2016 University of the District of Columbia Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

As the only public institution of higher learning in our nation's capital, and the only exclusively urban land-grant university in the United States, the University of the District of Columbia (UDC) continues its efforts to position itself as a leader in urban-centered, global education, research, community outreach and cooperative extension. UDC is a historically black, relevant and progressive urban land-grant institution in and for the District of Columbia that offers associate, baccalaureate, graduate and professional degree programs, as well as community education, workshops, demonstrations and certificate programs to learners of all ages.

The College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES) embodies the land-grant tradition of UDC. In addition to offering innovative academic programs in architecture, urban sustainability, urban agriculture, water resources management, health education, nursing, and nutrition and dietetics, we also offer a wide range of cooperative extension and continuing education programs through our five land-grant centers: (1) the Center for Urban Agriculture & Gardening Education; (2) the Center for Sustainable Development and Resilience, which includes the Water Resources Research Institute; (3) the Center for Nutrition Diet & Health, which includes the Institute of Gerontology; (4) the Center for 4-H & Youth Development; and (5) the Center for Architectural Innovation and Building Science, which includes the Architectural Research Institute and the Building Science Institute.

The CAUSES mission is to "...offer research-based academic and community outreach programs that improve the quality of life and economic opportunity of people and communities in the District of Columbia, the nation and the world." In CAUSES, we recognize that, like ecosystems, we are connected to people and places right here in our own neighborhoods and to those half way around the world. Pollution travels, resources are not always consumed where they are generated, and job markets are increasingly global and knowledge-based. Given these realities, we aspire to teach people to think in systems, work in diverse teams, and focus on connectivity and innovation. We apply these principals to all of our programs including our Master's and Bachelor's degree programs, professional development certificates and cooperative extension programs.

We are deeply committed to being relevant to the residents of the District of Columbia. Given our three-pronged approach of teaching, research and extension, we seek to make a measurable, positive difference in the lives of people right where they live and work. As a result, our programs focus on improving economic conditions, social and cultural circumstances, and the health of people and their living environments. Our research and community outreach programs are more than local. They also serve as a model for relevant learning far beyond our region. Our tag line, "Healthy Cities - Healthy People," captures these commitments.

Key to our success has been the integration of our academic and land-grant programs and the integration of Agricultural Experiment Station (AES) and Cooperative Extension Service (CES) responsibilities into one land-grant mission. Land-grant universities have always sought to be relevant to the needs of their communities by focusing on research that makes a difference in the lives of local people and

organizations; and by offering education both on their campuses and in local neighborhoods. Consistent with the priorities of the USDA, and the needs of residents and public, private, and non-profit sector partners in the District of Columbia, our goals are derived from key NIFA objectives, such as improving food security, food safety, mitigating climate change, and combating childhood obesity and other food related health problems, improving water management and water safety, and expanding alternative energy.

Finding solutions to real-life challenges requires collaboration across academic disciplines, hands-on work, and perseverance. For CAUSES, it means that we work together across many fields to find solutions to the aforementioned challenges. Yet given our location, our focus is exclusively urban. After all, our community is totally urban, and sets us apart from all the other land-grant universities in the United States. We also create important alliances like urban agriculture and urban sustainability, and urban health and resiliency. Central to our ability to find solutions is the University's Firebird Farm, formerly Muirkirk Farm, which tests innovative food production methods and is quickly becoming a go-to place for home gardeners and anyone who wants to learn how to make agriculture a viable profession in an urban setting.

Some urban producers are initially motivated by the goal of improving their own health, quality of life and economic opportunity; some are motivated by the goal of making their neighborhoods safer and creating opportunities for their neighbors and extended family. Yet research in the tradition of the Land-grant University is not enough when urban populations are the focus. We must work with coalitions across the city to link urban agriculture to health, urban sustainability, and resiliency. We have accomplished this through our Urban Food Hubs concept that was pioneered by Dr. Sabine O'Hara, Dean of CAUSES and Director of Land-grant Programs (O'Hara, S. 2015. Food Security: The Urban Food Hubs Solution. Solutions January-February, www.thesolutionsjournal.org; O'Hara, S. 2017. The Urban Food Hubs Solution: Building Capacity in Urban Communities. Metropolitan Universities Journal. Vol. 28 No. 1 (Winter), DOI: 10.18060/21477). The Urban Food Hubs concept offers a comprehensive approach to urban food security that incorporates the whole value chain through four integrated components: (1) food production; (2) food preparation; (3) food distribution; and (4) closing the loop through waste and water recovery.

To date we have implemented four Urban Food Hubs across the District of Columbia. Three of them are located in food desert neighborhoods is Wards 5, 7 and 8.

Some of our College-wide stakeholder events for FY 16 include the following:

1. International Society for Ecological Economics
Hosted the Bi-annual conference of the International Society for Ecological Economics (ISEE) with CAUSES Dean, Dr. Sabine O'Hara, serving as conference chair and president of the International Society for Ecological Economics (ISEE). The theme was "Transforming the Economy: Sustaining Food, Water, Energy and Justice." The event included speakers and attendees from across the globe. With a total of 496 participants, research presentations and interactive sessions included topics such as Sustaining Food and Water; Transforming Economic Growth and Redefining Economic Measures; Social Stability and Economic Behavior; Public Policy for Local and Global Sustainability; Ecological Education and Communication; Bio-Physical Economics; Social Energetics: Connecting Natural and Social Sciences; Sustaining Sources and Sinks; and Urban Sustainability and other Regional Approaches.

2. Northeast Region Pre-Conference Meeting
In conjunction with the ISEE conference, we also hosted a one-day meeting titled "Urban Agriculture and Sustainability in the Northeast Region," which invited participants from the ISEE conference and the Northeast Region to 1) learn about the foci of active research programs in urban agriculture and sustainability; 2) discuss current and emerging research priorities for the region; 3) establish a network of partnerships, and 4) learn about UDC's Urban Food Hubs. Thirty-three participants presented their

ongoing research and outlined eight research and education priorities for urban agriculture and sustainability.

3. Food and the Creative Economy
Designed and implemented an event featuring Chef Spike Mendelsohn, DC based chef and restaurateur, best known as the 5th place finisher of the 4th season of Top Chef, which aired 2008 - 2009. The event was a part of the Creative Economy Month of DC Mayor, Muriel Bowser. Twenty-six participants enjoyed an intimate evening with Chef Mendelsohn and were exposed to his extraordinary culinary expertise and creativity. Through his presentation and demonstration, Chef Mendelsohn showed us that meals can be nutritious and delicious when prepared with fresh food, using healthy cooking methods. The participants were delighted with their new found knowledge from the chef's demonstration and enjoyed the prepared dish.

4. Invention: The Motor of the Creative Economy
A second event organized in conjunction with the Mayor's Creative Economy Month featured Inventor and UDC Emeritus Professor Thomas Kakovitch. Kakovitch holds 26 patents. One of his patents, an innovative aeration device called the Flo-Vex, is the technology behind the pioneering aquaponics systems of the University of the District of Columbia and its College of Agriculture, Urban Sustainability and Environmental Sciences. One of these cutting edge systems is in operation at the East Capitol Urban Food Hub, where 37 stakeholders gathered to hear Professor Kakovitch share how he discovered his Flo-Vex idea and the benefit of its use with urban aquaponics systems.

In addition to providing non-credit bearing learning and capacity building programs in the tradition of the cooperative extension service, the five land-grant centers of CAUSES and the Urban Food Hubs also strengthen UDC's academic programs. The centers offer learning and leadership opportunities by providing students with hands-on, practical service learning experiences, internships and research opportunities that (a) foster relevant experiential learning and (b) facilitate employability and skills development. Given our three-pronged approach of teaching, research and extension, we seek to make a measurable, positive difference in the lives of people right where they live and work. Our vision is to be a world leader in designing and implementing top quality, research-based academic and cooperative extension programs that measurably improve the quality of life and economic prosperity of people and communities in the District of Columbia, the nation, and the world.

This annual report documents accomplishments and results for our Agricultural Experiment Station research and Cooperative Extension Service programs for Fiscal Year 2016. The focus of our programs is consistent with the NIFA objectives outlined in the 2014 Farm Bill, and includes: (1) Climate Change; (2) Global Food Security and Hunger; (3) Health, Nutrition and Childhood Obesity; (4) Alternative Energy and Capacity Building; (5) Water Safety and Water Management; and (6) Food Safety. The activities of our Center for 4H and Youth Development cut across all of these six programmatic areas in terms of the content areas of our youth development programs. Our current planned programs include all of the aforementioned with the exception of the Water Safety and Water Management program, which we have added for FY 16 reporting. Also, we have retitled the Sustainable Energy planned program to Alternative Energy and Capacity Building. For this year's reporting purposes, 4H activities will be reported under the current planned program area of Urban Families, Youth, and Communities. For the next reporting period, 4H activities will be reported across the other six programs areas.

Planned programs within this report include:

1. **Climate Change**

Research

Establishment of Computational Infrastructure at UDC to Conduct Climate Change Research for the District of Columbia

To understand and adapt the climate change related issues, a number of federal, state and local government agencies have launched several evaluations of vulnerability of their critical infrastructure to the possible effects of climate change. Climate change has the potential to increase the variability in extreme weather events. Washington, DC is very important because the city houses a significant number of federal agencies, several national monuments, international embassies and serves as a major economic center for the Washington Metropolitan area.

The increase in temperature can result in extreme precipitation events which can have significant impacts on the critical infrastructures of the District of Columbia, life and property of residents and on the overall economy of the Metropolitan DC area. There is a need to study the climatic parameter such as precipitation and its trend which would be useful for planners, engineers and water resource professionals in making informed decisions about climate change in planning, designing, operating, and maintaining the water resources systems. In this research, the key inputs, temperature and rainfall, are treated as key natural variables which have significant influence in climate change. Understanding these natural variables will benefit our decision-making in adaptability of climate change.

During the reporting period, the following was accomplished under the major goal of the project:

- Computer Server Systems and accessories were identified, selected, procured, and implemented.
- The Database system design was completed for precipitation.
- The stored procedure analytical tool to store the data was completed.
- Hourly long-term precipitation data was collected, processed and uploaded into the database server.
- The web site design was completed and implementation is in progress.
- Faculty researchers have introduced climate change research in their course works.
- The team has researched and designed the preliminary layout for the website development which will serve all stakeholders to include: engineers, water resources professionals, agricultural professionals and health professionals.

The project hired one computer science graduate student and one architecture graduate student to work on the project which provided a valuable opportunity for our students. The involved faculty members trained the students and team members of the project. The results dissemination is in progress. The results from the analytical tool were presented in ASCE conference. Once the web site design is implemented, the students will be able to use.

The preliminary results from this research were presented at the National Capital Region Water Resources Symposium in April, 2016. The title of the research was "Development of Rainfall Storm Event Analysis Tool based on Cloud Computing."

Tasks for the next reporting period include the procurement of additional requirements of the computational systems and its accessories; website development that will serve as a hub for students, faculty, water resources, engineers, agricultural and health professionals to access climate change related research; and completion of the development of a software system to analyze the long-term precipitation record to conduct storm event analysis.

Analysis of Watering Devices for the Planting and Survival of Young Urban Canopy Trees

Urban forestry is the art, science and technology of managing trees, forests and natural systems in and around cities, suburbs, and towns for the health and well-being of all people. It is care and management of urban forests, i.e., tree populations in urban settings for the purpose of improving the urban environment. Grey and Deneke describe urban forestry as the management of trees for their contributions to the physiological, sociological, and economic well-being of the urban society. It was further stated that urban

forestry deals with woodlands, groups of trees, individual trees and where people live. Currently underway by the Director for the Center for Urban Agriculture and Gardening Education is research to analyze watering devices for the planting and survival of young urban canopy trees. Specifically, the project compares various watering methods and their ability to encourage deep taproot growth. The watering methods tested include the Grouses Waterbucks, Gator Bags, and manual watering with a water hose.

We are focused on the tree-planting community in the greater Washington Metropolitan area including non-profit environmental groups and for-profit commercial tree-planters.

According to the Natural Environment Research Council (Centre for Ecology and Hydrology), "Establishment of trees in the built (i.e. urban) environment cannot be regarded as a routinely successful enterprise. The overall picture is that there are many dangers for a newly planted tree and in some cases the chances of survival are as little 1 in 2." (Tree Roots in the Built Environment - Ch. 5, Establishment of Young Trees. 2013.)

The traditional method of planting urban trees is using a 5-7 year old nursery tree in a B&B (Bag and Burlap) root ball or in some cases, a large nursery pot. This method has been successful but comes with some drawbacks: high cost and long-term watering and maintenance. A new innovation, the Waterbox (and its bio-degradable version, the Greenbox), is being used successfully around the world to establish younger (1-2 year old) trees; and with this comes a large advantage of cost savings (up to 90%), very little maintenance, and improved early taproot establishment.

Along with several related questions, this research focuses on determining whether such a device would be effective in DC's urban conditions and soils. In addition to known lowering of costs and maintenance, this research will determine if the Waterbox can create better and deeper tree root systems despite DC's typical urban and compacted soils, which would improve survival rates and even perhaps lessen the risk of trees blowing over in windstorms.

As an additional experimental comparison, we will plant the same trees using the Gator Bag/Gator Ring (currently used by DDOT (DC Dept. of Transportation), and as a control, bare ground (i.e. with no watering except normal rainfall).

To represent a mix of hardwood trees commonly planted in the Greater Washington, DC area, we selected White Oak, Swamp White Oak, Sweet Gum and Hackberry. Overall, the primary goals of our experimental process went reasonably as planned. In this second year, we still encountered problems setting up a watering system as this plot was not on the main grid at Firebird Farm. However, we have found that the site for this planting is the heaviest soil at Firebird Farm and stays waterlogged for extended periods of time. Moreover, the site is at the far end of the farm and is subject to significant run-off and inflow of water from the adjacent forest. Thus, additional watering which is the intended protocol of the research can hinder rather than support root development and tree growth.

This project was completed in 2016. During the reporting period, we were able to assess the growth of tree canopy and tree roots to see the efficacy of the research project. The information will be disseminated to our stakeholders. This critical information will lead the research on urban tree production and global climate change mitigation involving urban tree production. Our target audience includes home urban arborist, gardeners and regional small scale urban and peri-urban farming operations interested in growing trees for urban gardens which will advance food and nutritional security in the District of Columbia. The information will be crucial for our urban forestry program, which will disseminate these findings to urban arborist in Washington, DC. We hope to disseminate this information to local urban arborist via information bulletins and web based informational systems. We will continue to train, and disseminate the information learned from this project to the community at large.

Determining Effects of Nitrogen Fixing Plants on Nutrient Density and Productivity in Agroforestry and Polyculture Systems

Like urban centers around the world, DC is faced with challenges in providing fresh, healthy food to its residents, especially the underserved and low-income populations. Five percent of all households in the District have very low food security, while a total of thirteen percent have food insecurity. DC ranks second worst in the nation, exceeded only by Mississippi for the highest number of households with children that cannot afford enough food (20). Over 34,000 people live in areas classified as "food deserts," living more than a mile away from a supermarket (USDA ERS 2014). Most of these areas are in Wards 5, 7, and 8, where 95% of the population is African-American and more than one third of the households have yearly income below the federal poverty line of $22,000 for a family of four (19). In the face of these statistics, the District of Columbia is looking for ways to improve access to fresh, nutrient dense food for all of its residents.

The District of Columbia is embedded in lush East Coast temperate forest. As issues of sustainability and food security are addressed, practical solutions to creating and increasing local productivity are being considered. The mayor of the District of Columbia has created a food policy council. Recently, the DC Urban Food Farm and Food Security Act of 2014 passed. Under this act, the mayor will identify urban plots to lease out to qualified applicants, offer tax credits for land owners who lease their land to growers, and work to promote buying locally grown food in order to support urban food production within the District (3). While this is a big step in helping to increase the availability of locally grown food, it is important that sustainable agricultural practices are a part of this change.

Sustainable and organic farmers throughout the nation are warming up to and embracing ideas such as permaculture, agroforestry, restoration agriculture, edible landscaping, rooftop gardening, and farming the woods. All of these models have the core concept of working with native plants and forestlands to produce sustenance crops that have marketable potential incorporated into a closed-loop system of agriculture. Urban runoff and agricultural waste are leading contributors of nutrient, bacterial, and toxic pollution to area waterways including the Anacostia Watershed and the Chesapeake Bay (11). Agroforestry and polyculture systems use nitrogen fixing trees and bushes along with cover crops to provide nitrogen. Polycultures and closed loop systems of food production have the potential of significantly lessening pollutants by decreasing agricultural inputs and limiting potentially toxic outputs. Agroforestry and polyculture systems rely on nitrogen fixing trees and bushes along with cover crops to provide nitrogen. Assessing the impact of nitrogen fixing plants on the resiliency and productivity of the system provides alternatives to standard nitrogen inputs. Determining nitrogen contributions from trees and bushes vs. cover crops will help provide information that growers can use to create efficient low-input and closed-looped nitrogen cycling.

Traditional large-scale growing practices have a significant environmental impact and also are not possible within urban settings. Agroforestry and/or polyculture, i.e. the cultivation of multiple crops in a closed loop system, is rising in popularity as growers and homeowners look for sustainable, low input methods of production for both sustenance and market crops. Such solutions can be applied to backyards or abandoned city lots. While there is a lot of potential for these types of systems to be successful at providing food and restoring ecosystems, it is still a new concept and requires some shifting from traditional practices. In order to demonstrate viable polyculture crops for the Mid-Atlantic region, we plan to design a ¼ acre plot that will consist of a variety of species including fruit and nut trees, fruit bushes and vines, and plants that are beneficial as ground cover, for nutrient building properties, or to attract beneficial insects. By using a wide range of plants, it will help to ensure that regardless of the season or environmental fluctuations, something will be flourishing and providing sustenance for the grower and creating a system where the plants complement rather than compete with each other.

Polyculture systems have other benefits for urban areas. Through design, the edges of the plot can be used as a noise barrier for those situated near high traffic roads or to block the view for those located near

undesirable vantages. They also help to protect an area from sunlight and wind. Hedgerows are beneficial for the other plants in the guild by hosting pollinator and predatory species that help ensure a good harvest and protection from pest species. Other plants, such as daffodils, are beneficial both to plant around urban houses and in the polyculture plot for deterring rodents from entering the house or feasting on the bounty growing in the plot (16). All of these benefits will help to enhance the beauty of the city and the health of those living here.

UDC CAUSES and Bread for the City began City Orchard at the Firebird Farm in 2011. The project consists of 540 apple and 120 Asian pear trees along with blackberries, blueberries, raspberries, and strawberries. Apples, while chosen for their familiarity and acceptability among urbanites as the premiere fruits, require much care and spraying because they are being grown in a temperate forested region. Though disease resistant strains were chosen for their potential to resist fire blight, other diseases such as cedar apple rust and apple scab make it almost impossible to produce aesthetically pleasing fruit without the use of chemical fungicides and other agents, which make apples one of the most toxic fruit on the market. This project makes clear that more work needs to be done in understanding and creating minimal input systems that are self-sustainable. Hence, this project will help identify potential perennial food crops that can help increase local food security while help reduce toxic agricultural and landscape runoff from chemical fertilizer use.

This research project was approved very close to the end of the fiscal year. Thus, preliminary results will be reported in the FY 17 annual report.

During the next reporting period, we plan to break ground and establish the experimental polyculture plots. Due to the shortened timeframe, work, labor and maintenance costs for last year will be redirected into supply funds in order to obtain larger trees. This will enable us to get quicker soil based results, as the mature trees will be able to cycle nitrogen faster than younger ones.

One student intern will be hired in May, 2017 to assist with plot maintenance, soil sampling, and data collection/analysis. All data collected in the summer of 2017 will be presented by the student at the 2017 Dupont Summit in Washington, DC. Additionally, the principal investigator will work with the student to develop a fact sheet about polyculture and permacultures in the region for distribution to the public. Finally, educational workshops about maintaining and creating polycultures in the urban area will be developed for the late summer and early fall of 2017.

2. Global Food Security and Hunger

CAUSES recognizes Global Food Security and Hunger as one of the most important themes in urban sustainability and urban agriculture. Without securing a steady and dependable supply of highly nutritious food, urban communities cannot claim to attain sustainability. With more than half of the world's population, and over 80 percent of the U.S. population now living in urban communities, food travels over longer distances resulting in declining nutrient density, high energy demand and greenhouse gas emissions associated with a transport intensive food system, increasing vulnerability of urban food supplies, and growing health disparities due to unequal access to fresh food.

