

Central State University Combined Research and Extension Plan of Work 2020-2024

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I. Plan Overview

1. Executive Summary

Central State University (CSU), the only state-assisted Historically Black College and University (HBCU) in Ohio, is a residential, co-educational institution located in Wilberforce, 20 miles east of Dayton, Ohio. Central State was designated as an 1890 Land-Grant Institution on February 7, 2014. Over the past years, the University has aligned its mission with the mission of the Land-Grant legislation and has transformed the previous College of Science and Engineering into the College of Engineering, Science, Technology and Agriculture (CESTA) to provide educational opportunities to the general population, and to enhance its teaching, research and extension activities to solidify its Land-Grant status. Dr. Cynthia Jackson-Hammond, CSU's President, is committed to the Land-Grant mission and vision, and is guiding the institutional efforts statewide and beyond. The State of Ohio is supporting CSU's Land-Grant mission with 100% match for the Evans-Allen Research, Cooperative Extension and the McIntire- Stennis programs. Dr. Alton B. Johnson serves as the Dean of CESTA and the Director of CSU's 1890 Land-Grant Programs and has the oversight of all Land-Grant Programs and the related linkages with The Ohio State University, the other Land-Grant Institution in the State of Ohio. Dr. Johnson and the CSU Land-Grant Program is guided by the CSU Land-Grant Advisory Council (LGAC). The LGAC consists of 12 regular members and 2 Ex-Officio members and represents a cross-section of stakeholders from Ohio. Members come from the Ohio Farm Bureau, Ohio Farmers Union, Ohio Agribusiness Association, Natural Resources Conservation Service of USDA, commodity groups, a technology company, farmers and an agricultural vocational institution from the area. The composition of the LGAC is expected to be dynamic as we expand the horizons of our 1890 Land-Grant Mission.

The necessary administrative structures for operating the Land-Grant Programs have been set in place. Dr. Subramania I. Sritharan serves as the Associate Director of Research and Mr. Anthony Barwick serves as the Interim Associate Extension Administrator. CSU is expected to get additional funding for its Evans-Allen and Cooperative Extension Programs through the application of appropriate formulas for the capacity allocations. This will essentially enable CSU to expand its research and extension programs and to serve the State of Ohio with appropriate programs focusing on critical issues affecting the State and the Nation. CSU is proposing to serve all peoples of Ohio including the rural population, while particularly focusing on all underserved and small farmers.

CSU is expected to obtain enhanced levels of Federal support for its Evans-Allen and Cooperative Extension Programs from the newly enacted Farm Bill of 2018 compared to the level of funding for 2016-2018. The State of Ohio has been providing 100% matching funds, and it is expected this pattern will continue in the future. This would enable CSU to engage in expanded sets of activities for research and extension. CSU has not been engaged in farm research but will start farm research and assist the Cooperative Extension Program. The Cooperative Extension Program will assist farmers by guiding them on alternate crops, specialized crops, aquaponics, bee keeping, small animals, soil health, and in sustainable agriculture, while maintaining the integrity of the agricultural eco systems. CSU will take a systems approach as it engages in work ahead to serve the State of Ohio and the Nation. The systems approach will place emphasis on small and under-represented farmers, as well as other stake holders in the State of Ohio. The knowledge gained by CSU will be shared with the US and other nations globally. The systems will include (i) Plant Systems; (ii) Animal Systems; (iii) Food Nutrition and Health Systems; (iv) Natural Resources and Environmental Systems; and (v) Social and Allied Systems. The details of the issues addressed for each of the systems is described below.

i. Plant Systems

Issues to be addressed under plant systems include Establishment of Alternative Crops, Increased Use of Natural Products, Modification of Plant Chemistry, Development of Rapid Metabolite Quantification Systems, and Natural Plant Products Research. Growers in Ohio and across the US face low crop prices and struggle to keep their farms solvent. The overproduction of major grain crops (corn, soybeans, and wheat) by US farmers suppresses commodity prices.

Alternative crops are needed to provide growers new revenue streams. Moreover, large-scale adoption of alternative crops can reduce overproduction of major crops, thereby increasing commodity prices. Hemp, *Cannabis sativa* with a Δ^9 -tetrahydrocannabinol (THC) content less than 0.3%, can be utilized as a food, fiber, feed, bioenergy, and medicine. It is first necessary to explore and develop natural products from plants to provide knowledge and help establish valuable niche markets for alternative and specialty crops. Interesting candidates for Ohio include amaranth, sweet potato, high-amylose corn, tree fruit and nut crops, medicinal plants, hemp, and hops. In particular, high-amylose corn, is of interest. Corn is one of the most diverse grain crops whereby many variations exist through evolution and extensive breeding efforts. The special variety known as high-amylose corn, has amylose content in the starch above normal levels. Recent developments have increased the status of high-amylose corn, particularly the concentration on bioplastics and the search by food companies for a starch type that resists digestion. As a food ingredient, consumers could benefit from high-amylose starch because it has a lower glycemic index than other starches.

