young people create opportunities to feel connected to their communities by having them engage in positive extracurricular and community service activities. This program targeted middle school-aged youths from low-income, at-risk populations in Kanawha County. Students attending the program had a daily academic support system in place to assist with tools for being successful. There were monthly presentations and workshops provided to and by the students. Teachers serve as an extended network for keeping the agent informed about the individual's overall performance in the classroom. Class attendance and grades were monitored	Youth Development

		in order to have a first line of engagement for keeping students on task. Mentoring and confidential consultation were included for providing a platform of encouragement for them to meet their educational goals. As a result, 13 youths were reached through the program, all of which report an improvement in their overall confidence and ability to succeed in the future.	

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Date Submitted:	4-29-2020
Submitted by:	Ami M. Smith

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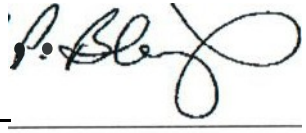
Signature: 	

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