Using the pioneering work of Dr. Sabine O'Hara, CAUSES has begun implementing the concept of Urban Food Systems Hubs that operationalize her work on Sustaining Production (O'Hara 1996, 1998, 2004, 2012, 2013). Sustaining Production expands the traditional success measures of production such as profit maximization and productivity to simultaneously consider reducing emissions (negative externalities) and improving sink capacities. The Urban Food Systems Hubs consist of the following components:

1. Food production through highly efficient small-scale urban systems, including hydroponics and aquaponics;

2. Food preparation through commercial kitchens that serve as business incubators;
3. Food distribution through networked farmers markets, grocery stores and restaurants; and
4. Waste management and recycling through food waste processing, composting, energy generation, and water management.

All four components of the Urban Food Systems Hubs offer business opportunities. To capitalize on these opportunities, the Hubs serve not only as sustainable production facilities, but also as training sites especially in the food desert areas of Wards 5, 7 and 8 where unemployment is high and food related public health problems including diabetes, hypertension and obesity are prevalent.

Among the eight wards in the District of Columbia, Ward 8 is the most underserved and is located in the southeastern quadrant of Washington, DC, south of the Anacostia River. The average household income in Ward 8 is $48,000 and unemployment is 24 percent. This compares to an average household income of $99,500 across all eight of the DC Wards and to an average $162,000 per household in Ward 3, which is home to the highest household incomes in the District of Columbia. Twenty percent of the population in Ward 8 is under the age of 18; 91 percent are African American, 1.5 percent are Hispanic, slightly more than 4 percent are Caucasian, and less than 1 percent are Asian. The percentage of college graduates in Ward 8 is 7.6 percent compared to an average of 22.5 percent across all eight Wards.

Research

Promoting Sustainability: Growing Nutrient Dense Rice Using Drip Fertigation and Biodegradable Mulch

Rice is a staple crop of many cultures around the world. Traditional methods of growing rice have proven unsustainable in the face of growing water scarcity, environmental degradation, and shifting ecosystems. Flooded rice paddies are a major source of methane from anaerobic organisms. The average size of a rice farm in America is over 450 acres and growing. According to a study by the Lower Colorado River Authority (LCRM), rice growers in Texas used three times the amount of water as the entire city of Austin in 2012 (Henry, Terrence 2012). This research tested sustainable models of rice production involving reduced water usage while promoting small-scale intensive practices that reduce environmental impacts.

Developing methods that make rice an economically viable option for farmers and consumers is an important component of sustainability. Various drip irrigation and fertigation methods with biodegradable mulch to control weeds were tested to increase rice nutrient density and profitability while maintaining the environment.

Our goal is to contribute to the momentum of small-scale rice production by increasing viable options for farmers. As small-scale processing equipment becomes more accessible, the capability of growing rice and other small grains, which have been the base of humanity's food security, should be in the hands of small farmers to insure a sustainable future. Our future depends on creating models of adaptability. Putting grain production into the hands of the small farmer is a step in the right direction.

The primary goals of this research were achieved. The second year of producing Duborskian and Koshihikari rice varieties proceeded without incident. The crop was rotated to a different .8 acre plot according to the farms crop rotation plan. Rice can have allelopathic qualities which may affect yield. The plot is on a newly felled area with heavy clay Russett-Christiana Complex soil and poor nutrient availability. Two tons per acre of high calcium limestone was applied to the plot based on soil analysis from the previous year. The field was also amended with leaf compost and dry fertilizer before planting based on the results of the soil analysis. Foliar nutrients were applied and later adjusted based on plant sap analysis and plant growth stage.

The amendments were incorporated into the top 10 inches of soil using an Imants spader. A Rain-Flo 2600 plastic layer with drip layer was used to create 5" high, 30" wide beds on a 60" center. The area was divided into 4 plots of (6) 180' rows. Plots 1 and 3 had 6" drip and 2 and 4 had 1" drip tape with 12" drip spacing with 0.45gpm/100' output. In row plant spacing was reduced from 10" to 5" to observe effects of spacing and tillering on yield potential. A Rain-Flo water wheel transplanter was used for transplanting 21 - 28 day old rice plugs at the 4 leaf stage. Earlier planting dates were achieved this year. Abundant rainfall in June allowed for a vigorous growth stage. With low soil nitrogen and heavy rains, the Duborskian variety reached ripening stage with minimal watering through drip irrigation. In general, irrigation was greatly reduced with a more abundant rainfall season. The Koshihikari variety grown with was grown this year with .95 acre/ft of water which is 25% of average water use in paddy rice systems.

Pests this year included the rice stink bug, Japanese beetles, cucumber beetle, and European starling. Diatemacous earth was observed to be a very effective control of stink bug. For the European starlings, various types of audible bird deterrents failed and only row cover was effective in controlling bird damage. Birds resulted in an estimated 10% loss of Duborskian and 10 - 20% loss of Koshihikari.

Disease encountered this year was minimal. Sheath blight was observed in a section of the 1" plot of Koshihikari. University of MD confirmed sheath blight due to Rhizoctonia.

Average yields in paddy systems are approximately 8000 lbs/acre. Paddy systems are anaerobic and produce reduction reactions which increase nutrient availability. Those same aneorobic conditions also contribute to heavy metal uptake plaguing paddy rice production. Aerobic systems such as upland and dryland systems are expected to produce half that amount. Koshihikari harvest was 4333 lbs/acre and Duborskian harvest was 3452 lbs/acre. Although Koshihikari has a higher yield, it appears more susceptible to disease such as sheath blight. Duborskian produces lower yields, but its early harvest date provides many advantages. Both varieties have excellent flavor. Although labor intensive, growing rice with these methods as a specialty crop has great potential in the local region.

We have presented our research and findings at local and regional urban farming and small scale farming events including the Pennsylvania Association of Sustainable Agriculture, Chesapeake Association of Sustainable Agriculture (CASA), New England Organic Farming Association, Carolina Farm Stewardship Association, Virginia Association of Biological Farming, Rooting DC, and DC Parks and Recreation. We also sponsored a farm field day in cooperation with CASA.

Our target audience includes home gardeners and regional small scale farming operations interested in growing rice and other grains for sustenance and as a specialty crop. The crop was also planted at one of the UDC Urban Food Hubs for demonstration and teaching purposes. Urban residents were able to be acquainted with the procedures for producing rice.

Although 2016 was the last year for this project, we will continue to train and disseminate the information learned from this project to the community at large.

The Potential for Reducing Impacts of Solar Radiation on a Crop Producing Green Roof, and Modifying Roof Microclimates, through the Utilization of an Adjacent Crop Producing Green Façade

The District of Columbia has millions of square feet of roof area. This roof area negatively impacts the urban environment and climate in several ways: the roof surface area absorbs a significant amount of heat, and is the greatest factor in residential energy consumption in certain climates (Kliman, 2001). Light colored roof coatings can ameliorate this problem by reducing the heat absorption; however, these coatings require regular maintenance, darken with dirt accumulation and age, and do nothing to address the increased runoff created when the previously vegetated site was replaced by an impermeable surface. These reflective roofs, coupled with the higher thermal mass of typical building materials like concrete and

brick, are significant factors in the urban heat island in urban environments such as the District of Columbia. Vegetated, or green, roofs can mitigate the effects of the urban heat island and water runoff in several ways. By improving the thermal performance of a building, a green roof can reduce the annual load for cooling the building (Garrison, 2012). A smaller mechanical system translates into reduced CO2 emissions. The plants also reduce the radiation reflected back into the atmosphere from the roof. Finally, water retention and evapotranspiration of rainfall helps reduce runoff. These green roofs can contribute to an urban environment in other positive ways. A well-designed green roof can have a park-like setting, and serve as a nice amenity for building users. A green roof can also be used to grow crop-producing plants. In this configuration, the roof serves as an important component in helping to ensure food security in an urban environment. One of the challenges with fully utilizing the roof for cultivation of plants is the fact that many roofs have a penthouse for the mechanical system. This penthouse has solid vertical walls that reflect the sunlight and heat back onto the roof. The reflected light and heat is deleterious to the growth of many plants - particularly crops. This study is conducted to determine the viability of using a three dimensional modular lattice system to support crop-producing vines that would cover the walls and reduce this reflected sunlight and heat.

The research project is a parallel study that would utilize two existing green roofs - the one on the UDC campus, and one at a k-12 independent school located due west in McLean, Virginia. The UDC roof will test conditions and impacts in a dense urban environment, five floors above grade. The Virginia site will test conditions and impacts in a heavily vegetated suburban environment, two floors above grade. The test areas will be divided into three sections. The lattice on one section will support dense vine crops. The lattice on the second section will support moderately dense vine crops. The third section will serve as the control, with no lattice or vines. The roof area adjacent to the walls will be planted with micro greens. Measurements will be taken at regular intervals away from the wall to determine temperature, relative humidity, and solar radiation.

It is anticipated that the dense vine crops will provide shading and reduce the reflected sunlight by as much as 20%. It is further anticipated that the air temperature adjacent to the vines will be reduced by 2-8°C (Connelly, 2012). These two variables should provide a better environment for the plants located in the adjacent shallow beds, and result in a higher crop density. With thriving crop producing vines, and an increase in the usable roof area for planter beds, the overall potential for increased food production on the roof is significant. The ability to increase food security, while also mitigating the urban heat island and reducing the harmful runoff, simply by using existing roofs in the District has an enormous potential to positively impact the overall sustainability of the city. Furthermore, this condition of reflected heat is not limited to roofs with penthouses or partial floors on the same level. The results of this study will have relevance to the creation of urban farms, and even the homeowner with the garden plot. Student participation will provide hands-on learning experiences for college level and k-12 students, and there are numerous outreach opportunities through the activities of the Center for Urban Agriculture and Gardening Education, Cooperative Extension Service of UDC.

The primary goal of this study is to determine whether the installation of a green façade, constructed with a commercially available three-dimensional modular trellis system, can successfully reduce the reflected heat and light from building penthouses located at the same level as the green roof on the adjacent roof surfaces/planters. Solar insolation values and temperatures at the roof penthouse walls and regular intervals away from the wall will provide valuable data regarding the potential of the façade to impact the microclimate on the adjacent roof. By altering the density of the foliage on the green façade, the research will measure and observe whether the reduction reflected light and heat and modifications to the microclimate are sufficient to allow for the successful production of crops, such as micro greens, on the roof surface adjacent to the wall. The data will also provide information regarding the ideal density of the green façade. Further, the study will test the viability of crop producing vines in this type of installation. A series of measurements will document the magnitude and extent of microclimate modification from the green façade. Crop densities will also be measured on the adjacent green roof.

The magnitude and extent of the impact that will be determined by this study are important variables that can be used in the implementation of new green roofs, as more urban environments tackle solutions to food security. Further, by comparing the results of the two different microclimate conditions of the study sites, it may be possible to make inferences on a broader scale. The potential to ameliorate the deleterious impacts of radiant and solar gain from vertical building surfaces on adjacent horizontal garden plots is significant. Urban gardens and farms throughout urban areas - including the Urban Food Hubs being implemented across the District by UDC - will be able to benefit from the knowledge of strategies that will allow for greater flexibility in design, and maximum use of the available land. It is anticipated that the results gained from this study can be disseminated not only in research publications, but also in many of the extension activities of the CAUSES Center for Urban Agriculture and Gardening Education.

This research project was awarded near the close of FY 16. Preliminary results will be reported in the FY 17 annual report.

We currently have a student research intern involved in the project, who is conducting background research to locate similar and related studies. She is also working with the Principal Investigators (PI) and the data logger supplier to confirm that we have identified all of the necessary components for the study. Dr. Kliman, PI, is in the process of obtaining the façade system. It is currently being fabricated. Dr. Clarke, PI, is working with the company that currently maintains the green roof at the UDC site to coordinate the setup of the beds for the greens. Finally, the PIs are working to finalize the selection of plant materials to be used and order the seeds, as well as confirm the watering/irrigation design and plan.

The first year of the study was intended to be a pilot and an opportunity to resolve any issues that we might have encountered with the setup of the research sites. There was not a target audience for this first year, other than the research team.

Two presentations have been given:

- "Reducing Impacts of Solar Radiation on a Crop Producing Green Roof." Lightning Talk at the Urban Agriculture and Sustainability in the Northeast Region Conference. June 26, 2016.
- "The Potential for Reducing Impacts of Solar Radiation on a Crop Producing Green Roof, and Modifying Roof Microclimates, through the Utilization of an Adjacent Crop Producing Green Façade." Presentation for CAUSES Research Collaborations Meeting. May 24, 2016.

Both of these presentations were a description of the overall study, along with the intended results and target audience.

For our work during the next reporting period, we plan to do the following:

- Complete acquisition of materials for years one and two.
- Set up the entire study/install all necessary research components at both study sites.
- Finish background research on relevant related studies.
- Collect data over a period of at least 6 months.
- Download data for each site and begin analysis.
- Review data after the first month to determine if any modifications to study plot configurations is necessary.

Farmers Market's Impacts and Food Security, Regional Economy and Diet

Following a pilot study of the University of the District of Columbia (UDC) Farmer's Market in 2015, this three-phase, interdisciplinary research project examines and quantifies the impact of farmers markets on

food security, regional economy, and dietary behavior of residents in Washington, DC. Each phase's research is built on the previous one, with the research focus of each subsequent phase narrower than the previous one (from national to regional then to regional/low-income families). Each phase of the research project and its corresponding objectives, methods, data collection and expected outcomes are summarized as follows:

Phase I (2016-17): We will explore market relationships with food security at both the city and household level nationally. This phase will utilize public-use data and be completed through statistical analysis using a panel regression at city- and household-level on a national scale.

Phase II (2017-18): We will implement a randomized survey of 500 residents of DC and Washington DC Metropolitan Area provided through a contractor, in order to understand how people are interacting with farmers markets, as well as value and characteristics of all consumer food purchases. The survey results will used to explore local dietary habits, environmental knowledge, participation in farmer's markets, as well as to quantify farmers markets' impact on Gross Regional Product (GRP), income, and employment. Overall, this will aid us in identifying and quantifying the barriers, economic and social, to participation and utilization of local food markets in the DC region.

Phase III (2018-19): We will conduct qualitative research on low-income DC households and more clearly define policies and incentives to promote low-income communities to utilize local farmer's markets. This objective will be completed through focus group discussions and in-depth interviews of low-income families in DC.

It is anticipated that the results from this research project will be published in four separate research articles that contribute to direct-to-consumer agricultural marketing, food security and nutrition and diet literature. The research articles will be presented at academic and extension conferences, as well as disseminated to the public through CAUSES outreach activities. The survey data obtained through the project will be maintained by UDC CAUSES' urban agriculture data hub as a public accessible baseline data for regional farmers' market usage, diet and health, and food security. In addition, this research project will present a unique opportunity for training CAUSES students in survey development and implementation on a broad scale.

Farmer's markets offer a unique way for urban residents to access local, affordable, and health vegetables. Research has shown that when farmers produce for local, instead of national or global, markets, their customer base diversifies and available produce options for local residents increase (Halweil 2015). This diversification can also be good for local dietary and nutrition concerns. A case study in New York found that in local markets, farmers produced higher quantities of produce that matched dietary intake deficiencies of impoverished communities (Peters et al. 2003), while another study in 2013 indicated that helping SNAP participants participate increased low income nutrition significantly (Obadia and Porter, 2013). Our study region, the District of Columbia, is one of the fastest growing cities in the U.S. with vast disparities in socioeconomic and health status. In 2012, unemployment rates within DC vary from 3.9 percent in Ward 3 to 24 percent in Ward 8. Average family income varies from $246,528 in Ward 3 to $43,973 in Ward 8 (Neighborhood Info DC, 2016) and this disparity is still increasing.

Our research will directly addresses the Sustainable DC goals for 2032 of having 5 times as many green jobs as now, cutting city-wide obesity rate, and aiding 75% of residents in accessing healthy, local food within ¼ mile of their home. In Phase III of our research, we will focus on identifying key barriers to farmer's market participation and how economic, social, and cultural factors relate to local food access. In DC, there are broad issues to accessing fresh, healthy food, especially in underserved and low-income regions. Many of DC's low income wards have extremely high unemployment rates. Thirteen percent of all households in DC have food insecurity, five percent with very low food security (increased by 1% in the past 4 years). In 2008-2012, 30.5% of households with children in the District of Columbia indicated that

they were unable to afford enough food. This is the second worst rate in the nation, exceeded only by Mississippi (Food Research and Action Center, 2013).

Nearly 200,000 DC residents live on neighborhood blocks where the closest healthy food retailer is more than 3 times farther than the closest fringe food retailer. Nine of DC's Census tracts (with a combined population of over 34,000 people) are classified as "food deserts" where the majority of residents live more than a mile away from a supermarket (USDA ERS 2014). Most of these food deserts occur in Wards 5, 7, and 8, where 95% of the population is African-American and more than one third of households have yearly income below the federal poverty line ($22,000 for a family of 4). Black unemployment rates in DC are the highest in any U.S. State, with over 13.6% of black residents unemployed (Wilson, 2015). In 2010, 1 in 9 DC residents were classified as being in "deep poverty" or living on income half that of the official poverty level, most of whom live in Wards 7 and 8 (DC Fiscal Policy Institute 2011). These food access and unemployment issues can be addressed through local, direct to consumer produce markets. The missing part of this puzzle is how to address sociocultural and economic barriers to proliferating these markets.

Our research will work on increasing farmer's market participation and food security and ameliorating food and health-related socioeconomic issues throughout the city. Specifically, our project focuses on the NIFA goal of increasing overall food security. Additionally, our econometric study will focus on food miles and how far people must travel to get to local, fresh food locations, addressing the NIFA goal of reducing greenhouse gasses. Our research will directly address the Sustainable DC goals for 2032 of having 5 times as many green jobs as now, cutting city-wide obesity rate, and aiding 75% of residents in accessing healthy, local food within ¼ mile of their home. In particular, our project focuses on identifying key barriers to farmer's market participation and how economic, social, and cultural factors relate to local food access. Additionally, we will be conducting the broadest econometric study conducted in DC, detailing both how farmer's markets contribute to the national and local economy and how expanding markets will expand job opportunities at multiple levels. Finally, we will also be investigating the impact of farmer's markets on impoverished regions and food access, using focus groups and in person surveys.

During the reporting period, our activities included:

- Phase I: literature review and introduction conducted (not completed), national farmers' market data obtained from USDA; summary statistics on national farmers' market finished; Food security data collected and summary statistics conducted.
- Phase II: questionnaire geographic region defined.

No training was provided yet. Estimated start date for training is May 2017.

The current results are preliminary and not yet ready to be disseminated to communities of interest. Once we have more robust results, we will attend national academic conferences and community gatherings/events in DC to present the results to the related audience. The results from phases of our study will also be used as guidance for UDC to improve and expand its farmers' markets programs in order to reach out to a broader customer body, especially in the food desert areas in DC.

During the next reporting period, we plan to accomplish and initiate the following steps towards our research objectives:

- Develop questionnaire and in-depth survey instruments, obtain IRB approval for the study (Feb - May 2017);
- Hire a student assistant to start working in May 2017;

- Complete Phase I paper draft by June 2017;
- In June 2017, we will send out questionnaires to contractor to be implemented and get back by Oct 2017; and
- Collect supplementary, in-depth survey data at UDC Van Ness and East Capitol Farmers' Markets from May to Nov, 2017 and input, clean and analyze data in Dec, 2017.

This project's Phase I and II's main audience is academic and related policy makers (e.g. USDA). Phase I hypothesizes that farmers market has a positive impact on food security at both regional and household's levels. However, a preliminary statistical exploration shows that the relationship may not be significant. Possible reasons include: 1) Food security data from Current Population Survey is collected every December, a season that farmers' markets are usually off; 2) Farmers' market data (# of operation) are only available at the state level. A city or metropolitan area level study is more ideal to detect any impact; and 3) Farmers' market sale total by region are not available (or not yet obtained). The number of market operations itself is not sufficient an indicator of farmers' markets' impact. Therefore, more data sources need to be explored and added into the Phase I analysis in order to examine the impact.

The DC Sustainable Agriculture Research and Education (DC SARE) Ethnic and Specialty Crop Development Program

Our farm uses sustainable growing methods to produce a range of fresh herbs and vegetables that are rare in area supermarkets. Many of them are so-called ethnic crops that do not originate on the American continent, but can be grown locally. As defined by the USDA, specialty crops are fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops that are cultivated or managed and used by people for food, medicinal purposes, and/or aesthetic gratification to be considered specialty crops. Firebird Farm is the home for many herbs and spices from Ethiopia and several species of vegetables from West Africa. Located just north and east of the District, the farm enjoys a humid subtropical climate that allows us to grow ethnic crops. Our crops include, but are not limited to, collards, hybrid kale, hybrid pac choi, hybrid patty pan squash, hybrid smooth leaf spinach, specialty salad greens, swiss chard, mustard greens, bunching onions, red Russian kale, baby peppers and long beans.