Establishment of Alternative Crops: Growers in Ohio and across the US face low crop prices and struggle to keep their farms solvent. The overproduction of major grain crops (corn, soybeans, and wheat) by US farmers suppresses commodity prices. Alternative crops are needed to provide growers new revenue streams. Moreover, large-scale adoption of alternative crops can reduce overproduction of major crops, thereby increasing commodity prices. Currently, hemp commands premium grain and metabolite prices, driving droves of farmers to grow this crop. However, a number of challenges remain with hemp production. Basic agronomic production practices and improved understanding of plant chemistry need to be developed. Due to the rapidly expanding craft beer industry, hops (*Humulus lupulus*) may also serve as an alternative income source for farmers. To date, hops production is limited by the high set-up cost, management of tall plants, and post-harvest processing expenses.

Increase Use of Natural Products: Plant-derived natural products typically earn superior prices at market due to their difficulty of crop production, limited availability, and challenges of extraction. At present, difficulties with the process of extracting and purifying compounds on a large scale severely restrict the use of plants for production of natural products. Erasing processing challenges will allow companies to expand their use of plant-derived natural products. An increased market demand will provide cultivators of alternative high-value crops to produce. Importantly, the rapid development of the hemp industry across the US has brought on-line a number of extraction facilities. The existing extraction technology can generate a range of crude multi-metabolite extracts to fully purified single compounds. Hemp-derived cannabinoids are being extracted and isolated on a large scale to supply the herbal supplements market. Expanding the use of hemp extracts and cannabinoids beyond medical applications could further increase the demand for such products. Isolation of natural products offers the opportunity, not only for farmers to have alternative profitable crops, but may reduce US dependence upon oil-based synthesis of key industrial compounds.

Modification of Plant Chemistry: Plants are nature's pharmacy, synthesizing an estimated 200,000 to 1 million metabolites. Each plant produces hundreds of natural products, some of which are species-specific or only found within a few close relatives. These compounds serve as nutrients, spices, fragrances, pesticides, medicines, industrial compounds, and scaffolds for pharmaceutical development. Plants synthesis these compounds for their defense to abiotic and biotic stress. However; to animals or humans, the presence of some natural products may be beneficial whereas others are detrimental. Modification to plant chemistry provides opportunities to improve the nutritional content and safety of foods. Platforms for stable and transient genetic modification of hemp are being developed to further our ability to redirect natural product biosynthesis toward targeted metabolites. These systems will also allow identification of genetic factors underlying hemp natural product biosynthesis and accumulation. Our other efforts in modification of plant chemistry seek to maximize the use of plant-derived natural products. During some extraction processes, low-value, toxic, or otherwise undesired by-products may be generated. We are evaluating methods to modify extraction by-products into high-value compounds of agricultural, industrial, or medical interest.

Development of Rapid Metabolite Quantification Systems: Synthesis of natural products in plants responds to a number of developmental and environmental cues. Moreover, the abundance of natural products within a plant requires sophisticated methods to distinguish and quantify each metabolite. We plan to develop simple and robust tools for on-farm quantification of key metabolites. The systems will be a cost effective, disposable, user-friendly, hand-held devices that tests samples within minutes. Rapid metabolite quantification technology will also improve plant breeders' ability to develop new varieties with desired natural product profiles.

Natural Plant Products Research: Agricultural systems in Ohio are overwhelmingly dominated by two crops: corn and soy.

Small farms in the State, which traditionally have made a living from dairy and vegetables, have been struggling for years and are steadily disappearing. Both large and small farmers alike need alternative crops, which are lucrative, to diversify production, reduce risk exposure and increase profitability. Growing a diverse selection of crops can expand market access for farmers and help offset commodity price swings and financial uncertainty. Strategic diversification improves the overall economic picture for small farmers, however support is required to prospect alternative crops. For example, former tobacco farmers in Kentucky are profiting by producing sweet potato, grossing up to \$7000 per acre, due to research supported from local institutions of higher learning. Meanwhile, there is an increasing trend among the population nationwide to use alternative medicine and products based on biological ingredients. According to the NIH, over 50 plants have proven medicinal properties, some of which are already available as dietary supplements. However, the sources for the plant materials remains heavily foreign-based, and sound research into cultivation and extraction methods is deficient. Likewise, small to medium enterprises requiring high-quality raw materials for natural products are becoming more numerous. Thus research and extension to advance local farmers to cultivate high-quality plant materials for use in product formulations is rather timely. Natural products from plants, venom, animals, fungi and bacteria are in high demand as sources of biochemical diversity for medicinal, herbal and industrial formulations. New and novel biochemical research is needed to combat disease, allergies and microbial resistance to antibiotics, as well as to provide energy and constitute the basis for everyday consumable products. Chemicals from a variety of natural sources may serve as safe and effective alternatives to synthesized drugs with fewer side effects and petrol-based resources. These natural compounds also may be better accepted by diverse populations with different ethnic backgrounds. The success of bio products, including biofuels, biopolymers, bio detergents and biocosmetics, requires a broad range of economical materials available for formulation.

The potential of plant and phytochemicals for use in food and non-food products can be employed for growth and increase production to enhance economic viability of small rural agricultural-based communities. It is first necessary to explore and develop natural products from plants to provide knowledge and help establish valuable niche markets for alternative and specialty crops. Corn is one of the most diverse grain crops, whereby many variations exist through evolution and extensive breeding efforts. Corn is also the largest crop in the United States, which produces over 7 billion bushels of dent corn per year. Processed corn products are diverse, including cooking oil and various corn chips, grits, meals, flours, and starches. Corn starches can be processed further into a variety of food and industrial products, including fat substitutes, sweeteners, alcohol, paper, adhesives, paints, soaps, and cosmetics among a wide assortment of others. Although most of these products are made from dent corn, other types of corn are gaining importance as the industry focuses on niche markets and competitive advantages for specialty corns. Recent developments have increased the status of high-amylose corn, particularly the concentration on bioplastics and the search by food companies for a starch type that resists digestion. The research at CSU will focus on this specific commodity concerning production and processing practices for supporting regional growers and industry. A partnership is being established in which high-amylose corn will be promoted to a network of more than 100 growers in southwestern Ohio. Producers will receive a premium price for their harvest and the resources to handle and market the harvest are in progress. CSU will play a crucial role in supporting research and development of this valuable commodity for local stakeholders. The successful implementation of natural product economy and production of alternative crops in agriculture demands interdisciplinary and integrated approaches to address relevant issues that are interrelated to agricultural production and community planning and development. The science and applications involving sustainable plant and animal systems must integrate agriculture, biology, chemistry, agronomy, and economics. CESTA at CSU must be a force to produce and disseminate knowledge of process biological products (such as food, feed, fiber, medicinal herbs, new agricultural products and biofuel), while promoting conservation of natural resources, preserving environmental quality, and ensuring the health and safety of people. We plan to develop a farm research center in the lands around the campus and engage in related research. Experimental plots in individual farms around CSU will also be planned and related studies will be conducted.

Animal Systems

We propose to take up on issues critical to the Ohio Agriculture with respect to animal systems and also address new pathways that can assist small farmers. Poultry industry is critical to Ohio's agriculture and our research and extension efforts will focus on this industry. It is also necessary to assist the farmers and producers in the industry with food safety issues.

Avian Systems: Ohio is one of the largest egg farming states in the Nation. Egg, chicken and turkey farms in Ohio create

more than 20,586 jobs annually generating \$718 million to the State's economy. Ohio farmers in all aspects of poultry production, including related food safety issues, require assistance; and it is critical to provide field-based diagnostic investigation services to the poultry industry, producers, aviculturists, veterinarians and governmental agencies of Ohio. CSU has to perform appropriate examinations, interpret history and laboratory tests, and visit farms, hatcheries, processing plants and other avian enterprises to diagnose, report and formulate prevention and control plans for spontaneously-occurring diseases of poultry and a variety of other avian species.

Small Animal Systems Research Program: One of the long term goals of the University is to re-establish an animal science research program. CSU intends to start the program with small animals by expanding the research capability of the existing CSU animal facility, adapting it for small production animals such as angora rabbits for natural product use. English Angora varieties of rabbits are known to produce good quality of wool in cold conditions. Ohio has the appropriate weather for wool production for this variety of Angora rabbit. Research into the suitability of the sub-varieties of Angora rabbits for the local climatic condition will be initiated by examining the various varieties and documenting their productivity. The fiber length and strength will be tested in the varieties. Currently 90% of the angora wool comes from Asian countries such as China; hence, there is a demand for home grown wool.