The UDC Ethnic Crops program was established to meet the needs of the rapidly changing ethnic makeup of the region's consumers. We will look to expand upon our Ethnic Crop Program by experimenting with a few ethnic crops to determine their ability to grow in Washington, DC. Ethnic and specialty crops are in high demand in a diverse metropolitan area like Washington, DC. This is, in part, why CAUSES entered into ethnic crop production. In making these products accessible and affordable, we are helping to connect most consumers to new types of food. We are also giving native born and local immigrant populations a taste of home, right here in the Mid-Atlantic. In his position as ethnic crop development specialist, Yao Afantchao works closely with local community gardeners and advises residents how to grow and cook a variety of flavorful international menu options. This program also introduces commercial growers to expanding ethnic produce marketing opportunities. According to BBC News, the Washington, DC area has the largest population of Ethiopians in the U.S. - about 250,000 people - and is the second largest metropolitan population of Ethiopians in the world (coming second only Ethiopia's capital of Addis Ababa). There is, therefore, a sizable market for Ethiopian food products in Greater Washington.

Growing Ethiopian herbs and spices on the farm helps us to further expand our reach into this market. Ethnic produce presents a significant opportunity for Mid-Atlantic farmers as high-value alternative crops and excellent sources of income. Ethnic food products in North America account for more than 12 percent of all retail food sales, and are projected to sustain five percent annual growth. Ethnic crops grown at Firebird Farm during the reporting period include: gboma (African eggplant), sawa sawa (edible flower), jamma jamma (huckleberry), avuvo (broad leaf vegetable), kitely (a cross between a tiny eggplant and green tomato, Scotch Bonnet (hot pepper), jute leaf (similar to okra), and waterleaf (much like greens).

The main objective of the DC Sustainable Agriculture and Education Program (SARE) Ethnic Crops is to develop an educational outreach program that will train and sustain urban food producers in the District of Columbia. We developed a "Train the Trainer" program for an Agriculture Extension Educator/Advisor who will share information with growers across the Washington Metropolitan (District of Columbia, Virginia, West Virginia) for the best sustainable practices in growing ethnic crops in order to satisfy the growing demand of ethnic crops, especially in growing and diverse immigrant population of the region.

During the reporting period, 15 individuals (9 males and 6 females), representing 8 countries, including the United States, signed up for the Hands-on Ethnic Specialty food training to learn about food production, processing and eventually value addition and marketing to the Washington DC metro area. Due to logistical constraints, instead of providing training at three (3) separate individual lots as planned, the food producers were each assigned their own plot at the UDC Firebird Farm and they would share information and products with their constituents in the District of Columbia, Maryland, and Pennsylvania. Hands-on training about the production process was provided and two workshops were organized: 75 participants including trainees, farmers, entrepreneurs, restaurant owners, and African and Caribbean grocery store owners attended the workshops to learn about ethnic food production, processing and cooking as well as opportunities in the Washington, DC Metro area. Five new small holder farmers or landowners expressed interest in the production of ethnic crops in the Washington DC Metro, provided it is commercially viable.

With the help of labor provided by 60 volunteers, the DC SARE Ethnic Crops project harvested 6000 lbs. of fresh ethnic vegetables, which were distributed among trainees, their respective communities, volunteers, and African and Caribbean retail stores to test marketability and demand for the harvested ethnic crop. Through five (5) presentations and guided tours of the African Ethnic Vegetables program, we reached about 1200 individuals who also received booklets and manuals about how to begin their own gardens or join the African Ethnic program as producers for the market.

Aquaponics System and Crop Production at Firebird Farm

Urban agriculture has been defined as the cultivation of crops and rearing of animals, including aquaponics, aquaculture and urban forestry, within and surrounding the boundaries of cities. The Center for Urban Agriculture and Gardening Education (CUAGE) focuses on a multifunctional approach to food production activities, as well as herbs, medicinal and ornamental plants for home consumption and for the market. CUAGE contributes to fresh food availability of urban dwellers, as well as to the greening of the nation's capital and teaches the productive reuse of urban waste. CUAGE will seek global relationships in urban and peri-urban agriculture. In developing countries, urban agriculture is recognized for the provision of local food, as well as recreational, educational and social services. An important aspect of urban and peri-urban agriculture is that it provides income and employment and contributes to local economic development, poverty alleviation and the social inclusion of the urban poor and women. CUAGE describes this system as urban agroecology.

An aquaponics system is a process of growing fish in a tank. Aquaculture is known as fish or shellfish fish farming that refers to breeding, rearing and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes and oceans. Aquaculture includes the production of seafood from hatchery fish to shellfish which are grown to market size in tanks, ponds, cages and raceways. It also includes productions of ornamental fish for the aquarian trade and growing plant species used in range of food, and pharmaceutical, nutritional, and biotechnology products. If you connect the fish tank water (fish waste) to water a hydroponics system, plants get an automatic food supply of almost everything they need to grow from the fish water and in turn the plants filter the water for the fish. The fish waste from the tank helps to grow different vegetables and/or crops organically. Plants grow fast because they get rich alive nutrients.

We have implemented aquaponics systems in two greenhouse facilities at the Firebird Farm. There are two 500 gallon water tanks in one greenhouse and two 300 gallon tanks in the other greenhouse. The

farm grows tilapia species. There are approximately 300 tilapia in both tanks of the aquaponics system of the farm. The fish weigh approximately three pounds each. Demonstration activities were conducted with stakeholders to include a crop harvest festival day at the farm. We continue investigations and experiments on crop production, infrastructure and maintenance of this sustainable method of food production for the District of Columbia and other urban areas.

Raised beds and pots with rocks/pebbles were prepared in one aquaponic system at Firebird Farm. Different crops were planted in raised beds and in pots filled with pebbles and rocks for demonstration. Fish waste was used to water and grow the crops. Vegetable seedlings planted in the raised bed (soil) performed much better than the vegetables planted in the pots filled with small rock/pebbles - oak leaf lettuce, collard greens, peppers, mustard greens, and kale. There were several improvements made to the aquaponics system on the farm. Gutters were installed in the larger aquaponics system with an automated water system, whereas four troughs were installed in the smaller aquaponics system.

Testing Varieties of Strawberries for use in Urban Agriculture
The urban population of the world has grown rapidly, from 746 million in 1950 to 7.2 billion in 2014. Within the United States, the Northeastern region is the most urbanized. Even within this heavily urbanized region, Washington, DC is notable because it has a population density greater than any state in the country and continues to grow by 1,000 residents per month. Supporting this population growth in a sustainable way is a primary challenge for Washington, DC, in part, because land for agriculture becomes increasingly removed from the city center, reducing access to locally grown food. Further complicating sustainable development and food production within the metropolitan Washington, DC area are the changing climatic conditions which increase severe weather events such as heat waves and deluges and alter normal temperature and precipitation cycles. In 2016 we initiated a pilot project to explore improving food security as a mitigation strategy against the negative impact of climate change and regional population growth on food production. Specifically, we grew six varieties of strawberries on three green roofs to determine which varieties were the highest performers in urban agricultural production.

Land devoted to "urban agriculture" has increased dramatically in recent years. Despite the increase in land devoted to urban agriculture, demand for land in Washington, DC is high, which drives up costs for land and makes it difficult for urban agriculture to be profitable. To overcome these spatial and economic barriers, urban agriculture has expanded in green spaces, backyards, abandoned land and buildings, and on rooftops.

Urban agriculture faces the additional challenge of extreme climate variability, especially in the form of heat waves and elevated nighttime temperatures (i.e., urban heat island effect). The Washington, DC area is expected to experience an increase in temperature and precipitation. Despite the predicted increase in overall precipitation, this precipitation is likely to be increasingly in the form of severe deluges instead of more evenly distributed precipitation events. This can result in direct damage to crops and indirect damage through flooding or even drought-like conditions in interim periods due to an increase in evaporation caused by higher temperatures. Major row crops, such as wheat and corn, have never been particularly well-suited for production in urban environments, but are expected to be especially hard-hit by climate change. Their yields are anticipated to decline as temperature increases.

We initiated variety trials with strawberries because of their high nutrient content and because of a collaborative project that was initiated with the Beltsville Area Research Center (USDA-ARS). Dr. Kim Lewers, a Research Geneticist from the USDA-ARS, specializes on strawberries and teamed with Dr. Matthew Richardson (UDC) to supervise an undergraduate research project. The six varieties used for this project were Sweet Ann, Seascape, San Andreas, Portola, Albion, and Monterey.

We used three study sites: 1) the 1,858 m^2 green roof on UDC's Van Ness campus, 2) the green roof on Thomson Elementary School in downtown DC, and 3) the green roof on Alexandria's Fire Station. Each of

the six varieties were planted in three randomized complete blocks on UDC's green roof. UDC's green roof has 117 planter boxes around the perimeter and each box has a surface area of 0.9 m^2. Within each randomized complete block, each variety was planted in one box. The blocks were positioned on three different sides of the building to incorporate varying environmental conditions due to microsite. Within each box, we planted three individual slips. These individual plants were subsamples and each planter box was the individual sample (i.e., replicate). On the other two green roofs, three of each variety were planted in individual 2-gallon pots (N = 18). The positions of these plants were randomized.

When plants started producing berries, we weighed the yield from each plant twice per week, separating the marketable yield from the damaged, diseased, and unmarketable yield. The marketable yield was scored using a 1-9 scale, which was developed by the USDA and takes into account anything that reduces the visual appeal of the crop.

The reliability of the data during the pilot study was compromised by a late planting date, mortality of plants, turnover in the undergraduate research position, vertebrate and invertebrate pests, and inconsistent scoring of the harvested strawberries. However, the plants that did survive had a relatively high yield and demonstrated that the plants can thrive in hot rooftop environments. The experiment will be repeated in 2017 and 2018 and measures will be put in place to ameliorate the problems that affected the study in 2016.

Biological Control of the Harlequin Bug
The harlequin bug (Murgantia histrionica) is a stink bug and a major pest of crops in the plant family Brassicaceae, which includes important vegetable crops such as cabbage, turnip, broccoli, cauliflower, and many others. The bug is especially prevalent in urban areas that use hoop houses to grow crops because food for the bug is potentially present year-round. There are no known natural enemies of the bug, although parasitoids have not been thoroughly studied. We partnered with an Entomologist at the USDA-ARS's Beltsville Area Research Center (BARC) to direct an undergraduate research project in 2016. The major objective of the project was to determine whether parasitoids are an important cause of mortality of eggs of harlequin bug.

Harlequin bugs were reared on collard greens in a laboratory at BARC to ensure a supply of fresh eggs. Sentinel egg masses were deployed at BACR, two urban agriculture locations in Washington, DC with known populations of harlequin bug, and two urban agriculture locations in Washington, DC with no known populations of harlequin bug. Eggs were deployed twice for 72 hours at each location and attached to crops in the Brassicaceae and woody or non-host plants. At all locations we also deployed fresh eggs in the field in mesh bags to prevent parasitoids from accessing them. The eggs in mesh bags helped determine the percentage of non-viable eggs. At all locations traps plants (collard greens with harlequin bug pheromone lures) were deployed at the same time as eggs to determine local presence of harlequin bug. After 72 hours, eggs were collected from field locations and held in the laboratory for approximately four weeks, parasitoids were collected, and evidence of parasitism was noted to derive totals for the number of parasitized eggs.

A low level of parasitism by wasps was found across the six field sites: 11 Trissolcus euschisti and 4 Gryon pennsylvanicum were identified. From this low level of parasitism, we believe that parasitoids are not an important cause of mortality of the harlequin bug. However, the wasps may be incorporated as part of an integrated pest management strategy to control harlequin bug. We are continuing the research in 2017 to determine the cues the wasps use to find their host. This work will be done in the laboratory using an olfactometer as well as in urban agriculture systems.

Extension

From consuming produce that is tastier and higher in nutritional value to decreasing CO2 emissions by

harvesting as locally as your backyard, District residents are all "a buzz" about the many benefits of local food production. Urban agriculture has caught on, and unlike large-scale intensive agriculture operations, urban agriculture utilizes comparatively smaller spaces while focusing on diversified, edible crops. Many residents already subsidize what they buy at the grocery store through community garden plots and by growing in their backyards, yet are in need of technical assistance with issues ranging from cultivar selection and planting dates to fertilizing, soil contamination, and integrated pest management. Alternately, other District residents don't have access to grocery stores, let alone yard space or a nearby community garden in which they can grow their own food.

The Cooperative Extension Service works with District residents on both ends of the spectrum. We provide technical assistance to the established gardeners, and also help the up and coming gardeners start their own gardens by providing free consultation, connecting them with available resources, and providing technical assistance. Some of the activities for fiscal year 2016 include offering workshops; demonstrations; site visits; presentations and providing technical assistance to District residents through phone, email, and in-person consultations.

DC Master Gardener Program
The DC Master Gardener Program was started as a means of extending the horticultural and pest management expertise of University of the District of Columbia Extension to the general public. The program is designed to train volunteer horticultural educators for the University of the District of Columbia Extension- the principal outreach education unit of the University of the District of Columbia. Participants receive 45-50 hours of basic horticulture training and then agree to work in their communities to teach District of Columbia Residents how to cultivate garden spaces and manage landscapes sustainably using research-based information. This environmental horticulture approach reduces fertilizer and pesticide use resulting in improved soil and water quality.

Benefits of the Master Gardeners Program for communities:

- Enjoy a healthier environment by reducing fertilizer runoff into our watersheds and the Bay.
- Save money and reduce health risks by minimizing use of toxic pesticides.
- Improve soils and save landfill space by composting yard waste.
- Reduce water use through horticultural practices.
- Create beautiful and ecologically sound landscapes for local conditions.
- Learn ways to provide habitat for native wildlife and beneficial insects.
- Teaching the benefits of home food production and developing skills and knowledge in growing food, managing community gardens, or contributing to food banks or kitchens.

In FY 16, 198 (which includes 47 trainees) Master Gardeners and Trainees provided 6,000 hours of horticultural expertise to the District of Columbia. The value of volunteer time is $38.77 per hour according to www.independentsector.org with a total value of $232,620.00 in savings to the District of Columbia. Forty-seven (47) Master Gardener Trainees completed 50 hours of basic horticulture training, a final exam and 50 hours of volunteer hours. Various Master Gardener projects through all eight wards have been established which includes the UDC Food Hubs, schools, parks, beautification projects, landscape design, youth gardens, local and national botanical gardens, and partnerships with non-profit organizations. Here are the highlights and success stories:

Master Gardeners volunteered 600 hours to the success of the Ward 3 Food Hub (green roof/greenhouse). The value of their volunteer time is $23,262.00 in savings to the university. Their duties included propagation of vegetables and companion plants, planting, maintenance, and harvesting. 2,340 lbs. were harvested and donated to the following: food banks (1,000 lbs.), UDC Center for Nutrition, Diet, and Health (500 lbs.), East Capital Street Farmers' Market (500 lbs.), and volunteers (340 lbs.).

1/3 of Master Gardeners continue their education in horticulture related field and obtain employment.

At UDC/CAUSES, we partner with local organizations such as Bread for the City to promote local food and nutritional security. Bread for the City tends and manages the City Orchard on UDC's Firebird Farm. All of the fruit is donated to feed their constituents--the vulnerable residents of DC who rarely have access to fresh fruit. The farm also donates produce to groups that feed underserved populations like DC Central Kitchen. Partner organizations bring volunteers to Firebird Farm and regularly pick-up produce from the farm.

Urban agriculture is a global and growing pursuit that can contribute to economic development, job creation, food security, and community building. It can, however, be limited by competition for space with other forms of urban development, a lack of formalized land use rights, and health hazards related to food contamination. The use of green roof technology in urban agriculture has the potential to alleviate some of these problems, without adversely affecting the benefits provided by urban agriculture. It would not only enable the use of land for development and agriculture, but may facilitate the formation of formal space and water use agreements and enable redistribution of ground level resources among urban farmers. This could decrease the use of contaminated land and water at ground level and alleviate health concerns.

During the reporting period, we have continued to work diligently and purposely to continue to build capacity for expanded research in aquaponics, sustainable agriculture, ethnic crops and specialty crops at our research farm in Beltsville, MD. At Firebird Farm, our goal is to research and test techniques in sustainable and organic agriculture and to apply them to an urban agricultural setting in DC communities.

3. Health, Nutrition and Childhood Obesity

Research

Changing the Health Trajectory for Older Adults through Effective Diet and Activity Modifications
Midlife and older adults comprise the fastest growing population segment in the U.S. Baby boomers, who make-up much of this population shift, have higher rates of obesity, chronic disease and disabilities than previous generations. Older adults are at higher risk of developing arthritis, sarcopenia, diabetes, hypertension, hypercholestrolemia, age-related mascular degeneration, and cardiovascular disease (CVD) than younger adults. These conditions that are associated with disabilities, compromise physical capacity and loss of independence but are preventable by diet or/and physical activity, providing the basis for the proposed work of this transdisciplinary team. Adults make daily choices without being aware of how that seemingly, inconsequential decisions may impact their health. Numerous biological, environmental and behavioral risk factors influence an individual's daily health choices. To better understand the factors influencing age-related diseases and health-promotion in midlife and older adults, this multistate research project will examine: (1) environmental factors influencing the adoption of health-promoting lifestyle changes and (2) evaluation of lifestyle interventions that lead to measurable outcomes. The projects under each of these study areas, either directly or indirectly, address overweight/obesity and chronic disease reduction in midlife and older adults.

The major goals of this project are to: 1) identify biomarkers of successful aging and the impact of diet/physical activity on these biomarkers throughout the life cycle; 2) examine the community environment, including its traditions, culture, and beliefs, and how it can be used to promote healthy eating and successful aging; and 3) examine the effectiveness of novel interventions in influencing/promoting the attainment of a healthy weight via increased fruits, vegetables, and grains intake and physical activity for successful aging.

During the reporting period, we accomplished the following:

1. Created the survey instrument to identify the barriers for consuming a healthy diet high in whole grains, fresh fruits and vegetables in wards 5, 7 and 8 in Washington DC.
2. Pilot tested survey in collaboration with the Institute of Gerontology, University of the District of Columbia to ten participants.Volunteers fit the age requirement, and were not required to reside in the target wards. After administration of the survey, many participants provided feedback that included: some were uncomfortable providing income information; some questions were similar and seemed repetitive; the survey was a bit too long; some open ended questions were difficult to respond to; and some questions were not specific enough.
3. Based on the feedback, the survey instrument was revised and improved.
4. Pursuant to revision of the survey instrument applied for the University of the District of Columbia, IRB approval was received on April 6, 2016.
5. Pursuant to IRB approval the student research assistants began communicating and visiting church leaders, congregate site directors and housing complexes to recruit participants to administer and complete the survey. This effort culminated in acquiring six (6) potential sites in wards 5, 7 and 8 that were willing to collaborate and participate in this research effort.
6. Project leaders contacted key informants from each site to obtain socioeconomic and demographic information about the people served by their organizations, and advised the research team on methods of recruiting participants.
7. The research assistants and the PI and Co-PI met with the groups in each site and oriented the participants regarding the purpose, objectives and methodology for completing this critical research.
8. Upon orientation, the research assistants have administered the survey to 57 participants. The survey was administered by the student interns in face-to face mode, so that they could answer any questions from the participants and gather valid data.
9. The goal of NE-1439 is to survey 125-150 participants and the student interns are currently continuing to administer the new version to participants and will continue until the goal is reached.
10. The student interns are also trained to upload all the collected data to Excel spreadsheets for analysis.

The PI, Dr. Ganganna, presented the updated report on NE-1439 at the Multi-state Annual Meeting in Rhode Island on June 8th, 2016 and presented her research for the College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES) during the college meeting. The NE-1439 research was presented for the research group of CAUSES in October of 2016.

Our research efforts are focused on volunteers from wards 5, 7 and 8 in the age group of 49-85. The survey will also focus on grandparents who are responsible for shopping, preparing meals and taking care of grandchildren dependent on them.

Since the project is still on-going, the preliminary results have not been disseminated to communities, as the gathering data and analysis is not complete.

During the next reporting period, we plan to accomplish our goal of gathering demographic data; food frequency information; and perceived physical and architectural (building designs and/or configurations that prohibit easy access and movement) barriers to healthy food choices and other inquiries that are intended to identify potential cultural and attitudinal barriers to healthier eating. Organizing focus groups will be planned and instigated. Focus groups are intended to collect qualitative data regarding barriers to healthy food access and healthy eating. Focus group leaders, in coordination with the principle investigator and the statistician of the project, will develop a guide for group discussion. The guide will elicit: participants' abilities to purchase fresh fruits, vegetables, and whole grains; grocery shopping behaviors; perceived barriers to accessing fruits, vegetables, and whole grains; perceptions regarding

physical conditions including physical activities; and suggestions for improving accessibility and affordability. Moreover, the guide will elicit cultural, community, and social factors that influence dietary choices and behaviors. Focus group templates will be constructed and research assistants will be trained as focus group leaders. Additional qualitative data will be gathered from focus groups. It is intended that this technique will reveal more details than the survey data regarding opinions, beliefs, and attitudes towards foods and food choices. Transcripts will be produced for each group session.