iii. Food and Nutrition and Health Systems

Health of individuals and overall populations encompass many factors: behavioral, economic, environmental, cultural, educational, and genetic. Diet and nutrition are important to overall health. Diseases related to obesity, sedentary lifestyles, nutrient deficiencies and food insecurity, are major dietary health concerns in the U.S. We seek to expand knowledge of the factors affecting health-particularly those that can be addressed through nutrition and exercise intervention – through nutrigenomic research, nutrition/exercise education and programming, and the creation or enhancement of food production and delivery systems to underserved populations. CSU strives to positively impact community health, by working with individuals and systems to determine the best practices in health promotion. We also seek to understand the mechanisms of action of nutrients in disease development and progression, with the goal of recommending nutrients as potential preventative or adjuvant treatment modalities. For example, research in the prevention of diabetes type II and obesity utilizing various treatments including nutrigenomic testing. Appropriate data will be collected, analyzed and published in peer reviewed literature, extension bulletins and curriculum, and incorporated into undergraduate course work ensuring that all stakeholders benefit from our research results. Studies will focus on prevention and/or reduction of chronic diseases invulnerable and underserved populations. Individuals within these groups face barriers to nutrient access and participation in exercise and physical activities, which can adversely affect their health and quality of life. One common barrier is insufficient knowledge of exercise professionals on how to adapt “typical” exercise programs or to make accommodations for specific subpopulations. CSU research will address this and other barriers in order to provide evidence to enhance the health and quality of life of all individuals. For example, because underserved populations often lack access to nutrient-dense foods, CSU aims to develop novel or enhance existing methods of food production to ensure a sustainable and accessible supply of affordable, safe food and have direct impacts on sustainability efforts, agricultural economy, and human health. In addition, CSU aims to develop undergraduate students who are able to go into underserved areas and provide nutrition education based on best practice and research based exercise programming to vulnerable individuals. We propose to engage in all related research and training of students in these areas.

iv. Natural Resources and Environmental Systems

Pollinator Issues: Honeybees are the most important managed pollinators, contributing \$15 billion for the US economy. The honeybee colonies are in a 40-50% decline in the country. In particular, managed bee colonies are in a 60% annual decline in Ohio. Promoting mite resistant bees is one of the most effective ways to mitigate the bee decline. It is imperative that we develop new methods for increasing genetic diversity and to improve queen bee quality. The limiting factors affecting local honey bee resources include fewer queens and the nuclei available to fulfill the demand of beekeepers in the region.

Water Resources and Water Quality: Water issues in US are related to 1) variability in availability of the resource for agriculture, domestic, industrial and commercial uses, firefighting and recreation; 2) floods and droughts; 3) water quality; 4) economics of water resources and 5) ways for energy generation. The major phenomenon of change in climate impacts all aspects of water, which requires planning structural and non-structural measures. A major water issue in Ohio is related to water quality. Nitrogen and Phosphorus in agricultural runoff and leaching continues to be a non-point source pollution affecting water quality in Ohio watersheds by causing harmful algal blooms. So far, little research has been done

in cropped acres of southwestern Ohio to quantify the impact of nutrient pollution on water quality. We intend to assess the effectiveness of several agricultural best management practices in reducing nutrient loads in the Great and Little Miami watersheds that drain into the Ohio River, and subsequently, into the Mississippi River and Gulf of Mexico. We expect to achieve the result by utilizing advance geospatial technologies, coupled with on-farm research. While water quality related to agricultural runoff is important, water distribution and wastewater management in municipal areas have to be focused to serve people for an enhanced quality of life at optimal cost. The water resources issues including the water quality issues will be addressed by strengthening the International Center for Water Resources Management (ICWRM) in CESTA at CSU. The ICWRM is currently engaged in assessing the water quality in the streams and farms in the Appalachian areas of Ohio in the application of Smart Water Technologies for the Montgomery County Environmental Services (MCES). The ICWRM has advanced water quality instrumentation, excellent hydraulics/hydrology instrumentation and a remote sensing laboratory. The remote sensing laboratory has licenses to advanced legacy software, spectro-radiometers and advanced GPS units for ground truthing work. Issues that will be taken up for research will include:

Solving Problem Of Harmful Algal Blooms In Lakes And Rivers: Research on controlling nutrient loading from the Maumee River, Ohio that contributes to *Microcystis* specifically, and algal blooms along the Maumee Bay shoreline of western Lake Erie basin is critically needed. The study involves modeling (using the US EPA WASP water quality model) the hydrodynamics of Lake Erie in the Maumee bay region, modeling the fate and transport of nitrogen, phosphorus, dissolved oxygen and chlorophyll, and decoupling of hydrodynamics and transport models resulting in the prediction of algal bloom concentrations.

Sustainable Use of Water in Natural Gas Production: We need to develop innovative methods to treat wastewater during natural gas well drilling, development and production. We also need to study the impact of natural gas extraction on local water resources, land use, land cover, water quality and the wildlife in the Marcellus and Utica shale regions along eastern Ohio.

Smart Sensors for Monitoring and Control of Combined Sewer Overflows: ICWRM will engage in developing smart sensors to minimize infiltration and inflow in sewer systems under extreme rainfall. The research is being piloted by the Montgomery County Environmental Services for the sewer systems for the City of Dayton service area.

Renewable Energy: The ICWRM has unique capabilities in hydropower research. Studies have indicated there are more than 50,000 unpowered small dams and other hydraulic drops available in irrigation systems in the US. Technologies to develop hydropower units for the unpowered dams and other hydraulic drops can enhance the contribution from renewable sources for isolated communities and other stakeholders. We will engage in developing appropriate technologies towards generating small hydropower units.