Parental Practices Supporting Positive Eating Behaviors during Independent Eating Occasions Among Early Adolescent Children

It is necessary to further explore the impact of parental practices and its effects on early adolescent eating behaviors during independent eating occasions. In the first phase, formative qualitative research methods will be used to explore the behaviors around independent eating occasions among adolescents, including the extent to which they report how parents' rules, expectations, modeling and availability of foods influences their choices and behaviors. Among parents, we will seek to identify the extent to which they are aware of the food choices and behaviors that their children make while they are eating independently. This data collection aims to understand the phenomena of eating related parental practices; how parents are motivated or impeded in practicing them, how they are successfully implemented, and if children's eating is impacted positively when parents utilize various positive practices. In objective two, quantitative methods will be employed to identify associations between parental practices and food and beverage choices, eating behaviors, and weight among early adolescents with attention to examining independent eating occasions. An appropriate, validated instrument does not currently exist to measure these associations; therefore, we need to develop and test a questionnaire to determine which parental practices should be promoted. Results from objective one and two of our study will provide a broader understanding of the influences that determine the frequency of positive parental practices and the effects of these practices on obesogenic behaviors of early adolescents. These findings will allow us to identify realistic strategies and motivators in order for parents to promote positive practices. Ultimately, sharing how best to influence early adolescents' eating behaviors and particularly those when the parent is absent would be valuable in trying to shape healthful food intake among early adolescents to prevent obesity.

The major goals of this project include:

Objective One - Explore and identify key parental practices (role modeling, making healthy foods available, and setting rules/expectations and other practices) that may impact eating behaviors and food choices during independent eating occasions and weight among low-income, multi-ethnic early adolescents.

Objective Two - Examine the association between key parental practices and positive eating behaviors during independent eating occasions among low-income, multi-ethnic early adolescents.

During the reporting period, data collection for objective one was completed with three African American girls and two boys and their mothers. The data is being coded on an excel spreadsheet and will be uploaded to the project Dropbox prior to the annual meeting in March 2017. The project provided training for two nutrition students. Both students were involved in data collection and all aspects of the project. We are currently moving into the analysis of data. The target audience for this project includes African Americans.

Plans for the next reporting period include the development of protocols to be used for data collection for objective two and manuscript writing for objective one.

Extension

Over the past 30 years, obesity rates among children and adolescents have almost tripled throughout the United States. An estimated 17% of children and adolescents aged 2-19 years are obese. The Healthy

People 2010 goal of 5% obesity among children was not met. Obesity in children is defined as a BMI greater than or equal to the age-and sex-specific 95th percentiles of the 2000 CDC Growth charts. Childhood obesity is associated with an increased risk for developing type 2 diabetes, high blood pressure, sleep apnea, and high blood cholesterol www.cdc.gov/nchs/data. Children who are obese are also more likely to become obese adults, further increasing their risk for obesity related diseases, including heart disease and certain cancers. Obesity rates have affected low-income children at a disproportionate rate. Data published from the 2009 Pediatric Nutrition Surveillance System study showed that almost one third of the 3.7 million low-income children aged two to four years old were obese or overweight. Obesity in low-income children ages two to four years old has increased in the District of Columbia, from 10.9% in 1998 to 13.3% in 2008 (Center for Disease Control, Morbidity and Mortality weekly report, http://www.cdc.gov/mmwr) with more boys being obese as compared to girls.

The Center for Nutrition, Diet and Health (CNDH) programs and activities address two priority areas of the USDA National Institute of Food and Agriculture (NIFA): 1) to combat childhood obesity and other food related illness; and 2) to improve food and water safety. Our program objectives follow:

- Expose participants to evidence-based guidelines for age-appropriate nutrition and physical activity.
- Educate participants on meal planning strategies to increase consumption of fresh fruits and vegetables, whole grains, healthy proteins, and dairy or high-calcium alternatives.
- Demonstrate healthy cooking skills through modified techniques in food preparation.
- Teach food and health literacy skills.
- Provide instruction on safe food handling and storage techniques.

FY 2016 events and associated program activities included:

Food, Nutrition, and Health Fairs
On a monthly basis, CAUSES-CNDH provides nutrition education and health promotion materials, healthy recipes, and food demonstrations for annual health fairs. In FY 2016, CNDH lead a Snack Remix event for patient families of the Pediatric Center at Family and Medical Counseling Services in Ward 8, a kid-friendly fair of healthy food samples and their corresponding recipes. Other features included partnerships with sponsors such as Giant Foods and Trader Joes, and fresh produce basket giveaways. Furthermore, CNDH staff provided healthy food samples, informational materials, and consultation to indirect contacts at other annual events such as the NBC4 Health and Fitness Summit in January, Anacostia Elementary Campus PTA Fair for children and parents in February, a Food Summit hosted by Capital Area Food Bank in April, and "Health Beyond the Pews" for the faith-based Leadership Coalition for Healthy Communities in June.

Nutrition Education in the PreK-12 Classrooms
Research shows that children who have access to enough food and children who eat healthy perform better in school and have the ability to concentrate more effectively than children who do not. The nutrition educator performed monthly nutrition lessons for preschool children in three child development centers and one elementary school. Throughout the month, teachers were provided with gift cards for healthy food activities and curriculum tools to reinforce the learning goals and objectives in-between sessions conducted by the nutrition educator. One component of USDA's MyPlate and food safety served as a primary theme each month.

WeCan @ Unity Healthcare
CNDH has an ongoing partnership with organizations that provide alternative prescriptions of a monthly supply of fresh and local produce to food assistance patients on the condition of their commitment to weekly attendance to group exercise and nutrition education classes. The CNDH Nutrition Specialist

facilitated the nutrition education group sessions at a Unity Healthcare clinic on a bi-weekly basis. Participants learned food and health literacy skills, provided feedback on their challenges and progress in a supportive environment, and were exposed to various methods for preparing the fresh produce they received. Upcoming steps in progress include their participation in an evaluation plan based on a USDA Specialty Crop Block Grant awarded to CAUSES-CNDH this year. This project aims to evaluate the impact of various exposure levels to nutrition resources (FV Rx/CSAs, recipes and produce guides, food demonstrations, and nutrition classes) on recipe usage and fresh produce consumption among clients receiving any form of federal or charitable food assistance. Through a community-based participatory model, clients of these services and stakeholders will be involved in providing input and consultation on modifying these resources in ways that are understandable and relatable to them.

SMART Nutrition for Senior Residents

"SMART Nutrition" is an acronym for Safe, Manageable, Affordable, Relevant, and Tasty nutrition geared toward senior residents. These group sessions, held at the Bernice Fontaneau Senior Wellness Center in Ward 3, were designed to give senior citizens practical healthy aging and chronic disease prevention strategies with a sustainable food, nutrition, and physical activity emphasis. Participants engaged in interactive nutrition education, healthy food budgeting, cooking demonstration, and food safety activities. The adapted evidence-based Eat Smart, Live Strong curriculum for older adults and the Food Preparation/Nutrition Education component of the UDC Urban Food Hubs Model served as the core foundation to the group sessions. Future directions for SMART Nutrition will be the development of a train-the-trainer 15-credit Community Nutrition and Wellness land-grant certificate program. This will be a merge into further expansion and capacity-building for the Urban Food Hubs through the accomplishments of Bridge Park below.

11th Street Bridge Park - Community Nutrition and Wellness Training

The east side of our nation's capital is plagued with disparities in health, economics, and the built environment. Our highest income Ward (Ward 3) has access an array of grocery stores, upscale restaurants, and attractive run/walk/bike paths within a one to two mile radius. On the contrary, Wards 5, 7, and 8 have limited grocery stores (four in Ward 5, three in Ward 7, and one in Ward 8) and safe open play spaces within walking distance according to the DC Office of Planning of the Government of the District of Columbia. The UDC-CAUSES initiative with 11th Street Bridge Park aims to increase the capacity and access to healthy fresh food and open spaces for physical activity to Washington DC residents dwelling along the Anacostia River within Wards 6 and 8. Through ongoing stakeholder engagement and grant-funded resources with this partnership, the design of local garden spaces was achieved in addition to urban agriculture training opportunities for faith-based community partners. Subsequently, the missing piece to this puzzle was, once a food dessert community achieves greater access to fresh produce, that accomplishment alone does not always translate to a willingness to conform to adequate consumption of these foods. This presents a unique challenge when individuals have had limited exposure to garden-fresh non-convenience foods. In an effort to bridge the gap between healthy food access and lifestyle behaviors, the Bridge Park Community Nutrition and Wellness Trainings was developed and led by Dr. Tia Jeffery, a registered dietitian/nutritionist and project specialist for the Center for Nutrition, Diet, and Health (CNDH), and Kayla Rodgers, George Washington University MPH candidate and certified personal trainer.

This component of the program envisions an active community empowered with skills to take ownership of their health by living independently, free of limitations associated with obesity and preventable chronic diseases. We aim to give the underserved communities in the District of Columbia the proper tools to understand the benefits of nutrition and physical activity on health and well-being. Furthermore, this training provided a supportive environment conducive to improving eating and lifestyle behaviors, healthy food preparation skills, and engagement in the recommended amounts of physical activity. During the summer months prior to implementation in the fall, we engaged in meetings with input from faith-based stakeholders and community members on a bi-weekly basis.

Bi-monthly workshop sessions were held at Union Temple Baptist Church and Wayne Place Transitional Facility (Far Southeast Family Strengthening Collaborative, LLC) from mid-September to early December. Approximately 10 transition living participants regularly attended Wayne Place sessions and 15-20 faith community participants regularly attended the sessions held at Union Temple. The series kicked off with health and body composition screenings conducted by Yusef Battle, an Exercise Physiologist and owner/founder of the Fit Solution, Inc. in the Greater Washington DC metro area. Participants gained insight on their "health numbers" and how those numbers could impact their risk factors. For instance, Body Mass Index (BMI) is often the most convenient method for assessing obesity risk although the results are not based on where the body fat is predominately located. However, the comprehensive body composition assessment allowed participants to see and understand their distribution of muscle to fat tissue, the influence of diet and exercise on the distribution ratio of muscle to fat tissue, and how results could impact their metabolism, heart disease, type 2 diabetes, and cancer risk regardless of the numbers on the scale.

The remainder of the sessions engaged participants in holistic health, nutrition education, especially as it relates to spiritual healing, healthy cooking demonstrations, and fitness demonstrations as well as pre and post-tests of physical activity concepts. This program encouraged participants to set measurable goals and make informed decisions about their eating habits and other lifestyle practices. Topic themes included "Assessing Health Risk" "The Real Foods of DC (Fresh produce emphasis)," "Lean Proteins and Clean Fats," "What's Sleep Got to do With It," and "Deceptions...from the Garden of Eden to the Supermarket." Participants were especially engaged in the hands-on food demonstrations that provided individuals with creative preparation techniques for their urban garden fruits and veggies, often commenting that they began using the recipes at home as a useful tool and they expressed interest in obtaining other CAUSES-CNDH certifications such as safe food handling. "I enjoyed the healthy cooking demos, they were practical with simple ingredients, and quick preparation ideas," stated one faith community member of Union Temple Baptist Church.

Our next steps will build upon the health trainings accomplishments with the 11th Street Bridge Park faith community partners and beyond. This holistic approach aligns with the evidence-based connection between health and healing with spirituality. With wider capacity, a participatory certificate training plan will mobilize the congregation to lead in mobilizing their local communities as health promotion sites. Our goal is for underserved residents to have direct access to these resources and continued collaboration efforts with local partnerships that position us to empower our community to make informed decisions about their lifestyle choices.

UDC's Farmers' Market

Operated by the CAUSES Center for Sustainable Development and Resilience (CSDR), on every Saturday at the Van Ness Campus from May to late November since 2013, the UDC Farmers' Market brings local, fresh, and sustainable produce to Ward 3 residents and beyond. The economic impact of the farmers' market goes far beyond the sales value because the local spending causes a larger multiplier effect throughout the economy that will stay local, compared to the spending that happens at grocery stores. Using the Sticky Economy Evaluation Device (SEED) methodology, it is estimated that UDC Farmers' Market in 2016 market season (mid-May to late-November) has an annual combined economic impact of $432,717 in the District of Columbia's economy.

Operating 26 days per year, the UDC Farmers' Market is estimated to enjoy gross annual receipts of $140,600. The CSD evaluation team also learned through its survey that the UDC Farmers' Market attracts approximately 300 shoppers per market day, which results in an estimated annual attendance of 7,500 shoppers. The impact of this public market comes in three major perspectives: a) vendors, b) nearby businesses, and c) a region's economy through local and state taxes contribution. In addition, core market statistics such as shopper frequency, geography and important demographic details, as well as suggestions for improvement are captured in our survey.

The UDC Farmers' Market is located on the west side of the Avenue in front of the UDC Law School at 4340 Connecticut Avenue, NW, 20008. It manages 1,600 sq. ft. of space with eight vendors. The vendors pay an annual fee of $150 to the CAUSES and their produce comes from farmers in 100 miles radius from the market. The main objectives of UDC Farmers' Market is to provide convenient access to fresh produce, to enhance social engagement, to enrich the community with useful knowledge that they can incorporate in everyday living and to improve the local economy by providing a useful source of income for many local farmers.

We are also responsible for making sure that every vendor is in compliance with the Market's rules and guidelines as well as the regulations of the United States Department of Agriculture (USDA). As part of the mission of the Land-Grant University, we are responsible for providing access to the market to low-income areas as well as educating the local community.

We total the economic benefit to vendors, nearby businesses, and the local community and multiplies the total by a number (called a Regional Input-Output Modeling System II multiplier, or RIMS II multiplier) calculated by the Bureau of Economic Analysis (BEA) or estimated in light of comparable BEA multipliers. This multiplier captures the impact of an initial round of spending plus successive rounds of re-spending the initial dollars within the District of Columbia and the Washington DC Metropolitan Area. The greater the interaction each dollar has with the local economy, the larger the multipliers are (and the "stickier" the economy is).

In 2016, UDC Farmers' Market is estimated to have brought the District a total economic benefit of $432,717 (Projected gross annual receipts at businesses near the market ($140,600) + Projected gross annual receipts at businesses near the market ($170,760) * DC multipliers, $44,220 personal income and one and half full-time equivalent job across all sectors. UDC Farmers' Market is estimated to have brought the Metropolitan Area a total economic benefit of $546,707, $167,557 personal income and six full-time equivalent job across all sectors.

The benefits that a farmers' market brings to the economy and community goes beyond monetary impacts. Socially, the UDC Farmers' Market provides a new common ground where people easily interact with social activity and increases the sense of community. Nutrition information about food sold at the market and cooking instructions are distributed and cooking demonstrations are provided by UDC land-grant program staff at the UDC Farmers' Market.

Environmentally, farmers' markets promote local transactions which minimize the food mileages and carbon footprint, and maximize the nutrition contents of the produce. According to our interviews with the vendors, produce sold at UDC Farmers' Market come within 103 miles radius, compared with nearby Giant's produce coming from 1100 miles radius. Serving as the food distribution platform, UDC Farmers' Market is an essential component for the CAUSES Urban Food Hub system and promotes healthy diet and lifestyle. It's social, environmental and educational benefits will be our next steps in the evaluation work.

Laura Lukes, Patron - "I come to the UDC market every Saturday. There is a huge variety of fresh produce, and very affordable, too, over regular supermarkets. I make my baby fresh food with the different vegetables. I'm devastated the season is ending!"

Farmer's Market at East Capitol Urban Farm
A significant portion of Ward 7 of Washington, DC, is considered food desert. This area of the District also ranks high in prevalence of poverty, obesity, and other health complications. Youth and adults are disconnected from convenient access to fresh and healthy, locally grown, produce.

In response to this, UDC CAUSES launched a Farmer's Market in this food desert at East Capitol Urban Farm. Over 3,000 pounds of local produce was offered at the market with over 500 pounds donated to DC Senior Citizens in the neighborhood. These senior citizens are housed by the DC Housing Authority. We are currently tracking the change in the behavior. We expect results in May 2017.

11th Street Bridge Park Community Gardens
Part of Wards 6 & 8 of Washington, DC, is considered food desert. UDC CAUSES, in partnership with the 11th Street Bridge Park project, launched eight community gardens with over one hundred 6' x 8' garden spaces on the property owned by and in partnership with faith-based communities. Approximately 67 people participated in urban agriculture training that included: food sourcing in the urban environment, food preparation, distribution, and resource recovery. The result is access provided to locally grown produce to over 100 families in these Wards. The initiative also increased awareness of urban agriculture and food & nutrition. UDC CAUSES is measuring change in behavior. Results should be available in May 2017.

4. Urban Families, Youth and Communities

Extension

4-H Clubs engage young people, ages five through eighteen, in developing knowledge, skills and attitudes that will enable them to become self-directing, responsible, productive citizens, and contributing members of society. The 4-H program educates youth in arts and sciences, health and fitness, science, technology, environmental science, math, sewing and fashion design, cooking and healthy eating and a host of other subject areas while encouraging fellowship and service opportunities. 4-H continues to develop new projects for its members to study beyond agriculture and animal husbandry, including photography, conservation, cooking, public speaking, various sports, history, art, and other pursuits.

During this reporting period, the UDC CAUSES 4-H program saw a year of progress, restructuring and increased volunteer engagement.

We moved from a team of three to a team of two, and we learned to give our volunteers more responsibilities to help us grow and maintain programs. We began the program year with 60 4-H clubs, and six major specialized 4-H programs. Our 4-H Nutrition Education program (food safety, security and nutrition), 4-H LifeSmarts program (sustainable energy, water quality and climate change), 4-H Soccer Program (Childhood Obesity), the Camping Program and our Military Partnerships Program are all programs that continue to engage youth in our primary NIFA goals. We continued to introduce STEM Education activities in new and different formats. We were able to serve 3,377 youth during this reporting period.

For the last two years, we have worked with UDC CAUSES professor Dr. Michelle Harris in the Department of Nutrition and Dietetics to send college students into the classroom for a minimum of six weeks to present programming to children about nutritious eating, exercise, food security, and food safety. The college students were given a stipend of $30.00 a week, as needed, for demonstrations and additional program materials.

Five schools participated and 150 youth were provided programming. Some college students went beyond the six week class mandate because they became attached to the feedback from the children. College students were advised at the beginning of the semester that this program would account for 30% of their classroom grade. There is a request to expand the program from teachers and we are looking for additional funds.

Soccer Program
Addressing childhood obesity takes many forms in CAUSES. Our UDC 4-H CAUSES Soccer program

engages youth in three age categories in learning about healthy eating, exercise, using the Health Rocks curriculum to learn about drug prevention , team building and skill mastery. 250 youth under the guidance of 4-H Extension Educator, Diego Lahaye, and 4-H Volunteer, Victor Molino, participated in the nine week day fitness program and soccer tournament championship. This program includes more than 70 % of youth from countries other than the United States. In 2017 more than 700 youth have already joined the program. Education about Childhood Obesity is provided by the CAUSES Center for Nutrition Diet and Health. Health Rocks, our drug prevention program, is presented by 4-H volunteers and interns.

This year our 4-H camping program began with a four week program conducted at the Columbia Height Education Center with youth focused on fitness and learning about 4-H programs that included Health Rocks, Childhood Obesity, Sustainable Living, cultural competence and team building. We culminated with and 4-H Leadership overnight camp of 50 youth at the Riverview camping facility in Maryland.

34 youth participated in the afterschool soccer program at Hearst Elementary School. They learned about nutrition, drug prevention and proper exercise.

Health and Fitness 4-H Activities were also provided at Riverside Community Center by volunteer Rob Sidel. He led the youth in learning martial arts and personal discipline. They continue to meet every Wednesday night from 6:30 pm -8:30 pm. Youth in grades 5-12 are a part of the program that serves 70 youth free of charge.

STEM
Students at Takoma Education Campus, both 7th graders and 5th graders, and Miner Elementary School, two classes of 6th graders, participated in learning about embryology with chicks hatching in their classrooms. Students monitored the development of the chicks candling and documented change. These programs were led by our CAUSES interns and the students commented that the program represented their favorite science project. 105 youth participated in the program twice weekly at their prospective schools. Presentations were also provided about food security as many schools are incorporating chicken coops and hen houses at their schools in the city. 4-H Beekeeping education programs were also provided for the youth at Miner Elementary School through the efforts of our college intern and trained volunteer leader, Clara McGinn. 27 youth participated in the program.

National Youth Science Day
50 youth participated in the National Youth Science Day program related to drones at their schools and at the capitol center this program year. Last year's hands-on science challenge explored the science behind drones and how they are being used to solve real world problems. Youth will learn everything from flight dynamics and aircraft types, to remote sensing and flight control, as well as safety and regulations.