Agricultural Water Quality: Nitrogen and Phosphorus in agricultural runoff and leaching continues to be a non-point source pollution affecting water quality in Ohio watersheds by causing harmful algal blooms. So far, little research has been done in cropped acres of southwestern Ohio to quantify the impact of nutrient pollution on water quality. We intend to assess the effectiveness of several agricultural best management practices in reducing nutrient loads in the Great and Little Miami watersheds that drain into the Ohio River and subsequently into the Mississippi river and Gulf of Mexico. We expect to achieve this by utilizing advance geospatial technologies coupled with on farm research. Related issues of smart and sustainable agriculture will be addressed.

Soil Information and Health: A critical component of plant productivity and environmental quality in agricultural systems is the concept of "soil security." To effectively manage water resources, informed management of soil resources is imperative. An assessment of soil information and health at local, regional and global scales will provide a holistic system-based approach to address the issues at the nexus of plant, animal, natural resources and environmental systems. We expect to utilize advanced machine learning and geospatial techniques to carry out this assessment at varying spatial scales and study the impact of agricultural best management practices on soil resources, crop productivity and environmental quality.

Agricultural Ecology: Biodiversity and saving endangered species are important for improving the ecosystems in farming areas. Organic farming has numerous benefits in improving the ecosystems. The agro-eco systems involve land, water and the biota. Farming and other activities in agricultural areas have to be conducted with sustainability goals. Organic farming is claimed to have numerous benefits in improving the ecosystems in agricultural areas. Biodiversity and saving endangered species are important for improving the ecosystems in farming areas.

v. Social and Allied Research Systems -Engaging Communities and Transforming Lives

The Engaging Communities and Transforming Lives program is formulated with a unifying goal to provide resource planning and economic development leadership to help farmers and urban communities better solve problems and address financial and economic issues. This planned program outlines measures that will be implemented in Ohio communities. The knowledge areas (KA's) that drive the plan are centered on (1) making better family economic decisions; (2) improving resource availability; (3) increased community planning and development activities; and (4) better control of animal reproductive performance. This program intends to take an interdisciplinary and integrated approach to address relevant issues that are interrelated to agricultural production and community planning and development. It is no secret that there is a direct correlation between poverty and poor nutrition. This plan involves collaboration with other partner institutions, city governments, businesses, federal agencies, policymakers and communities. Specific areas of our planned program include, but are not limited to, the following: explaining the economics and environmental impacts of renewable energy production and consumption; farm productivity and resource utilization efficiency; market analysis; community leadership, planning, and development; rural finance; needs of under-represented farmers/producers with limited resources; analysis of institutional and infrastructural constraints; strengths and challenges of local communities; and providing international trade-related educational programs, including trade shows, trade assistance, and consulting services[PS1] . Another priority research area is conducting economic impact analyses and evaluating drivers of local economies.

The 2020-2025 planned program will involve the Agricultural Research Development Program (ARDP) and Cooperative Extension Program (CEP), including education programs that will strengthen the capacity of communities while developing their skills in the areas of leadership, business, non-profit, cooperative, and workforce (career) development. Addressing socioeconomic improvement will also be done through collaboration with The CEP, the College of Business, city governments, and municipal entities in Dayton, Columbus, Cincinnati, and Xenia to name a few. The research and studies needed will be done in collaboration by the ARDP and CSU's CEP. Future initiatives will involve a wider range of community groups and municipalities as greater resources become available and best practices are implemented. The intent of involving these municipalities is to address the need for economic development and attract small business and entrepreneurs to the areas that are served by the planned program. Expanding business opportunities and providing training for stakeholders may create pathways for new jobs, rezoning of underutilized land to create urban farms, and small business opportunities for those with technical knowledge and requisite skills. There are opportunities for rural development, especially with reference to developing agricultural products and manufacturing them in rural areas. The planned program for the 2020-2025 period will work to deliver the following: a) deliver financial education programs, b) facilitate workshops, and c) host and joint sponsor conferences. It is possible that given the wide berth of the current plan, addressing the social and economic issues in this program may affect multiple outcomes in other areas of the Institutional Profile.

2. FTE Estimates

Year	1890 Extension	1890 Research
2020	30.0	30.0
2021	40.0	40.0
2022	50.0	50.0
2023	55.0	55.0
2024	60.0	60.0

II. Merit / Peer Review Process

The Merit Review Processes that will be followed are listed as follows:

Internal University Panel External University Panel

Combined External and Internal University Panel Expert Peer Review

A combined internal, external, and non-university merit review process will be used during this planning period. The Joint Cooperative Extension Program (CEP) and Agricultural Research Development Program (ARDP), the equivalent of an experimental station at Central State University, will utilize a combined internal and external university and external non-university panel so that we are able to gather important feedback to better address stakeholder demand. Members will be selected every two years to provide a review process of the Joint Extension/Research Plan of Work (POW) to establish the merit of the planned programs. Administrative unit members, specialists and researchers from both the internal and external land-grant universities will provide input into the plan of work. Additionally, non-university panel members will consist of various partnering agencies with similar types of research and extension priorities in the state will be used to establish the merit of the plan or work. The merit review process will focus on the four planned programs. A comprehensive and detailed program review will be conducted by the panel of the planned programs in the plan of work (POW) at least every other year.

Both CSU's Cooperative Extension and ARDP will utilize advisory committees at different levels to initiate program reviews of all planned programs during the next five years. The reviews will be conducted by panels selected specifically for the purpose of the review. These reviews may consist of peer review of grant applications (small and large) by internal faculty panel, administration, and stakeholders with expertise. Faculty from outside of Central State University Extension (CSUE) and ARDP will be used when needed. Local joint county program reviews conducted by advisory groups at the county level will be used to guide the program and research direction of the planned programs of the POW. Local program reviews will be conducted only where CSUE and ARDP offices establish advisory councils and program committees for merit review and comments on the effectiveness of program impact.

Peer review processes will consist of state program reviews by internal and external extension and research professionals from both land-grant universities of the state. The research program will be reviewed annually by scientific peers.

Stakeholder groups will evaluate the relevance of research priorities, the thoroughness of research procedures in individual projects, project outcomes, publications, and direct and indirect impact of the project on the stakeholders. Internal evaluators will consist of administrators and scientists not directly associated with the planned programs. Expert reviewers and peer review participants will be selected from governmental agencies (state and federal), other universities, and local officials directly related to the commodities or other outputs of the research. Publications by CSUE and ARDP are peer reviewed before publications in print or electronic media. ARDP encourages higher tier peer reviewed journals and tracking citations.

III. Stakeholder Input

1. Actions to Seek

To Seek Stakeholder Input:

Use of media to announce public meetings and listening sessions Targeted invitation to traditional stakeholder groups
Targeted invitation to non-traditional stakeholder groups Targeted invitation to traditional stakeholder individuals Targeted
invitation to non-traditional stakeholder individuals Targeted invitation to selected individuals from general public Survey of
traditional stakeholder groups
Survey of traditional stakeholder individuals Survey of the general public
Survey specifically with non-traditional groups Survey specifically with non-traditional individuals
Survey of selected individuals from the general public
Other (focus groups, public information booths at local gatherings)

To encourage stakeholder input, CSUE and ARDP will use local, regional, and statewide media outlets to solicit involvement and participation. The Extension offices, in cooperation with OSU Extension, will have committees to provide input for program planning, implementation, and evaluation. Local planning committees will be formed in each county office. CSUE and ARDP are encouraged to recruit, plan and implement public interaction, e.g., town hall meetings, and focus groups sessions. A one-on-one target outreach method will be conducted to gather information and include stakeholders' input. Town Hall meetings and focus group sessions will be held to increase awareness of our mission.

2. Methods to Identify

Methods Used to Identify Groups and Individuals to Collect Input:

Use of Advisory Committees
Use of Internal Focus Groups
Use of External Focus Groups
Open Listening Sessions
Needs Assessments
Use of Surveys
Other (1-on-1's with existing and stakeholder)

Multiple approaches will be used for the 2020-2025 planning period to seek stakeholder input. The approaches include formal surveys, focus groups, key informant approaches, advisory councils (collaborating groups, agencies, and organizations) and combinations of the preceding methods. Efforts will be made to ensure that the stakeholders involved will include representatives of the limited resources households in terms of geographic location, family status, income level, age, gender, disability status, and users or non-users of existing educational programs. Guideline manuals will be designed for collecting data from stakeholders and ensuring accomplishment of program priority goals.

Advisory Councils will assist Agents/Educators with identifying and engaging local advisory councils to gather information about the needs and issues in local counties. The Extension Advisory Council will provide recommendations and identify issues for educational programming. The Research Advisory committee will include researchers from USDA and State agencies, business representation and commodity groups. The Town Hall meetings will be implemented to identify issues or needs of citizens in cities targeting the general public. Open listening sessions and needs assessments will be conducted jointly between Research and Extension personnel. A series of focus group sessions will be implemented to further prioritize issues identified in public hearings (e.g., town hall meetings).