DC Challenge Program
25 youth at the DC Challenge Program participated in our STEM education program learning about 3-D Printers. Volunteer Keith Hammond worked with extension staff to provide the programming. Youth communicated with international youth to learn how to make a prosthetic hand for children in war torn countries around the world. The also made friendship bracelets with the 4-H clover prominently displayed. 67 youth from across the city participated in Photography and Film Education learning about climate change and photographing effects in and around the city. 88 youth participate in our STEM Leadership Program to include three schools and two community programs.

Gardening Education
Gardening Education programs began that supported youth at local school to include Columbia Heights Education Campus, Washington Metropolitan Education Campus, Nalle ElementarySschool and Brightwood Educational Campus. These schools had new gardens installed on school grounds. 33 youth participated in the program. They learned about healthy eating and organic gardening.

As we forge towards a new program year, we will continue to form new clubs and activities to enrich the lives of our youth.

LifeSmarts
LifeSmarts, established in 1994, is a program of the National Consumers League offered to youth in grades 6 - 12. This competition prepares students to enter the real world as smart adult consumers. This is our 20th year participating in the 23 year old LifeSmarts program. Trained 4-H Volunteer, William Cocke, is the state 4-H LifeSmarts program coordinator. College intern, Lauriane Donang, worked with the teams and coaches at their schools to prepare for the state competition.

Participants focus on five key topic areas: consumer rights and responsibilities, the environment, health and safety, personal finance, and technology. A LifeSmarts team consists of five (5) youth and one adult coach working to win the state and national game show competition. Eight high school teams and two Junior Varsity teams advanced to the state competition with McKinley Tech winning to travel to the National Competition in Pittsburg, PA. The Junior Varsity teams do not travel to the competition. Participants in the LifeSmarts program must also conduct an in- school food observation report and they provide training to four school groups to earn a $1,100.00 award.

Military Partnerships Program
The Military Partnership Program included monthly program activities at the DC National Guard when parents were attending drill. We also planned monthly programs and summer activities for our youth. One major program made headlines. During the program year, youth in the 4-H military journalist program at the District of Columbia National Guard worked with Agent Diego Lahaye and two CAUSES interns Clara McGinn and Marco Feligioni to provide training about interviewing people and making quick comments that are to the point and very accurate. During the inauguration of our 45th president, Donald Trump, they interviewed guests and party goers. Their program was featured in the military newsletters and they have been asked to train youth in the State Department to do the same kind of programming they are doing.

Teen Moms Sewing and Nutrition Program
Two years ago our 4-H Teen Moms Sewing and Nutrition Program began in one school with 12 youth and the program continues to grow in small increments. The program participants learn to sew clothes for themselves, their babies and they receive a training program from Mr. Alex Bonilla, a former UDC business school graduate working at Bank of America and a 4-H soccer volunteer, about selling and marketing products on line. Youth from Columbia Heights Educational Campus, Washington Metropolitan High School, and currently not in school youth attend the program.

27 youth participated in the program this year with another 16 interested in joining us. The program has new interest and new volunteers. This year professional tailor, Mr. Phifer, will lead them in designing a clothing line. 16 non parent youth also participated in a handmade crafts program that included making hammocks which they will sell at the UDC Farmers Market in May of 2017.

5. Alternative Energy and Capacity Building

Research

The Five Pillars of Economic Development

Many underserved urban neighborhoods have been excluded from economic development success even in times of economic expansion. Economic development challenges are typically exacerbated in times of economic stagnation. Washington DC is especially challenging in this regard. It is a tale of two cities.

Wards 2 and 3 in the NW of the District have household incomes of $110,000 per year, low unemployment rates of 4% or less and less than 10% of the population are African American; neighborhoods in Wards 7 and 8 east of the river have household incomes of $35,000 per year, unemployment is close to 20% and over 80% of the population are African American. This bi-furcation distorts economic development success as averages within the District are not sufficiently descriptive of the realities of the most city's underserved neighborhoods.

Yet economic development success is possible. The key lies in identifying viable economic development strategies that strengthen the individual and community based assets of underserved communities and meet local needs. Using the pioneering work of Dr. Sabine O'Hara (O'Hara, S. and Vazquez, J. 2007) as its starting point, this alternative approach to economic development provides a bottom-up methodology to assessing a community's economic development potential that enables local residents to define and shape their own future. The research seeks to generate information about local needs and individual and community based assets in two Washington DC neighborhoods, Deanwood and Congress Heights.

The following project components have been successfully completed:

Data Collection: In its initial phase, the research project developed a sizable data base of indicators by Ward that provide information of five key areas that are indicative of a community's economic development potential, the five pillars of economic development: (1) health, (2) education, (3) social and cultural amenities, (4) environmental quality and (5) access to information and transportation.

Focus Groups: In addition to these quantitative indicators, the research uses an innovative story writing process in the Deanwood and Congress Heights neighborhoods that represent the different histories, economic conditions, and demographics within the most underserved Wards, Ward 7 and 8 of Washington DC. To assist with the logistics of the research project, the PI hired a three-months full-time project coordinator who is a recent UDC graduate and resident of one of the neighborhoods where the two focus group meetings were held. Fourteen UDC students were trained to engage in the various aspects of the research project, including as focus group facilitators, recorders, and as research assistants. The project's PI, Dr. Sabine O'Hara, designed the focus group process and content and held two training sessions for facilitators and recorders prior to conducting the focus groups.

During the introductory segment of the two focus group meetings, the PI educated more than 200 DC residents and CAUSES faculty and staff members on the health disparities and economic development disparities in Washington DC and introduced the community based approach to economic development that the Five Pillars model offers. To provide appropriate background information for the focus group participants, the project PI and project coordinator prepared and disseminated quantitative data about key quality of life indicators in the two selected neighborhoods that were taken from the previously selected database of indicators. The project PI briefed all participants on the major findings of the quality of life comparisons between the eight Wards in the District of Columbia. In addition, flyers were available during the focus group meetings to summarize the data collected.

The Story of the Future of the Selected Neighborhoods: Based on the focus group results, a first story draft was developed that records the collective vision of success and prosperity 25 years into the future. This community based vision of economic development success will yield invaluable information about the aspirations and needs of local residents, demographic sub-groups, and key stakeholders including the business community, service providers, the public sector and other relevant groups. The story also indicates a significant level of awareness among Deanwood and Congress Heights residents about available sustainable economic development options that the two neighborhoods wish to explore.

Story Feedback: In March 2016, the focus groups reconvened at DC Scholars Public School on East

Capitol Street in DC's Ward 7. Three CAUSES staff members who had been involved in the focus groups took turns reading the story to meeting participants. Overall, the story was well received and meeting participants confirmed that the story captures well the discussion the focus groups had had about their future vision of their neighborhoods with respect to the Five Pillar areas. Meeting participants requested, however, that the story be further personalized and that there be one protagonist created for the Deanwood neighborhood and one for the Congress Height neighborhood. This has since been accomplished and the story has been re-written in a more personalized story format based on the demographic characteristics of the majority populations in the two neighborhoods.

Two final neighborhood meetings will be held in early May of this year, one in Deanwood, and one in Congress Heights to share the final version of the story and to solicit feedback in the overall structure of the final report of the Five Pillars of Economic Development research project. Since the data collected is extensive, the final report will only include selected indicators in the five pillars areas, with additional data being made available in an appendix to the report.

Dissemination of Results: A preliminary meeting with focus group participants from both neighborhoods regarding the proposed dissemination of the report revealed a strong preference for a web-based dissemination strategy. The PI has identified a UDC student who will assist in developing a website that displays the indicators collected in the Five Pillar areas. An initial six indicators will be selected for each of the Five Pillar areas for a total of 30 selected indicators for each of the eight Wards or a total of 240 indicators. Even at six indicators per Pillar this constitutes a significant amount of data that will have to be updated annually to indicate a trend in the data.

In addition to the website design, a final report and publishable article are currently in preparation.

Extension

The Five Pillars research project revealed several areas for follow up work in the cooperative extension programs of CAUSES. The desire to create energy at a neighborhood scale from alternative energy sources, including solar, bio-digestion, and geothermal, played a prominent role in the focus group meetings. This unexpected result of the Five Pillars research project has resulted in a reconsideration of the energy sources for the UDC Urban Food Hubs. The first component of the Urban Food Hubs, Food Production, has long focused on energy efficiency and on designing aquaponic and hydroponics systems that are highly energy efficient; and the fourth component of the Urban Food Hubs, Waste and Water Recovery, has long focused on waste reduction and water reuse; the East Capitol Street Urban Food Hub will now add a solar energy component. Three solar panels were installed at the site in late September 2016 and the 30x90 ft greenhouse was operated largely off the grid. CAUSES is currently identifying additional funding sources to add an alternative energy source to all of its food hubs and to begin a workforce development and training program in solar installation and maintenance in collaboration with the District Department of Energy and the Environment.

6. Water Safety and Water Management

Research

Development of a Novel Stormwater Runoff Collection and Treatment System for Urban Agriculture and Food Security

With the fast increase of urban population, vast quantities of energy and water are being consumed whilst harmful quantities of wastewater and stormwater runoff are generated through the creation of massive impervious areas. In addition, rising oil prices, unreliable rainfall and natural disasters have all contributed to a rise in global food prices. Food security is becoming an increasingly important issue, especially urban residents here in US. There is an urgent need of developing effective and economical feasible solution for

the best management practices to minimize storm water runoff, reduce soil erosion, maintain groundwater recharge, and minimize surface water and groundwater contamination from combined sewer overflows[1]. In the last decade, researchers from universities and nongovernment organizations, as well as industry consultants, have proposed new techniques and methodologies to remedy wastewater which include using micro/nanostructured membrane/filtration, nanoparticle catalytic, and chemical reaction etc[1-12]. However, these methods often times are inapplicable for urban agriculture farm or household, because the cost of the system and requirement of post processing are usually time-consuming and expensive [4, 5, 12]. This project will address this issue by the design and development of a novel stormwater collection and treatment system which can harvest and store stormwater from densely populated urban areas and use it to produce food at relatively low costs. This will reduce food miles (carbon emissions) and virtual water consumption and serves to highlight the need for more sustainable land-use planning. The broader goal is to assist in exploring an efficient and cost effective way to improve regional and global food security, create local capacity and improve social, economic and environmental condition of people and organizations in the District of Columbia through integrating research, teaching and community service in this project**.**

This project will be accomplished through two tasks: 1) Storm water Treatment Material preparations; and 2) Storm water collection and treatment system design and development. The efficiency of the system will be evaluated at the EPA Certified Environmental Quality Testing Lab at the UDC Van Ness Campus. To broaden the impact of the project, the results will be disseminated through the following approaches: 1) Live demonstration of the stormwater collection and treatment system at the Firebird Farm of UDC; 2) Hands-on workshop and training sessions; 3) Presentation and tour program at University open house and Engineering Discovery Day at UDC to local high school students and visitors; and 4) Conference poster/presentation and journal publications. The research is very much useful for the District of Columbia because it can help solve the urban stormwater runoff issue and reduce the cost of stormwater management cost to meet the increasing volume of stromwater runoff and pollution, especially in metropolitan area.

The project was awarded late in the fiscal year. Between July 2016 and Sep 2016, the following progress was made:

Objective 1: To design and manufacture the metallic oxide nanoparticles infused mesoporous material.
Completed:

1. **Major activities completed**: a hybrid mesoporous materials with metallic oxide nanoparticles has been developed. A new synthesis method has been proposed to prepare this hybrid material at a cost effective and efficient way.
2. **Data collected**: Using the modified hydrothermal method, we could potentially synthesize the hybrid material within 24 hours.
3. **Discussion of the results**: current preliminary results have shown that this modified hydrothermal method can be used to synthesize the material with a very high yield rate (~70%) and a short time frame (less than 24 hours). The next step is to test this method by preparing more samples, and to optimize this method to further reduce the time and improved yield rate.

Objective 2: To characterize the microstructure and evaluate the pollutant removal performance of the synthesized material.
Nothing yet to report.

Objective 3: To design a stormwater collection and treatment system with synthesized material.
Completed:

1. **Major activities completed**: an initial design of the stormwater collection and treatment system has

been drafted and some essential parts have been quoted and ready for ordering.

2. **Data collected**: a compact and expandable stormwater collection and treatment system prototype has been designed, which can be used to harvest and store stormwater from densely populated urban areas and use it to produce food at relatively low costs. This system consists of an expandable storage tank that has a minimum volume and occupied space of 5 cubic feet and can expand to a theoretical maximum volume of 9 cubic feet almost doubling the size of the tank. The filtration system consists of a mechanical filtration with a filter size of 250 microns and a chemical filtration system with a mesoporous nanostructured material to filter heavy metals and other pollutants.

3. **Discussion of the results**: current preliminary modeling and calculation have shown that this system can be easily built and it can be attached to the down spout of a typical DC house.

Objective 4: To evaluate its performance, and optimize the design to reduce the cost and time-consumed of per-liter clean water processed.
Nothing yet to report.

During the next reporting period, we will characterize the microstructure and evaluate the pollutant removal performance of the synthesized material; continue to optimize the synthesis process of the hybrid material; and improve our design of the stormwater collection and treatment system. More contaminants including different trace metals, and organic contaminants, will be tested to evaluate the performance of the system. The results will be disseminated to the targeted audience through various outreach activities, including publication, demonstration and workshop.

7. Food Safety

Research

Soil Analysis for Trace Elements and Urban Gardening in the District of Columbia: Food Safety

As food security and global warming made urban gardening popular in the densely populated cites like the District of Columbia, soil contamination and food safety is also raising health concerns. Growing edible crops in a contaminated growing media or soil with a high level of heavy metals such as Pb and Cd may pose risk to human health. The goal of this study is to identify and quantify trace elements (Pb, As, Cd, Cr, Cu, Ni, Se and Zn) in the soil and products of home and community gardens, to include idle places that can potentially be used for urban gardening in the District. The objectives of this work are five-folds: (1) a background study for soil contamination and urban gardening in DC, (2) testing trace elements in the soil of home and community gardens, (3) geocoding soil test results, (4) assessment of potential accumulation of trace elements in different products that might grow on the contaminated sites, and (5) development of guidelines for best practices that reduce human exposure to high levels of metals. Soil samples and plant tissues will be collected and analyzed according to EPA methods in the new UDC Environmental Quality Testing Laboratory using Inductive Couple Plasma and Mass Spectrophotometer (ICPMS). The expected outcomes include geocoded soil test results using ArcGIS10 or ArcInfo at the UDC Modeling and Simulation Laboratory. This research project is interdisciplinary as it encompasses soil chemistry, biology, nutrition, food safety, computer science, agronomy, soil sciences and geographic information system, and as such it will benefit the university in training students from various majors, as well as providing support forward a mission of sustainable DC. Most importantly, the outcome of this work will also be applied to write a bigger grant proposal.

During this reporting period, the accomplishments of this research project include:

- Analyzed soil quality data for samples collected from all 8 wards of DC, including trace metals,

minerals, pH, extractable phosphate and nitrate level.

- Analyzed soil quality data of samples from a community as well as home gardens for the level of arsenic and lead and compare measured data with EPA soil screening guidelines.
- Developed a GIS Map for Arsenic level, including garden plots that exceeded level of EPA soil screen guidelines.
- Assessed potential accumulation of arsenic and lead in vegetable crops grown in a contaminated soil using pot experiment.
- Made presentations of the project finding at local and national conferences

The result shows that some garden plots are highly contaminated in lead up to 8 times EPA soil screening guidelines of 400 mg/kg. Out of more than 500 samples, 83% have excess phosphate.

The main output of the reporting period was to analyze several soil samples for the application of national laboratory accreditation, the National Environmental Laboratory Accreditation Program (NELAP). UDC submitted all required data for this accreditation, including two sets of proficiency tests, demonstration of capability, and method detection limits. We also initiated fee based laboratory service for soil and water analysis for metal elements. Most importantly, a new website was created for the lab service: www.udc.edu/EQTL.

Presentations made during the reporting period:

Rose, Sania, Trinh Vu, Yacov Assa, Sebhat Tefera, and Tolessa Deksissa (2016). Analysis of Arsenic, Copper, and Lead Contamination in Urban Gardens in the District of Columbia. The 2016 Emerging Researchers National (ERN) Conference in STEM, Washington, DC, February 25-27, 2016. PowerPoint Presentation

Rose, Sania, Trinh Vu, Yacov Assa, Sebhat Tefera, and Tolessa Deksissa (2016). Analysis of Arsenic, Copper, and Lead Contamination in Urban Gardens in the District of Columbia. The 73rd Joint Meeting BKX and NIS for 2016 will take place in Hampton, Virginia, April 6 - 9, 2016. PowerPoint Presentation

Deksissa, Tolessa, Sebhat Tefera,and Yacov Assa (2016). Urban Soil Quality Assessment as Green Urban Stormwater Management Strategy. NCR-AWRA 4th Annual Water Symposium, Washington, DC, April 8, 2016. PowerPoint Presentation

Deksissa, Tolessa (2016). Unbiased Soil and Water Quality Monitoring: Academic and City Collaborations, Director, Water Resources Research Institute, Sustaining Water Resources in the Mid Atlantic, Dec. 6, 2016. PowerPoint Presentation.

There was no major change in the plan and implementation of the project except sample collection approaches. We applied two ways of sample collection approaches. First, the free based soil testing service include soil sample collection in which our graduate students or lab personnel had to go out to the community or home gardening sites and collect soil samples as requested by the residents. Second, the service did not include sample collection by laboratory personnel. Instead, we let the individual gardener collect and submit their samples. The number of sample received and analyzed 3 times higher in the first approach than in the second approach. This shows that our future laboratory service is expected to include sample collection.

This project has created training and professional development opportunities for PI's, faculty, graduate and undergraduate students. Working on this project, the PI's had the opportunity to conduct and set up a new research project, apply state of the laboratory techniques, including trace metal analysis in soil, bio-solids and plant tissues using the latest lab equipment, Nexion 300 D ICP-MS. Faculty and students were trained on the basic operation of sample preparation and analysis. All participating personnel got the chance to

publish paper and make presentation at national conferences. The project advanced professional experience of three researchers including the PI: Sebhat Tefera, Yacov Assa and Tolessa Deksissa. We also trained 15 graduates for the last three years and 20 undergraduates this year alone on the lab analysis. This project was very successful in terms of training large number of graduate research assistants, researchers and faculty.

During this reporting period, three (3) graduate assistants and two lab senior personnel or co-principal investigators have participated on this research project. Students assisted in sample collection, sample preparation and sample analysis. The lab personnel assisted in the sample preparation for lab analysis.

The results of the project have been disseminated via conference proceedings, local and national oral and poster presentations and direct contact with the DC residents that have received free soil testing service as part of the project activities. DC urban gardeners have received interpretation of their soil testing result and recommendations for further action to improve their soil quality. During this reporting period, we have communicated the need of soil quality testing with more than 400 gardeners. As of 2017, about 600 soil test results together with recommendation have been disseminated to DC gardeners.

The target audience of this project includes DC residents who are currently gardening or planning to garden, home gardeners and community gardeners, DC Department of Environment, Environmental Protection Authority, urban agriculture researcher, and sustainable DC affiliates. During this project, we analyzed soil samples for more than 500 garden plots or gardens. The majority of the gardens tested for trace metals and minerals were home gardens (78%).

This is the final year of the project. The next project activity is to compile the final technical report of the project. We also plan to write fact sheets or guidelines for safe urban gardening practices.

Aquaponic Systems at Firebird Farm
A study related to our Aquaponic Systems at Firebird Farm includes a thesis project - "Assessing Microbial Contamination in an Aquaponic System: Food Safety."

As the human population grows, food production and food safety become more important than before. Globally, there are over 870 million people that are currently undernourished, which accounts for about one eighth of the population. The demand for food is expected to increase by 14% every decade, which is particularly detrimental in developing countries where food scarcity is already a serious issue. Aquaponic is a system that allows people to produce multiple different types of food while using less space and fewer resources than many other systems. In the near future, aquaponic or similar systems will be essential in order to keep up with the high demand of food. The increases of these systems have a great deal of benefits, but they also face a number of challenges with respect to food safety.

The World Health Organization revealed that every year, thousands of people die globally due to food related illness, and millions of people worldwide are getting sick from contaminated food. This study discovers the issue of microbial contamination of food in an aquaponic system using E. Coli and Listeria as biological indicators. The study raises three important questions. First, has the current aquaponic management technique at the Firebird Farm created a significant risk in microbial contamination? Second, does the current sanitization practice result in microbial contamination. Third, what are best management practices to secure food safety at the Firebird Farm? These three research questions were explored based on extensive literature review and laboratory analysis of microbial contamination in greenhouse aquaponic system and high tunnel aquaponic system at the University's Firebird Farm.

The objectives of this study are: 1) assess food safety and risk of microbial contamination at the UDC aquaponic systems at Firebird Farm; 2) analyze key indicators of microbiological contamination; 3) recommend HACCP plan for UDC Aquaponic systems. Samples were collected from high tunnel,

greenhouse, and hydroponic systems and tested for E. coli and Listeria spp using IDEXX Quanti-tray 2000 for water samples and Enrichment culture for surface samples. The results show that the geometric mean of water samples met EPA and FDA criteria (below 126 CFU/100 ml) in E. Coli.

In the high tunnel system, the surface samples are negative for E. Coli presence except one sample out of six samples from soil samples, and one sample out of three sample from plant trough. For Listeria analysis the surface samples are negative except the two out of three samples from biofilter, the three out of six samples from soil, and the three out of three samples from plant trough in high tunnel are found positive. Listeria spp is bacteria that is commonly found in soil and most likely not pathogenic. In the hydroponic system analysis, all seedling samples were positive for E. coli and negative for Listeria. These consistently positive results indicate that there is a suitable environment and exposure risk for E. Coli 0157 and may be the cause of initial contamination in the aquaponic system.

Based on the overall findings of this study, one may conclude that the possible microbial contamination of aquaponic system products can be in any stage between farm and plate. There is possible contamination from hydroponic system where all seedling samples are positive for E. coli above action level. Nevertheless, this finding is only based on limited sample collection and more samples need to be collected from considerable number of hydroponic systems for confirmation study. Recently, FDA and EPA numerical criteria based the geometric mean of sample which is less 126 CFU of generic E. Coli per 100 mL of water. It should also be noted that this study is based on a limit data due to limited budget for the laboratory analysis. Further research related to regular monitoring of aquaponic system products and equipment using appropriate number of sample collection from considerable number of aquaponic systems is recommended.

Finally, the findings of this study seeks to contribute and raises awareness to the general public and to UDC farm workers in regards to the potential contamination of produces at any time and stage and the risk associated to consuming fish or vegetable from the aquaponic systems that might be contaminated in E. Coli or Listeria.

Extension

Certified Professional Food Manager Program (CPFMP)
"Each year, roughly one out of six Americans get sick; 128,000 are hospitalized, and 3,000 die from foodborne illness," (Academy for Nutrition and Dietetics, 2016). Foodborne illness is a major problem throughout the country, and even here in Washington, DC. "More than 200 diseases are spread through food" (World Health Organization, 2016). With 5,500+ food establishments in the District of Columbia alone, the need for intelligent, passionate, and dedicated Certified Professional Food Managers is urgent. There are only 22 sanitarians, two administrative staff, two supervisors, one program manager, and one food technologist employed by the District of Columbia. Thus, the Certified Professional Food Manager course is necessary to continue to train qualified individuals to help monitor and ensure our food's safety.

The Certified Professional Food Manager Course is taught by Paul Brown Jr. It is a vital program in the District of Columbia that helps residents get the certification and confidence needed to gain employment in commercial food operations. One student, Delores Robinson, in August 2016 said, **"I was able to remember almost everything you said word for word...I got my pay day because of your class."** It also helps to safeguard that the food that is being served to the public and residents of the District of Columbia, is safe and free from physical, chemical and biological contamination. The course is a three day, 16 hour course which delves into basic food safety and sanitation, and how to make sure employees, facilities, and food products are food-safe compliant. It runs from 9:00 am - 4:00pm each day, and culminates with students taking a nationally recognized exam from Prometric. The course is taught regularly throughout the year at the University of the District of Columbia and we also work with a couple of

partners throughout the city as well. The areas of focus in the city have been wards 5, 7, and 8. The vast majority of students tend to be African American and women.

The course helps students get food manager certification by taking and passing a National Exam, which is good for five years. We also help them by giving the students some practice tests to get ready for the National Exam. We give them a pre-test before we start teaching to see what they know before any lessons are taught and a post-test to see what they've learned from the lessons taught and from studying independently at home. Finally, we have a DC Food Code exam which explains the rules and regulations for food managers working in the District of Columbia.

We focus our CPFM course on teaching basic food safety and its principles. We use the book, NSF HealthGuard Professional Food Manager Certification Training Version 6.0, as a guide to delve into the important aspects of food safety, foodborne illness, the food facility, pest management, and the principles of food safety.

This certification is helpful to anyone who would like to take the course, but is vital to those seeking employment in food service. It aids those working in commercial kitchens, restaurants, fast food, daycares and schools or those who are looking to go into business for themselves. This usually happens through the increasingly popular mobile food facilities (food trucks), bed and breakfasts', and catering businesses. This certificate is a requirement to work in commercial food settings or where food is being served to the public. It allows for upward mobility for those already employed in lower level food service.

Students have come from a host of different agencies throughout the city and surrounding area. We have partnered with and taught students from places such as, Homes for Hope Community Inc., Grant Associates Inc., New Course Restaurant and Catering, DC Department of Health, DC Department of Aging, Bread for the City, Linden Manor, and Levy Foods.

From fiscal year 2015 to fiscal year 2016, test scores have been fairly static. The only dip we saw was in the National scores. The average pre-test score was down from fiscal year 2015, the average score was 62. In fiscal year 2016, the average score was 61, still up from FY 2014 when it was 59. In fiscal year 2015, the average post-test score was 89, in fiscal year 2016 the average post-test score stayed the same at 89. It's still up from FY 2014 when the average post-test score was 79. Lastly, the average National Exam score in fiscal year 2015 was 91, the average National Exam score in fiscal year 2016 was 85. It's down from FY 2015, but still up from FY 2014 when the average National Exam score was 79. The passing grade for the National Exam is 70, so there will be continued emphasis on independent learning and studying at home, and learning and studying of the materials and curriculum presented in the classroom.

While we had a good year, there is always room for improvement. We had 97 people to take and pass the National Exam. Twenty-one (21) of those students were male, so 21.65% of students who took and passed the National Exam were male. Our plan for Fiscal Year 2017 is to target and have more males take and pass the course to become Certified Professional Food Managers. The percentage of male students that we will work to obtain for FY 2017 is 35-40%. Also, we aim to raise the average scores on the National Exam. Our plan is to go more in-depth in lessons on the subject of food safety and to work to ensure greater clarity and comprehension.

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Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	24.0	0.0	20.0	0.0
Actual	0.0	0.0	15.2	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

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

2. Brief Explanation

We have established a Merit Review Process for research/extension in Land Grant Programs that continues to work well at ensuring that research proposals are judged fairly and on their merit. For Hatch and Mini-grants offered through the Station, the process includes: the Development of a RFP; Solicitation of RFP; Receipt of Proposals; Review of Proposal Packets for Completion of Requirements; Peer Review; Director's Review; Completion of Required Forms for submission to USDA; Electronic Submission to USDA for expert panel review; USDA Approval; and Issuance of Award. The Peer Review panel includes representatives from various departments/schools across the University. Research projects are often joint ventures, conducted by faculty as well as qualified research and extension staff.

The Peer Review Committee assesses our program's proposed research/extension projects and activities based on the following criteria:

• Knowledge base of the research
• Adequacy of procedures and experiment to meet the objectives
• Feasibility of accomplishing the objectives
• Scientific merit of the proposed research
• Familiarity with work of others related to the proposal
• Outcomes and Impacts
• Appropriate budget for proposed research
• Budget Justification

All research/extension projects are monitored by the Director and Associate Director to ensure that objectives and timelines are being met. An annual progress report is required and is reviewed by the Station Director prior to electronic submission to USDA. All projects must include student learning experiences.

Findings are published in refereed journals, posters are developed and presented at conferences, and fact sheets or Information Documents are prepared and distributed to stakeholders. Students participate in conference presentations as well as research seminars.

CAUSES has an Advisory Board comprised of community stakeholders from various industry and public sector areas including environmental science, business/finance, public administration, counseling, water resources management, marine science, engineering, and computer science.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to 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
- Other (distribution lists; website)

Brief explanation.

CAUSES regularly seeks stakeholder input through its partnerships with non-profit organizations, DC agencies, and residents through neighborhood organizations and the ANCs, a network of neighborhood representatives that are active in every Ward of the District of Columbia. In addition, we collect program feedback from participants, community partners, and faith-based organizations. Particularly important is our work with individuals and organizations in the most underserved Wards of the District, Wards 5, 7 and 8. These are largely low income communities, characterized by extensive food desserts, high unemployment, high school dropout rates and other significant challenges. We have reached out to seniors, youth, single mothers, ministers, community advocates, working class and middle class residents. Three of our Urban Food Hubs, which are currently in various stages of implementation, are also located in Wards 5, 7 and 8. Additionally, stakeholder input is sought at both research and extension activities such as the Farmers' Market, workshops, seminars, and demonstrations throughout the eight Wards of the District of Columbia. We let our stakeholders know that their input is essential to the research conducted and extension services provided to benefit them, their families, and communities within the District of Columbia. We encourage their input via stakeholder surveys, interviews, and one on one dialogue, and two major stakeholder events held annually.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Use Surveys

- Other (workshops, seminars, Quality of Life Day Event)

Brief explanation.

Our objective is to meet with residents and organizations across the eight Wards of the District. Currently, our focus is on the underserved population of the city, residents residing in Wards 5, 7 and 8. A large segment of this population are low income residents and many households in the District's most underserved Wards are led by a single parent or, in some cases, a grandparent(s). Research and Extension, separately as well as jointly, host a number of activities during the year including workshops, seminars, demonstrations, training sessions, a Farmer's Market on the University's main campus and one of our Food Hub locations as well as support for several other farmers markets across the District. At these events, stakeholder surveys are administered to willing participants and collected for assessment. In 2016 we also hosted an open house event at the Firebird Farm Agricultural Experiment Station and we hosted a stakeholder appreciation luncheon on our main campus at Van Ness. Since both events were very successful we plan to continue them in 2017.

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

Our objective is to meet with residents and organizations across the eight Wards of the District. Currently, our focus is on the underserved population of the city, residing in Wards 5, 7 and 8. A large segment of this population is low income residents with many households lead by a single parent or, in some cases, a grandparent(s). Research and Extension, separately as well as jointly, host a number of activities during the year including workshops, seminars, demonstrations, training sessions, and an annual Farmer's Market on the University's main campus. In addition, the CAUSES Landgrant center directors, along with the Dean and Associate Dean of Landgrant programs, have met with DC agencies and non-profit organizations to solicit information about priority needs for the District of Columbia. An important tool in structuring these informational meetings is the so-called Sustainable DC Plan, developed by former DC mayor Vincent Gray. The plan outlines the ambitious goals of making Washington DC the greenest, healthiest and most livable city in the United States by 2030. Moreover, the Sustainable DC Plan sets sustainable development targets that provide a roadmap for CAUSES to focus its activities in support of the Sustainable DC goals. The Directors of the five CAUSES Centers have now begun to convene networking meetings several times per year that bring together organizations and DC agencies in their respective areas of responsibility -- Urban Agriculture; Sustainable Development; Nutrition Diet and Health; Youth Development; and Housing and Community Planning.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- To Set Priorities

Brief explanation.

The assessment work of CAUSES is supported by a full-time assessment specialist, who is assisted by a full- time associate. This staff works closely with the five landgrant center directors and the five academic program directors in CAUSES to ensure that input received from stakeholders is reviewed, assessed and processed to improve on our applied research and community outreach activities. The result of this assessment and analysis work indicates that we are addressing many of the issues and concerns identified by our stakeholders. However, there are areas that offer opportunities for expansion and improvement of our work. Our ability to realize these opportunities depends largely on budget and personnel allocations, yet operational improvements will also be necessary to fully realize the potential of expanded and new research and community outreach opportunities. Especially critical are operational areas in human resources and procurement. The new President of the University of the District of Columbia has made operational and processing one of his priorities and has established a new organizational structure that includes a Chief Operating Officer with responsibility for HR, IT, procurement, and facilities. As the University's landgrant college, CAUSES and its leadership is keenly aware of the responsibility to build capacity that improves the social, economic and environmental conditions of the District and its diverse stakeholders through relevant research and community education programs. In its monthly management meetings, the CAUSES center directors, academic program directors and operations staff are carefully reviewing and updating our Plan of Work to expand our effectiveness and reach.

Brief Explanation of what you learned from your Stakeholders

Stakeholders concerns have remained relatively consistent. In line with the Sustainable DC Plan and its targets, concerns of the broad range of DC stakeholders include improving health and especially preventive measures that improve health conditions before treatment becomes necessary; improved access to locally grown, high quality food; water quality including the goal to make the rivers within the District fishable and swimmable; improved infrastructure; more access to parks and outdoor recreation; better sustainability literacy. In addition, we have observed a growing interest in Urban Agriculture. In 2015 we launched an Urban Agriculture Certificate program and enrollment has continued to increase. Issues and topics of concern include the following:

- Safety of Foods: Growth, storage, and preparation of foods
- Economic Development: Jobs, training, sustainable neighborhoods
- Obesity: Healthy children and adults; Prevention of Chronic Illnesses; Healthy Eating; Activities for Children
- Urban Gardening: Growing their own food; exposure to different types of food, including ethnic crops and organic foods
- Healthy Food Choices: Eating better for better health and longevity
- Healthy Lifestyles: youth activities related to physical fitness and proper nutritio
- Sustainable energy: continued availability of resources for themselves, their children and generations to come
- Urban Agriculture
- Aquaponics and Hydroponics

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1196560	0	899243	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1203661	0	689134	0
Actual Matching	896748	0	905650	0
Actual All Other	234411	0	0	0
Total Actual Expended	2334820	0	1594784	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	7101	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%		0%	
111	Conservation and Efficient Use of Water	20%		0%	
112	Watershed Protection and Management	20%		0%	
124	Urban Forestry	20%		50%	
141	Air Resource Protection and Management	20%		50%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	5.0	0.0
Actual Paid	2.2	0.0	2.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
142364	0	149954	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	165175	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
10125	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Establishment of Computational Infrastructure at UDC to Conduct Climate Change Research for the District of Columbia
During the reporting period, the following was accomplished under the major goal of the project:

- Computer Server Systems and accessories were identified, selected, procured, and implemented.
- The Database system design was completed for precipitation.
- The stored procedure analytical tool to store the data was completed.
- Hourly long-term precipitation data was collected, processed and uploaded into the database server.
- The web site design was completed and implementation is in progress.
- Faculty researchers have introduced climate change research in their course works.
- The team has researched and designed the preliminary layout for the website development which will serve all stakeholders to include: engineers, water resources professionals, agricultural professionals and health professionals.

Analysis of Watering Devices for the Planting and Survival of Young Urban Canopy Trees
This project was completed in early 2016. During the reporting period, we were able to assess the growth of tree canopy and tree roots to see the efficacy of the research project. The information will be disseminated to our stakeholders. This critical information will lead the research on urban tree production and global climate change mitigation involving urban tree production. Our target audience includes home urban arborist, gardeners and regional small scale urban and peri-urban farming operations interested in growing trees for urban gardens which will advance food and nutritional security in the District of Columbia. The information will be crucial for our urban forestry program, which will disseminate these findings to urban arborist in Washington, DC. We hope to disseminate this information to local urban arborist via information bulletins and web based informational systems. We will continue to train, and disseminate the information learned from this project to the community at large.

Determining Effects of Nitrogen Fixing Plants on Nutrient Density and Productivity in Agroforestry and Polyculture
Systems
This research project was approved very close to the end of the fiscal year. Thus, preliminary results will be reported in the FY 17 annual report.

2. Brief description of the target audience

1) District of Columbia residents
2) DC Public School Teachers
3) Youth, Grades K-12
4) Urban gardeners
5) Storm and waste water operators
6) Landscapers
7) Nursery Owners
8) Engineers
9) Water Resource Professionals

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	120	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of articles published

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of fact sheets published

Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of newsletter published

Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of workshops, demonstrations and technical assistance implemented.
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of research projects completed
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Number of soil, air and water samples test results
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of informational materials distributed
  Not reporting on this Output for this Annual Report

Output #8

Output Measure

- Number of conference presentations

Year	Actual
2016	1

Output #9

Output Measure

- Number of certificate of completion issued
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percent of program participants that will become more environmentally aware due to new knowledge from informational materials provided and workshop presentations
2	Percent of program participants that will implement new environmental skills to improve natural resources and the environment
3	Percent of soil, air, and water samples meeting EPA standards after implementation of research project.

Outcome #1

1. Outcome Measures

Percent of program participants that will become more environmentally aware due to new knowledge from informational materials provided and workshop presentations

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To understand and adapt the climate change related issues, a number of federal, state and local government agencies have launched several evaluations of vulnerability of their critical infrastructure to the possible effects of climate change. Climate change has the potential to increase the variability in extreme weather events. Washington, DC is very important because the city houses a significant number of federal agencies, several national monuments, international embassies and serves as a major economic center for the Washington Metropolitan area.

What has been done
The preliminary results from this research were presented at the National Capital Region Water Resources Symposium in April, 2016. The title of the research was Development of Rainfall Storm Event Analysis Tool based on Cloud Computing.

Results
One Hundred Twenty (120) scientists, engineers, students, and other professionals received valuable information on the development of a rainfall storm event analysis tool based on cloud computing to assist them with planning, identifying proper tools for analysis, and decision-making within their organizations. The symposium was very well received and the Water Resources Research Institute is making plans to continue the symposium in FY 17.

4. Associated Knowledge Areas

KA Code	Knowledge Area
141	Air Resource Protection and Management

Outcome #2

1. **Outcome Measures**

Percent of program participants that will implement new environmental skills to improve natural resources and the environment

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Percent of soil, air, and water samples meeting EPA standards after implementation of research project.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

There were no external factors which affected outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The symposium was very well received by attendees. The Water Resources Research Institute will host another symposium in FY 17, where we will continue dissemination of our research.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	45%		45%	
205	Plant Management Systems	45%		45%	
721	Insects and Other Pests Affecting Humans	0%		10%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.0	4.0	0.0
Actual Paid	3.8	0.0	3.5	0.0
Actual Volunteer	260.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
255022	0	167126	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	192474	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
219272	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1) Conducted bio-intensive field and hoop house experiments in the use of composted waste as a soil amendment for growing nutrient dense vegetables in urban gardens; their impact on the environment was conducted at Firebird Farm in Beltsville, MD;

2) Facilitated workshops, training sessions, demonstrations, field activities, and farm tours at for program participants to teach and update knowledge of sustainable agricultural techniques at each the Food Hub to establish, maintain, protect, and market both food crops and flower gardens;

3) Developed and distributed informational fact sheets, brochures, and newsletters related to production and protection of urban gardens;

4) Participated in local, National, and international conferences and meetings on sustainable agriculture and urban gardening;

5) Maintained Urban Ag and Master Gardening certifications; trained food producers and gardeners will participate in making nutrient dense food crops accessible and affordable in food desert areas of the District while beautifying the city through volunteer hours; and

7) Strengthened Ethnic and Specialty Crop Program.

Two presentations were given to describe new research initiatives and intended results:

- "Reducing Impacts of Solar Radiation on a Crop Producing Green Roof." Lightning Talk at the Urban Agriculture and Sustainability in the Northeast Region Conference. June 26, 2016.

- "The Potential for Reducing Impacts of Solar Radiation on a Crop Producing Green Roof, and Modifying Roof Microclimates, through the Utilization of an Adjacent Crop Producing Green Façade." Presentation for CAUSES Research Collaborations Meeting. May 24, 2016.

For the new Farmers Market study, activities included:

- Phase I: literature review and introduction conducted (not completed), national farmers' market data obtained from USDA; summary statistics on national farmers' market finished; Food security data collected and summary statistics conducted.

- Phase II: questionnaire geographic region defined.

2. Brief description of the target audience

1) District of Columbia residents
2) DC Public School Teachers
3) Youth - Grades 3-8
4) Urban community gardeners
5) Urban food producers and farmers markets
6) Landscapers
7) Nursery owners

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	36347	6000	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of articles published

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of fact sheets published

Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Newsletters published

Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of workshops, demonstrations and technical assistance implemented.

Year	Actual
2016	32

Output #5

Output Measure

- Number of research projects completed
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Number of soil, plant and water samples test results
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of informational materials distributed

Year	Actual
2016	3714

Output #8

Output Measure

- Number of conference presentations

Year	Actual
2016	2

Output #9

Output Measure

- Number of certificate of completion issued

Year	Actual
2016	51

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percent of program participants that will adopt urban gardening techniques learned from informational materials provided and workshop presentations
2	Percent increase in urban gardens using some compost material as a soil amendment
3	Percent of soil, plant and water sample results within acceptable crop production range
4	Percent increase in the growth of a variety of ethnic crops in home, school, and community gardens in the District of Columia.
5	Percent of new food producers that will adopt the bio-intensive method of urban agriculture production

Outcome #1

1. Outcome Measures

Percent of program participants that will adopt urban gardening techniques learned from informational materials provided and workshop presentations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
From consuming produce that is tastier and higher in nutritional value to decreasing CO2 emissions by harvesting as locally as your backyard, District residents are all "a buzz" about the many benefits of local food production. Urban agriculture has caught on, and unlike large-scale intensive agriculture operations, urban agriculture utilizes comparatively smaller spaces while focusing on diversified, edible crops. Many residents already subsidize what they buy at the grocery store through community garden plots and by growing in their backyards, yet are in need of technical assistance with issues ranging from cultivar selection and planting dates to fertilizing, soil contamination, and integrated pest management. Alternately, other District residents don't have access to grocery stores, let alone yard space or a nearby community garden in which they can grow their own food. The DC Master Gardener Program was started as a means of extending the horticultural and pest management expertise of the University of the District of Columbia Extension to the general public.