3. Methods to Collect

Methods for Collecting Stakeholder Input:

Meeting with traditional stakeholder groups
Survey of traditional stakeholder groups
Meeting with traditional stakeholder individuals
Survey of traditional stakeholder individuals
Meeting with the general public (open meeting advertised to all)
Survey of the general public
Meeting specifically with non-traditional groups
Survey specifically with non-traditional groups
Meeting specifically with non-traditional individuals
Survey specifically with non-traditional individuals
Meeting with invited selected individuals from the general public
Survey of selected individuals from the general public
Other (focus groups interviews, qualitative data)

Multiple methods will be used for collecting stakeholder input. Town Hall Meetings, surveys, face-to-face, focus groups, one-on-one interactions, and listening sessions will all be used to provide a means of collecting data for stakeholder input. In addition, internal faculty and staff committees, advisory committees, and groups will be able to collect stakeholder input. As we build partnerships with federal, state, and local governments and agencies, we will seek input. Informal, one-on-one, small group interactions, and Extension and Advisory Councils will be the dominant means of garnering input.

4. How Considered

How Collected Input Considered

In the Budget Process
To Identify Emerging Issues
Redirect Extension Programs
Redirect Research Programs
In the Staff Hiring Process
In the Action Plans
To Set Priorities

Stakeholders' input is crucial in building relevant research and extension programs. The stakeholder input process is essential to refocusing and reaffirming priorities on an on-going basis. The stakeholders' input will help research and extension be adaptive to society's needs. The process is also critical in identifying emerging issues. The stakeholder input will contribute to how business is conducted at all levels of the research and extension. This will constantly cause CSU to shift direction in staffing arrangements and budgetary considerations based on the greatest need of the population. Inputs will be gathered and used to establish action plans and to set priorities..

IV. Critical Issues

1 Plant Systems

Description:

Natural Products and Alternative Crops: Issues to be addressed under plant systems include Establishment of Alternate Crops, Increase Use of Natural Products, Modification of Plant Chemistry, Development of Rapid Metabolite Quantification Systems, and Natural Plant Products Research growers in Ohio and across the US face low crop prices and struggle to keep their farms solvent. The overproduction of major grain crops (corn, soybeans, and wheat) by US farmers suppresses commodity prices. Alternative crops are needed to provide growers new revenue streams. Moreover, large-scale adoption of alternative crops can reduce overproduction of major crops, thereby increasing commodity prices. Hemp, Cannabis sativa with a Δ^9 -tetrahydrocannabinol (THC) content less than 0.3%, can be utilized as a food, fiber, feed, bioenergy, and medicine. It is first necessary to explore and develop natural products from plants to provide knowledge and help establish valuable niche markets for alternative and specialty crops. Interesting candidates for Ohio include amaranth, sweet potato, high-amylose corn, tree fruit and nut crops, medicinal plants, hemp, and hops. High-amylose corn is of interest. Corn is one of the most diverse grain crops whereby many variations exist through evolution and extensive breeding efforts. The special variety known as high-amylose corn, has amylose content in the starch and is above normal levels. Recent developments have increased the status of high-amylose corn, particularly the concentration on bioplastics and the search by food companies for a starch type that resists digestion. As a food ingredient, consumers could benefit from high-amylose starch because it has a lower glycemic index than other starches. In addition, plant systems research and extension activities will include hydroponic and aquaponic production and season extension.

Term: Long

Science Emphasis Areas

Bioeconomy, Bioenergy, and Bioproducts
Sustainable Agricultural Production Systems

2 Animal Systems

Description:

Avian Systems: Ohio is one of the largest egg farming states in the Nation. CSU CEP avian veterinarian will serve the poultry producers through performance of appropriate examinations, interpret history and laboratory tests, and visit farms, hatcheries, processing plants and other avian enterprises to diagnose, report and formulate prevention and control plans for spontaneously occurring diseases of poultry and a variety of other avian species. Small Animal/Fish Systems Research Program: One of the long-term goals of the University is to re-establish an animal science research program. CSU has already invested in aquaponics research and extension programs that involves training and technical assistance of limited-resource and small farms in rural and urban areas. Additionally, CSU CEP is seeking farmer-partners and partners from other 1890 and 1862 Land Grants to develop an Extension-based comprehensive educational program for forage-based ruminant production systems (e.g., grass-fed beef/goat production). CSU CEP will start an apiculture (beekeeping) apprenticeship program. Of particular focus will be clients who are military veterans because beekeeping has shown to have salubrious effects on those that have suffered various form of trauma. CSU CEP educators are being trained by CSU apiculture scientist Dr. Hong Mei Li-Byarlay, on various aspects of managing beehives. This apprenticeship will include hands-on trainings, workshops, as well as technical assistance to beekeepers. To support this mission, CSU CEP will be purchasing hive management and honey harvesting tools that will be kept in trailers for our clients to borrow. The beekeeping apprenticeship program should increase bee populations across the state, causing an increase in its associated benefits, and diversify farm income for beekeepers. The descriptions of CSU Bee research programs are given under

Term: Long

Science Emphasis Areas

Bioeconomy, Bioenergy, and Bioproducts
Food Safety
Sustainable Agricultural Production Systems