What has been done
Forty-Seven (47) participants were trained as Master Gardeners, receiving 45-50 hours of basic horticulture training. Program trainees agreed to work in their communities to teach District of Columbia residents how to cultivate garden spaces and manage landscapes sustainably using research-based information. This environmental horticulture approach reduces fertilizer and pesticide use resulting in improved soil and water quality.

Results
In FY 16, 198 (which includes 47 trainees) Master Gardeners and trainees provided 6,000 hours of horticultural expertise to the District of Columbia. The value of volunteer time is $38.77 per hour according to www.independentsector.org with a total value of $232,620.00 in savings to the District of Columbia. Forty-seven (47) Master Gardener trainees completed 50 hours of basic horticulture training, a final exam and 50 hours of volunteer hours. Various Master Gardener

projects throughout all eight wards of the District of Columbia have been established which includes the UDC food hubs, schools, parks, beautification projects, landscape design, youth gardens, local and national botanical gardens, and partnerships with non-profit organizations. Master Gardeners volunteered 600 hours to the success of the Ward 3 Food Hub (green roof/greenhouse). The value of their volunteer time is $23,262.00 in savings to the University. Their duties included propagation of vegetables and companion plants, planting, maintenance, and harvesting. 2,340 lbs. were harvested and donated to the following: food banks (1,000 lbs.), UDC Center for Nutrition, Diet, and Health (500 lbs.), East Capital Street Farmers Market (500 lbs.), and volunteers (340 lbs.).

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #2

1. Outcome Measures

Percent increase in urban gardens using some compost material as a soil amendment

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Percent of soil, plant and water sample results within acceptable crop production range

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Percent increase in the growth of a variety of ethnic crops in home, school, and community gardens in the District of Columia.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our farm uses sustainable growing methods to produce a range of fresh herbs and vegetables that are rare in area supermarkets. Many of them are so-called ethnic crops that do not originate on the American continent, but can be grown locally. As defined by the USDA, specialty crops are fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops that are cultivated or managed and used by people for food, medicinal purposes, and/or aesthetic gratification to be considered specialty crops. Firebird Farm is the home for many herbs and spices from Ethiopia and several species of vegetables from West Africa. Located just north and east of the District, the farm enjoys a humid subtropical climate that allows us to grow ethnic crops. Our crops include, but are not limited to, collards, hybrid kale, hybrid pac choi, hybrid patty pan squash, hybrid smooth leaf spinach, specialty salad greens, swiss chard, mustard greens, bunching onions, red Russian kale, baby peppers and long beans. The UDC Ethnic Crops program was established to meet the needs of the rapidly changing ethnic makeup of the region's consumers. We will look to expand upon our Ethnic Crop Program by experimenting with a few ethnic crops to determine their ability to grow in Washington, DC. Ethnic and specialty crops are in high demand in a diverse metropolitan area like Washington, DC. This is, in part, why CAUSES entered into ethnic crop production. In making these products accessible and affordable, we are helping to connect most consumers to new types of food. We are also giving native born and local immigrant populations a taste of home, right here in the Mid-Atlantic.

What has been done

During the reporting period, 15 individuals (9 males and 6 females), representing 8 countries, including the United States, signed up for the Hands-on Ethnic Specialty food training to learn about food production, processing and eventually value addition and marketing to the Washington DC metro area. Due to logistical constraints, instead of providing training at three (3) separate individual lots as planned, the food producers were each assigned their own plot at the UDC Firebird Farm and they would share information and products with their constituents in the District of Columbia, Maryland, and Pennsylvania. Hands-on training about the production process was provided and two workshops were organized.

Results

75 participants including trainees, farmers, entrepreneurs, restaurant owners, and African and Caribbean grocery store owners attended the workshops to learn about ethnic food production, processing and cooking as well as opportunities in the Washington, DC Metro area. Five new small holder farmers or landowners expressed interest in the production of ethnic crops in the Washington DC Metro, provided it is commercially viable.

With the help of labor provided by 60 volunteers, the DC SARE Ethnic Crops project harvested 6000 lbs. of fresh ethnic vegetables, which were distributed among trainees, their respective communities, volunteers, and African and Caribbean retail stores to test marketability and demand for the harvested ethnic crop. Through five (5) presentations and guided tours of the

African Ethnic Vegetables program, we reached about 1200 individuals who also received booklets and manuals about how to begin their own gardens or join the African Ethnic program as producers for the market.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #5

1. Outcome Measures

Percent of new food producers that will adopt the bio-intensive method of urban agriculture production

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

There were no external factors which affected the outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Pre-tests were given to assess knowledge at the start of class.
Post-tests were given to assess knowledge after completing the course.
Participants demonstrated their new found knowledge and ability through work on community projects in the District of Columbia. The Master Gardener trainees made excellent contributions to projects throughout the District.

Key Items of Evaluation

One Master Gardener, Barry Bem, shared his experience as follows:

I took the course in 2016 and found it to be interesting and very useful. At every class, an expert in some aspect of gardening gave a computer presentation and answered any and all questions. This academic part of the course was sometimes intimidating because of the amount of new information and new vocabulary. However, the course book was very handy to review and reinforced what I had heard in presentations. The second part of the course

was volunteer work in various gardens around the city, and this work was equally valuable and enjoyable. The participants in the course were at all levels of gardening, from beginners to experienced; yet everyone was able to learn new things and also to learn from each other. I would certainly recommend the course to anyone interested in gardening.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Health, Nutrition and Childhood Obesity Prevention

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior	50%		50%	
704	Nutrition and Hunger in the Population	30%		0%	
724	Healthy Lifestyle	10%		20%	
901	Program and Project Design, and Statistics	0%		10%	
903	Communication, Education, and Information Delivery	10%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	2.0	0.0
Actual Paid	1.6	0.0	4.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
113152	0	183839	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	238628	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Changing the Health Trajectory for Older Adults through Effective Diet and Activity Modifications:

During the reporting period, we accomplished the following:

1. Created the survey instrument to identify the barriers for consuming a healthy diet high in whole grains, fresh fruits and vegetables in wards 5, 7 and 8 in Washington DC.
2. Pilot tested survey in collaboration with the Institute of Gerontology, University of the District of Columbia to ten participants.Volunteers fit the age requirement, and were not required to reside in the target wards. After administration of the survey, many participants provided feedback that included: some were uncomfortable providing income information; some questions were similar and seemed repetitive; the survey was a bit too long; some open ended questions were difficult to respond to; and some questions were not specific enough.
3. Based on the feedback, the survey instrument was revised and improved.
4. Pursuant to revision of the survey instrument applied for the University of the District of Columbia, IRB approval was received on April 6, 2016.
5. Pursuant to IRB approval the student research assistants began communicating and visiting church leaders, congregate site directors and housing complexes to recruit participants to administer and complete the survey. This effort culminated in acquiring six (6) potential sites in wards 5, 7 and 8 that were willing to collaborate and participate in this research effort.
6. Project leaders contacted key informants from each site to obtain socioeconomic and demographic information about the people served by their organizations, and advised the research team on methods of recruiting participants.
7. The research assistants and the PI and Co-PI met with the groups in each site and oriented the participants regarding the purpose, objectives and methodology for completing this critical research.
8. Upon orientation, the research assistants have administered the survey to 57 participants. The survey was administered by the student interns in face-to face mode, so that they could answer any questions from the participants and gather valid data.
9. The goal of NE-1439 is to survey 125-150 participants and the student interns are currently continuing to administer the new version to participants and will continue until the goal is reached.
10. The student interns are also trained to upload all the collected data to Excel spreadsheets for analysis.

The PI, Dr. Ganganna, presented the updated report on NE-1439 at the Multi-state Annual Meeting in Rhode Island on June 8th, 2016 and presented her research for the College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES) during the college meeting. The NE-1439 research was presented for the research group of CAUSES in October of 2016.

Parental Practices Supporting Positive Eating Behaviors during Independent Eating Occasions Among Early Adolescent Children

During the reporting period, data collection for objective one was completed with three African American girls and two boys and their mothers. The data is being coded on an Excel spreadsheet and will be uploaded to the project Dropbox prior to the annual meeting in March 2017. The project provided training for two nutrition students. Both students were involved in data collection and all aspects of the project. We are currently moving into the analysis of data. The target audience for this project includes African Americans.

Nutrition Education
On a monthly basis, CAUSES-CNDH provides nutrition education and health promotion materials, healthy recipes, and food demonstrations for annual health fairs.

The nutrition educator performed monthly nutrition lessons for preschool children in three child development centers and one elementary school. Throughout the month, teachers were provided with gift cards for healthy food activities and curriculum tools to reinforce the learning goals and objectives in-between sessions conducted by the nutrition educator. One component of USDA's MyPlate and food safety served as a primary theme each month.

CNDH has an ongoing partnership with organizations that provide alternative prescriptions of a monthly supply of fresh and local produce to food assistance patients on the condition of their commitment to weekly attendance to group exercise and nutrition education classes. The CNDH Nutrition Specialist facilitated the nutrition education group sessions at a Unity Healthcare clinic on a bi-weekly basis. Participants learned food and health literacy skills, provided feedback on their challenges and progress in a supportive environment, and were exposed to various methods for preparing the fresh produce they received.

"SMART Nutrition" is an acronym for Safe, Manageable, Affordable, Relevant, and Tasty nutrition geared toward senior residents. These group sessions, held at the Bernice Fontaneau Senior Wellness Center in Ward 3, were designed to give senior citizens practical healthy aging and chronic disease prevention strategies with a sustainable food, nutrition, and physical activity emphasis. Participants engaged in interactive nutrition education, healthy food budgeting, cooking demonstration, and food safety activities. The adapted evidence-based Eat Smart, Live Strong curriculum for older adults and the Food Preparation/Nutrition Education component of the UDC Urban Food Hubs Model served as the core foundation to the group sessions.

Bi-monthly workshop sessions were held at Union Temple Baptist Church and Wayne Place Transitional Facility (Far Southeast Family Strengthening Collaborative, LLC) from mid-September to early December. Approximately 10 transition living participants regularly attended Wayne Place sessions and 15-20 faith community participants regularly attended the sessions held at Union Temple. The series kicked off with health and body composition screenings conducted by Yusef Battle, an Exercise Physiologist and owner/founder of the Fit Solution, Inc. in the Greater Washington DC metro area. Participants gained insight on their "health numbers" and how those numbers could impact their risk factors.

UDC Farmers Market
Operated by the CAUSES Center for Sustainable Development and Resilience (CSDR), on every Saturday at the Van Ness Campus from May to late November since 2013, the UDC Farmers' Market brings local, fresh, and sustainable produce to Ward 3 residents and beyond.

2. Brief description of the target audience

1) DC Residents
2) Adult men and women over the age of 65 who live in Metropolitan Washington, DC
3) DC Public School teachers
4) Students, grades Pre-K through 9

5) Children 2 -5 years of age
6) Pre-School/Headstart and Daycare teacher volunteers
7) Non-commercial agency staff members
8) Non-profits
9) Residential Homes
10) Overweight individuals and non overweight individuals from the same environment
11) Obese individuals and non obese individuals from the same environment
12) Low income residents living in multi-family housing
13) Researchers/Biologists
14) Low-income adults who are responsible for planning and preparing the family's food with emphasis on households with young children
15) Low-income youth

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4285	15731	946	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Youth and adults will receive direct basic nutrition and food safety education
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Youth and adults will receive direct education on health issues and direct education and demonstration on physical activity
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Development of a manuscript for the publication of data on the mechanisms of action of g-T3 on MCF-7 breast cancer cells.
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Employ microarray experiments and a range of cellular and molecular biological techniques to determine the molecular basis of the action of y-T3.
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of articles published
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Number of fact sheets published
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of newsletters published
  Not reporting on this Output for this Annual Report

Output #8

Output Measure

- Number of workshops implemented

Year	Actual

2016	115

Output #9

Output Measure

- Number of research projects completed
  Not reporting on this Output for this Annual Report

Output #10

Output Measure

- Number of informational materials distributed

Year	Actual
2016	269

Output #11

Output Measure

- Number of certificate of completion issued

Year	Actual
2016	24

Output #12

Output Measure

- Number of conference presentations

Year	Actual
2016	3

Output #13

Output Measure

- Number of demonstrations held

Year	Actual
2016	26

Output #14

Output Measure

- Number of community listening sessions held

Year	Actual
2016	6

Output #15

Output Measure

- Nutrition and wellness programs for adults, youth, seniors, and underserved residents will be established in the community to promote healthy diet and lifestyle

Year	Actual
2016	5

Output #16

Output Measure

- Farmers Markets and community gardens will be established in the District of Columbia to assist with the availability of fresh produce to promote better diet and nutrition for residents.

Year	Actual
2016	10

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of parent participants who make better food choices (fruits/vegetables).
2	Percentage of participants who improved eating habits.
3	Development of broad applications for the inhibition of breast cancer cell proliferation and possibly cell transformation
4	Number of participants who improved their dietary intake, including an increase in fruits and vegetables
5	Percentage of participants, who through information and interactive approaches, have adopted better eating habits thereby increasing their daily intake of fresh fruit and vegetables.
6	Number of residents participating in nutrition education and healthy lifestyle program that increased their knowledge of proper diet, healthy food preparation, body mass index, and healthy lifestyle.

Outcome #1

1. Outcome Measures

Percentage of parent participants who make better food choices (fruits/vegetables).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #2

1. Outcome Measures

Percentage of participants who improved eating habits.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #3

1. Outcome Measures

Development of broad applications for the inhibition of breast cancer cell proliferation and possibly cell transformation

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of participants who improved their dietary intake, including an increase in fruits and vegetables

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Percentage of participants, who through information and interactive approaches, have adopted better eating habits thereby increasing their daily intake of fresh fruit and vegetables.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of residents participating in nutrition education and healthy lifestyle program that increased their knowledge of proper diet, healthy food preparation, body mass index, and healthy lifestyle.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The east side of Washington, DC is plagued with disparities in health, economics, and the built environment. Our highest income Ward (Ward 3) has access to an array of grocery stores, upscale restaurants, and attractive run/walk/bike paths within a one to two mile radius. On the contrary, Wards 5, 7, and 8 have limited grocery stores (four in Ward 5, three in Ward 7, and one in Ward 8) and safe open play spaces within walking distance according to the DC Office of Planning of the Government of the District of Columbia.

What has been done
In an effort to bridge the gap between healthy food access and lifestyle behaviors, the Bridge Park Community Nutrition and Wellness Training was developed and led by Dr. Tia Jeffery, a registered dietitian/nutritionist and project specialist for the Center for Nutrition, Diet, and Health (CNDH), and Kayla Rodgers, George Washington University MPH candidate and certified personal trainer.
This training provided a supportive environment conducive to improving eating and lifestyle behaviors, healthy food preparation skills, and engagement in the recommended amounts of physical activity.

Results

Participants gained insight on their health numbers and how those numbers could impact their risk factors. The comprehensive body composition assessment allowed participants to see and understand their distribution of muscle to fat tissue, the influence of diet and exercise on the distribution ratio of muscle to fat tissue, and how results could impact their metabolism, heart disease, type 2 diabetes, and cancer risk regardless of the numbers on the scale. Participants were especially engaged in the hands-on food demonstrations that provided individuals with creative preparation techniques for their urban garden fruits and veggies, often commenting that they began using the recipes at home as a useful tool and they expressed interest in obtaining other CAUSES-CNDH certifications such as safe food handling. One faith-based community participant from Union Temple Baptist Church in Ward 8 stated she enjoyed the healthy cooking demos and that they were practical with simple ingredients as well as quick preparation ideas.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Family and Social Support)

Brief Explanation

There were no external factors which affected the outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Urban Families, Youth, and Communities

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
608	Community Resource Planning and Development	10%		0%	
801	Individual and Family Resource Management	10%		0%	
802	Human Development and Family Well-Being	20%		0%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	20%		0%	
806	Youth Development	40%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	0.0	5.0	0.0
Actual Paid	6.8	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
385283	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1) Leadership Development Meetings
2) Sewing
3) Language Program - Spanish
4) Gardening Projects
5) Computer Labs
6) Water Quality and GIS Technology
7) Curriculum Development
8) Fact Sheets
9) Newsletters
10) LifeSmarts Consumer Education
11) Videotape series
12) Community Business entry-level training

2. Brief description of the target audience

1) Youth
2) Adults
3) Seniors
4) Military Personnel
5) DC residents
6) College students
7) Ex-offenders
8) Low to moderate income residents
10) Low income families with youth in high risk communities
11) Small, new start, home based businesses

3. How was eXtension used?

Webinars from eXtension were provided to the staff and volunteers.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1700	1980	3982	1450

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants in parenting workshops.

Year	Actual
2016	27

Output #2

Output Measure

- Conduct 15 sessions per year for junior and senior high schools in the District of Columbia on financial planning.

Year	Actual
2016	8

Output #3

Output Measure

- Percent increase in the number of 4-H clubs throughout the city.

Year	Actual
2016	40

Output #4

Output Measure

- Youth will receive training in the areas of STEM education, and sewing, health and fitness, and camping.

Year	Actual
2016	3100

Output #5

Output Measure

- Youth will receive leadership development training through conferences and special programs.

Year	Actual
2016	2490

Output #6

Output Measure

- Youth that are members of a military family will receive 4-H programming as members of the 4-H program and as a seperate group of military participants though the 4-H military partners program.

Year	Actual
2016	300

Output #7

Output Measure

- Number of youth participating in 4-H club activities that have a parent/s that is/are incarcerated. Not reporting on this Output for this Annual Report

Output #8

Output Measure

- Number of articles published

Year	Actual
2016	0

Output #9

Output Measure

- Number of fact sheets published

Year	Actual
2016	0

Output #10

Output Measure

- Number of newsletters published

Year	Actual
2016	0

Output #11

Output Measure

- Number of workshops implemented

Year	Actual
2016	0

Output #12

Output Measure

- Number of research projects completed

Year	Actual
2016	0

Output #13

Output Measure

- Number of informational materials distributed

Year	Actual
2016	2300

Output #14

Output Measure

- Number of conference presentations

Year	Actual
2016	4

Output #15

Output Measure

- Number of certificate of completion
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of children who have increased their knowledge of the essential elements of team work through participation in 4-H club actitivies.
2	Number of children who demonstrate responsibility as a result of participation in 4-H Program activities. participation.
3	Number of parenting workshop participants who have used their knowledge of support services available to apply for assistance in an effort to meet some of their parenting needs.
4	Number of Youth demonstrating an immediate and long-term commitment to civic engagement.

Outcome #1

1. Outcome Measures

Number of children who have increased their knowledge of the essential elements of team work through participation in 4-H club actitivies.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	250

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Parents, teachers and community leaders report that youth in their neighborhood are at risk for drug and gang activity. They make very unhealthy food choices and spend too much time on electronic devices, leading to poor health.

What has been done
Led by Extension Agent Diego Lahaye with volunteer efforts from seven community coaches and four CAUSES 4-H interns, youth were engaged in a nine week 4-H Soccer and Nutrition Program. The program also featured Health Rocks, our 4-H tobacco and drug prevention program. Trophies and awards were presented to Most Valuable players and most improved players. Presentations were made by area college students about the importance of staying fit and avoiding drugs to reach mastery in a sport.

Results
100% of the youth involved have improved health in the area of fitness.
70% of youth show mastery of skills in soccer techniques. Soccer is a sport that requires continuous practice to master.

Students report drinking more water and Gatorade as no soda was allowed at this program. They were more hydrated and healthy.

The time requirements and level of activity and the information provided about drug prevention resulted in 80% of youth reporting a commitment to avoid drugs.

460 parents attended the championship program. 700 youth are engaged in the 2017 program to date.

Former Professional Soccer Star Jose Soto has joined program efforts and is working to identify sponsors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

Number of children who demonstrate responsibility as a result of participation in 4-H Program activities. participation.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	43

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Parenthood is a leading cause of school dropout among teen girls. Thirty percent of all teen girls who have dropped out of high school cite pregnancy or parenthood as a key reason, and the rate is higher for
minority students: 36 percent of Hispanic girls and 38 percent of African American girls cite pregnancy or parenthood as a reason they dropped out. One in three (34%) of young women who had been teen mothers earned neither a diploma nor a GED, compared
with only six percent of young women who had not had a teen birth. Less than two percent of young teen mothers (those who have a baby before age 18) attain a college degree by age 30.