3 Food Nutrition and Health Systems

Description:

CSU's Family and Consumer Science (FCS/EFNEP program will continue to partner with CSU's Food and Nutrition and Health Systems researchers to provide up to date research-based information to our stakeholders. CSU will continue to provide Diabetes Empowerment Education Program to our minority, socially disadvantaged, and economically depressed stakeholders, hold demonstrations in incorporating more vegetables and fruits in their diets, and provide exercise options that can be done at home with no specialized equipment. A mobile kitchen will be obtained and taken to our service counties for cooking demonstrations and education. A nutritionist would work one-on-one with clients requiring nutritional plans. It will also be useful in 4-H programs where school kitchens cannot be used to provide education on human nutrition and learn cooking skills. A Health Education Mobile Unit (HEMU) will be purchased for educators to reach these communities to provide programs. The use of the HEMU will be coordinated with county health departments so that their medical staff could accompany CSU staff. It will include educational and spaces to perform health checks and other medical procedures. In response to the COVID-19 pandemic in low-income communities in Ohio, CSU will continue to provide education related to hygiene practices that mitigate the spread of pandemic, food safety plans for farmers, and provide vaccination education in our communities of service. The HEMU will allow county health department professionals who could bring additional vaccination resources to communities of poverty. In addition, the 4-H and programs will partner to jointly train children, youth, and families at risk about healthy eating on a budget, inexpensive production of produce for at-home consumption, and provide opportunities.

Term: Long

Science Emphasis Areas

Bioeconomy, Bioenergy, and Bioproducts
Family & Consumer Sciences
Food Safety
Human Nutrition
Youth Development

4 Natural Resources and Environmental Systems

Description:

Pollinator Issues: Honeybees are the most important managed pollinators contributing \$15 billion for the U.S. economy, but the honeybee colonies are in a 40-50% decline in the country. In particular, managed bee colonies are in a 60% annual decline in Ohio. Promoting mite resistant bees is one of the most effective ways to mitigate the bee decline. It is imperative that we develop new methods for increasing genetic diversity and to improve queen bee quality. The limiting factors affecting local honeybee resources include fewer queens and the nuclei available to fulfill the demand of beekeepers in the region. **Water Resources and Water Quality:** Water issues in the US are related to 1) variability in availability of the resource for agriculture, domestic industrial and commercial uses, firefighting and recreation; 2) floods and droughts; 3) water quality in agricultural and urban areas; 4) economics of water resources and 5) ways for energy generation. The major phenomenon of change in climate impacts all aspects of water, which requires planning structural and non-structural measures. A major water issue in Ohio is related to water quality. Nitrogen and Phosphorus in agricultural runoff and leaching continues to be a non-point source pollution affecting water quality in Ohio watersheds by causing harmful algal blooms. **Soil Health:** An assessment of soil information and health at local, regional and global scales will provide a holistic system-based approach to address the issues at the nexus of plant, animal, natural resources and environmental systems. **Agricultural Ecology:** Biodiversity and saving endangered species are important for improving the ecosystems in farming areas. Organic farming has numerous benefits in improving the ecosystems.

Term: Long

Science Emphasis Areas

Agroclimate Science
Bioeconomy, Bioenergy, and Bioproducts
Environmental Systems
Sustainable Agricultural Production Systems

5 Engaging Communities and Transforming Lives

Description:

Improving the overall conditions facing individuals and families in Ohio's communities, as well as addressing agricultural issues in rural, urban, and Appalachia locations will be aimed. **Building Families and Communities-Family Consumer Sciences:** Issues include childhood obesity, family resilience, financial readiness, health, hunger, and environmental degradation. Addressing these through research and programming focused on human nutrition, food and non- food products, food safety, hospitality/recreation, health, and financial education are planned. **Creating Youth Pathways to Success:** The 4-H and Youth Development program currently addresses societal needs by providing strong and resilient individuals, families, and communities in Ohio. **Developing Better Socio-Economic and Sustainable Communities:** The Community and Economic Development programs seek to empower communities to achieve their goals through education and technical assistance. This will be achieved through offering high school equivalency education, criminal record expungement program, and local and micro entrepreneurship and jobs programs. Also, we offer technical assistance to Ohioans through training clients in governmental disaster relief programs and assisting with completing applications to obtain disaster relief. **Improving Agriculture, Sustainability and Economics - Agriculture and Natural Resources (ANR):** This links our Land-Grant research and extension efforts by providing education to Ohioans through conferences, seminars, workshops, field demonstrations, and farm tours. The ANR will be involved in farmer training, dissemination of research results from CSU's ARDP program, providing technical support for agricultural and forestry operations.

Term: Long

Science Emphasis Areas

Education and Multicultural Alliances
Family & Consumer Sciences

Human Nutrition
Sustainable Agricultural Production Systems
Youth Development