What has been done
Trained 4-H Volunteers, nutrition educators and college interns developed our 4-H Young Mothers Sewing and Nutrition Program. Daily, the young ladies learn to sew clothes for themselves and their babies. They received a workshop training from trained 4-H volunteer, Alex Bonilla, Bank America, about best practices for marketing and selling their creations online and in the global market place. The youth, some not young mothers, also made hammocks that they will sell at the UDC Farmers Market this spring.

Results

86% present of the youth involved have reached a level of mastery in sewing. 100% have completed more then five projects. 100% of the youth that participated in the first year came back the second year. More then 80% report making clothes just for the baby. 73% report eating more healthy diets as a result of the workshops presented.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Number of parenting workshop participants who have used their knowledge of support services available to apply for assistance in an effort to meet some of their parenting needs.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	150

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One in seven District households is struggling against hunger, and while the nation's federal nutrition programs have a wide reach in Washington, DC, too many adults and children continue to slip through the nutrition safety net.

The ability to obtain enough food for an active, healthy life is the most basic of human needs. Without access to adequate healthy food, people are likely to be hungry, undernourished, and in poor health, with high rates of obesity, heart disease, diabetes, and other nutrition-fueled health problems. Additionally,(%)35.0 of District Children age 10-17 years old weight (Overweight or Obese), 2011-12

What has been done
CAUSES Nutrition and Dietetics students became 4-H volunteer leaders teaching nutrition and healthy eating and making food preparation demonstration for children in five different schools. The six or more weeks programs introduce veggies that children may have never tried before. Children played nutrition games and helped cook special recipes. The work accounts for 30% of the college student's grade.

Results
100 % of the children report that this 4-H Program is their favorite school activity. Program enrollment increased because of the popularity of the program by 75% percent. 89% of the youth report a clear understanding of the importance of eating healthy meals and snacks.
100% of the UDC College students continued to volunteer after their obligation was over and they returned for a second year as volunteers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #4

1. Outcome Measures

Number of Youth demonstrating an immediate and long-term commitment to civic engagement.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	70

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth influence 70% of household purchases and they are ill-prepared to make consumer wise decisions. Urban youth often miss information about emerging environmental problems such as climate change and water quality because of their regular environment and they usually travel by subway. Leadership platforms are all around them and they often don't engage even in the political spectrum.

What has been done
Youth were involved in the Consumer LifeSmarts Program. LifeSmarts is a game show competition that focuses on Consumer Education. Teams of five youth and a coach learn information about the environment, technology, health and safety, legal rights and responsibilities, and personal finance. Also, Extension Agent Diego Lahaye worked with our military youth to become Jr. Journalists for the 2017 Inauguration.

Results

100% of the youth in the program demonstrated more knowledge of consumer education through the competition and post test. After the competition, youth participants made presentations to four local schools about consumer issues. 100% of the youth involved report they will tell a friend about the program. 100% of the middle school youth report they will come to the competition as high school students.
Jr. Journalists improved their leadership skills interviewing senators and military generals regarding the importance of this civic event. They were featured in the military newspaper and media outlets. They were also asked to train youth from the State Department. 100% of youth expressed an interest in returning to the program. 100% show improvement in self-confidence.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Community Support)

Brief Explanation

In May of 2016 we lost one of our two extension agents and that position remains unfilled due to new hiring policies at the university.
We have a operating budget of only $10,000 for the entire program year. We have applied for external funds and are waiting for additional monies.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Program evaluations indicate that we are meeting our targeted populations and program outcomes. Problems with childhood obesity are being addressed with great outcomes through our UDC Nutrition program activities, soccer and nutrition program, Tae Kwon Do, bike repair program and teen mom nutrition. They are learning about food security with our 4-H school gardens, beekeeping education and agricultural tours to the our Firebird Farm, 20 "green roof and urban farm in the city - East Capitol Farm. These programs continue to be requested by the same schools with different classes of youth at a rate of about 70%. Through our NASA Globe program youth are learning about climate change, water quality education and environmental changes around the globe. Seven new schools are now engaged in the program. During the summer program an emphasis was placed on sustainable energy and living. Enrollment in specialized programs is increasing.

On average, 80% of youth in our program have gained the knowledge we wanted to impart. On Average, 80% return to the programs for a second year of programming.

Key Items of Evaluation

Youth team building, STEM education, childhood obesity prevention, climate change education through photography, civic engagement, and leadership education were areas of attention for this reporting period.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Alternative Energy and Capacity Building

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	40%		0%	
607	Consumer Economics	30%		50%	
802	Human Development and Family Well-Being	20%		30%	
903	Communication, Education, and Information Delivery	10%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	3.0	0.0
Actual Paid	2.2	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
142364	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Five Pillars of Economic Development

The research project ended December 2016. The following project components have been successfully completed:

Data Collection: In its initial phase, the research project developed a sizable data base of indicators by Ward that provide information of five key areas that are indicative of a community's economic development potential, the five pillars of economic development: (1) health, (2) education, (3) social and cultural amenities, (4) environmental quality and (5) access to information and transportation.

Focus Groups: In addition to these quantitative indicators, the research uses an innovative story writing process in the Deanwood and Congress Heights neighborhoods that represent the different histories, economic conditions, and demographics within the most underserved Wards, Ward 7 and 8 of Washington DC. To assist with the logistics of the research project, the PI hired a three-months full-time project coordinator who is a recent UDC graduate and resident of one of the neighborhoods where the two focus group meetings were held. Fourteen UDC students were trained to engage in the various aspects of the research project, including as focus group facilitators, recorders, and as research assistants. The project's PI, Dr. Sabine O'Hara, designed the focus group process and content and held two training sessions for facilitators and recorders prior to conducting the focus groups.

During the introductory segment of the two focus group meetings, the PI educated more than 200 DC residents and CAUSES faculty and staff members on the health disparities and economic development disparities in Washington DC and introduced the community based approach to economic development that the Five Pillars model offers. To provide appropriate background information for the focus group participants, the project PI and project coordinator prepared and disseminated quantitative data about key quality of life indicators in the two selected neighborhoods that were taken from the previously selected database of indicators. The project PI briefed all participants on the major findings of the quality of life comparisons between the eight Wards in the District of Columbia. In addition, flyers were available during the focus group meetings to summarize the data collected.

The Story of the Future of the Selected Neighborhoods: Based on the focus group results, a first story draft was developed that records the collective vision of success and prosperity 25 years into the future. This community based vision of economic development success will yield invaluable information about the aspirations and needs of local residents, demographic sub-groups, and key stakeholders including the business community, service providers, the public sector and other relevant groups. The story also indicates a significant level of awareness among Deanwood and Congress Heights residents about available sustainable economic development options that the two neighborhoods wish to explore.

Story Feedback: In March 2016, the focus groups reconvened at DC Scholars Public School on East Capitol Street in DC's Ward 7. Three CAUSES staff members who had been involved in the focus groups took turns reading the story to meeting participants. Overall, the story was well received and meeting participants confirmed that the story captures well the discussion the focus groups had had about their future vision of their neighborhoods with respect to the Five Pillar areas. Meeting participants requested, however, that the story be further personalized and that there be one protagonist created for the Deanwood neighborhood and one for the Congress Height neighborhood. This has since been accomplished and the story has been re-written in a more personalized story format based on the demographic characteristics of the majority populations in the two neighborhoods.

Two final neighborhood meetings will be held in early May of this year, one in Deanwood, and one in

Congress Heights to share the final version of the story and to solicit feedback in the overall structure of the final report of the Five Pillars of Economic Development research project. Since the data collected is extensive, the final report will only include selected indicators in the five pillars areas, with additional data being made available in an appendix to the report

Dissemination of Results: A preliminary meeting with focus group participants from both neighborhoods regarding the proposed dissemination of the report revealed a strong preference for a web-based dissemination strategy. The PI has identified a UDC student who will assist in developing a website that displays the indicators collected in the Five Pillar areas. An initial six indicators will be selected for each of the Five Pillar areas for a total of 30 selected indicators for each of the eight Wards or a total of 240 indicators. Even at six indicators per Pillar this constitutes a significant amount of data that will have to be updated annually to indicate a trend in the data.

In addition to the website design, a final report and publishable article are currently in preparation.

2. Brief description of the target audience

- DC residents - underserved communities

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	200	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total

Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops completed
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of fact sheets published
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of articles published
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of informational material distributed
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of conference presentations
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Number of certificate of completion issued
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of research projects completed

Year	Actual
2016	1

Output #8

Output Measure

- Number of newsletters published
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percent increase in renewable energy production use due to green infrastructure
2	Percent increase in water reuse and conservation due to green infrastructure
3	Percent increase in energy conservation due to green infrastructures
4	Discovery from research leading to impactful addition/change in an extension program.

Outcome #1

1. Outcome Measures

Percent increase in renewable energy production use due to green infrastructure

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

Outcome #2

1. Outcome Measures

Percent increase in water reuse and conservation due to green infrastructure

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

Outcome #3

1. Outcome Measures

Percent increase in energy conservation due to green infrastructures

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Discovery from research leading to impactful addition/change in an extension program.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many underserved urban neighborhoods have been excluded from economic development success even in times of economic expansion. Economic development challenges are typically exacerbated in times of economic stagnation. Washington DC is especially challenging in this regard. It is a tale of two cities. Wards 2 and 3 in the NW sector of the District have household incomes of $110,000 per year, low unemployment rates of 4% or less and less than 10% of the population are African American; neighborhoods in Wards 7 and 8 east of the river have household incomes of $35,000 per year, unemployment is close to 20% and over 80% of the population are African American. This bi-furcation distorts economic development success as averages within the District are not sufficiently descriptive of the realities of the most city's underserved neighborhoods.

What has been done

Economic development success is possible. The key lies in identifying viable economic development strategies that strengthen the individual and community based assets of underserved communities and meet local needs. Using the pioneering work of Dr. Sabine O'Hara (O'Hara, S. and Vazquez, J. 2007) as its starting point, this alternative approach to economic development provides a bottom-up methodology to assessing a community?s economic development potential that enables local residents to define and shape their own future. Information was generated via data collection and focus groups about local needs and individual and community based assets in two District of Columbia neighborhoods, Deanwood and Congress Heights. Focus groups were conducted and storytelling was a method used, resulting in feedback from participants.

Results

The research successfully generated information about local needs and individual and community based assets in two Washington DC neighborhoods, Deanwood and Congress Heights. A story was drafted and edited as a result of input from community participants. The story indicates a significant level of awareness among Deanwood and Congress Heights residents about available sustainable economic development options that the two neighborhoods wish to explore. Additionally, the research project revealed several areas for follow up work in the cooperative extension programs of CAUSES. The desire to create energy at a neighborhood scale from alternative energy sources, including solar, bio-digestion, and geothermal, played a prominent role in the focus group meetings. This unexpected result of the Five Pillars research project has resulted in a reconsideration of the energy sources for the UDC Urban Food Hubs. The first component of the Urban Food Hubs, Food Production, has long focused on energy efficiency and on designing aquaponic and hydroponics systems that are highly energy efficient; and the fourth component of the Urban Food Hubs, Waste and Water Recovery, has long focused on waste reduction and water reuse; the East Capitol Street Urban Food Hub will now add a solar energy component. Three solar panels were installed at the site in late September 2016 and the 30x90 ft greenhouse was operated largely off the grid. CAUSES is currently identifying additional funding sources to add an alternative energy source to all of its food hubs and to begin a workforce development and training program in solar installation and maintenance in collaboration with the District Department of Energy and the Environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
607	Consumer Economics
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations

Brief Explanation

There were no external factors which affected the outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Based on the focus group results, a first story draft was developed that records the collective vision of success and prosperity 25 years into the future. This community based vision of economic development success will yield invaluable information about the aspirations and needs of local residents, demographic sub-groups, and key stakeholders including the business community, service providers, the public sector and other relevant groups. The story also indicates a significant level of awareness among Deanwood and Congress Heights residents about available sustainable economic development options that the two neighborhoods wish to explore.

In March 2016, the focus groups reconvened at DC Scholars Public School on East Capitol Street in DC's Ward 7. Three CAUSES staff members who had been involved in the focus groups took turns reading the story to meeting participants. Overall, the story was well received and meeting participants confirmed that the story captures well the discussion the focus groups had had about their future vision of their neighborhoods with respect to the Five Pillar areas. Meeting participants requested, however, that the story be further personalized and that there be one protagonist created for the Deanwood neighborhood and one for the Congress Height neighborhood. This has since been accomplished and the story has been re-written in a more personalized story format based on the demographic characteristics of the majority populations in the two neighborhoods.

Key Items of Evaluation

The Five Pillars research project revealed several areas for follow up work in the cooperative extension programs of CAUSES. The desire to create energy at a neighborhood scale from alternative energy sources, including solar, bio-digestion, and geothermal, played a prominent role in the focus group meetings. This unexpected result of the Five Pillars research project has resulted in a reconsideration of the energy sources for the UDC Urban Food Hubs. The first component of the Urban Food Hubs, Food Production, has long

focused on energy efficiency and on designing aquaponic and hydroponics systems that are highly energy efficient; and the fourth component of the Urban Food Hubs, Waste and Water Recovery, has long focused on waste reduction and water reuse; the East Capitol Street Urban Food Hub will now add a solar energy component. Three solar panels were installed at the site in late September 2016 and the 30x90 ft greenhouse was operated largely off the grid. CAUSES is currently identifying additional funding sources to add an alternative energy source to all of its food hubs and to begin a workforce development and training program in solar installation and maintenance in collaboration with the District Department of Energy and the Environment.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Water Safety and Water Management

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
104	Protect Soil from Harmful Effects of Natural Elements	0%		50%	
111	Conservation and Efficient Use of Water	0%		50%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Paid	0.0	0.0	1.7	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	94066	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	113974	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The project was awarded late in the fiscal year. Between July 2016 and Sep 2016, the following progress was made:

Objective 1: To design and manufacture the metallic oxide nanoparticles infused mesoporous material.
Completed:

1. **Major activities completed**: a hybrid mesoporous materials with metallic oxide nanoparticles has been developed. A new synthesis method has been proposed to prepare this hybrid material at a cost effective and efficient way.
2. **Data collected**: Using the modified hydrothermal method, we could potentially synthesize the hybrid material within 24 hours.
3. **Discussion of the results**: current preliminary results have shown that this modified hydrothermal method can be used to synthesize the material with a very high yield rate (~70%) and a short time frame (less than 24 hours). The next step is to test this method by preparing more samples, and to optimize this method to further reduce the time and improved yield rate.

Objective 2: To characterize the microstructure and evaluate the pollutant removal performance of the synthesized material.
Nothing yet to report.

Objective 3: To design a stormwater collection and treatment system with synthesized material.
Completed:

1. **Major activities completed**: an initial design of the stormwater collection and treatment system has been drafted and some essential parts have been quoted and ready for ordering.
2. **Data collected**: a compact and expandable stormwater collection and treatment system prototype has been designed, which can be used to harvest and store stormwater from densely populated urban areas and use it to produce food at relatively low costs. This system consists of an expandable storage tank that has a minimum volume and occupied space of 5 cubic feet and can expand to a theoretical maximum volume of 9 cubic feet almost doubling the size of the tank. The filtration system consists of a mechanical filtration with a filter size of 250 microns and a chemical filtration system with a mesoporous nanostructured material to filter heavy metals and other pollutants.
3. **Discussion of the results**: current preliminary modeling and calculation have shown that this system can be easily built and it can be attached to the down spout of a typical DC house.

Objective 4: To evaluate its performance, and optimize the design to reduce the cost and time-consumed of per-liter clean water processed.
Nothing yet to report.

2. Brief description of the target audience

DC residents; High School teachers and students; Urban Gardeners; Resesearchers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Optimize the design of the treatment system to reduce the cost and time-consumed of per-liter clean water processed
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Design and completion of an efficient storm water collection and treatment system

Outcome #1

1. **Outcome Measures**

Design and completion of an efficient storm water collection and treatment system

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	100%		100%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	1.5	0.0	1.0	0.0
Actual Paid	2.3	0.0	2.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
165476	0	94149	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
149458	0	195399	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5014	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research: Soil Analysis for Trace Elements and Urban Gardening in the District of Columbia

This is the last year for the project. During this reporting period, the accomplishments of this research project include:

- Analyzed soil quality data for samples collected from all 8 wards of DC, including trace metals, minerals, pH, extractable phosphate and nitrate level.

- Analyzed soil quality data of samples from a community as well as home gardens for the level of arsenic and lead and compare measured data with EPA soil screening guidelines.

- Developed a GIS Map for Arsenic level, including garden plots that exceeded level of EPA soil screen guidelines.

- Assessed potential accumulation of arsenic and lead in vegetable crops grown in a contaminated soil using pot experiment.

- Made presentations of the project finding at local and national conferences

The result shows that some garden plots are highly contaminated in lead up to 8 times EPA soil screening guidelines of 400 mg/kg. Out of more than 500 samples, 83% have excess phosphate.

The main output of the reporting period was to analyze several soil samples for the application of national laboratory accreditation, the National Environmental Laboratory Accreditation Program (NELAP). UDC submitted all required data for this accreditation, including two sets of proficiency tests, demonstration of capability, and method detection limits. We also initiated fee based laboratory service for soil and water analysis for metal elements. Most importantly, a new website was created for the lab service: www.udc.edu/EQTL.

Presentations made during the reporting period:

Rose, Sania, Trinh Vu, Yacov Assa, Sebhat Tefera, and Tolessa Deksissa (2016). Analysis of Arsenic, Copper, and Lead Contamination in Urban Gardens in the District of Columbia. The 2016 Emerging Researchers National (ERN) Conference in STEM, Washington, DC, February 25-27, 2016. PowerPoint Presentation

Rose, Sania, Trinh Vu, Yacov Assa, Sebhat Tefera, and Tolessa Deksissa (2016). Analysis of Arsenic, Copper, and Lead Contamination in Urban Gardens in the District of Columbia. The 73rd Joint Meeting BKX and NIS for 2016 will take place in Hampton, Virginia, April 6 - 9, 2016. PowerPoint Presentation

Deksissa, Tolessa, Sebhat Tefera,and Yacov Assa (2016). Urban Soil Quality Assessment as Green Urban Stormwater Management Strategy. NCR-AWRA 4th Annual Water Symposium, Washington, DC, April 8, 2016. PowerPoint Presentation

Deksissa, Tolessa (2016). Unbiased Soil and Water Quality Monitoring: Academic and City Collaborations, Director, Water Resources Research Institute, Sustaining Water Resources in the Mid Atlantic, Dec. 6,

2016. PowerPoint Presentation.

This project has created training and professional development opportunities for PI's, faculty, graduate and undergraduate students. Working on this project, the PI's had the opportunity to conduct and set up a new research project, apply state of the laboratory techniques, including trace metal analysis in soil, bio-solids and plant tissues using the latest lab equipment, Nexion 300 D ICP-MS. Faculty and students were trained on the basic operation of sample preparation and analysis. All participating personnel got the chance to publish paper and make presentation at national conferences. The project advanced professional experience of three researchers including the PI: Sebhat Tefera, Yacov Assa and Tolessa Deksissa. We also trained 15 graduates for the last three years and 20 undergraduates this year alone on the lab analysis. This project was very successful in terms of training large number of graduate research assistants, researchers and faculty.

During this reporting period, three (3) graduate assistants and two lab senior personnel or co-principal investigators have participated on this research project. Students assisted in sample collection, sample preparation and sample analysis. The lab personnel assisted in the sample preparation for lab analysis.

The results of the project have been disseminated via conference proceedings, local and national oral and poster presentations and direct contact with the DC residents that have received free soil testing service as part of the project activities. DC urban gardeners have received interpretation of their soil testing result and recommendations for further action to improve their soil quality. During this reporting period, we have communicated the need of soil quality testing with more than 400 gardeners. As of 2017, about 600 soil test results together with recommendation have been disseminated to DC gardeners.

Food Handler Certification will include:

1) Pretest
2) Post Test
3) National Examination
4) DC Code Examination
5) Ability of agencies to pass DC inspections
6) Measure of knowledge acquired from food handler certification messages include in the national examination
7) Data Collection
8) Data Analysis
9) Reporting

2. Brief description of the target audience

- Catering and other small food preparation industries as well as non-commercial agency food handling staff members
- Ongoing participating food handlers
- Non-profits

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	79	198	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classroom instruction/workshops on Food Handler Certification Regulations to include DC Code Examination or Serve Safe National Examination, and Practice Examinations

Year	Actual
2016	15

Output #2

Output Measure

- Number of articles published

Year	Actual
2016	0

Output #3

Output Measure

- Number of fact sheets published

Year	Actual
2016	24

Output #4

Output Measure

- Number of newsletters published

Year	Actual
2016	24

Output #5

Output Measure

- Number of workshops implemented

Year	Actual
2016	15

Output #6

Output Measure

- Number of research projects completed

Year	Actual
2016	0

Output #7

Output Measure

- Number of informational materials distributed

Year	Actual
2016	5500

Output #8

Output Measure

- Number of conference presentations

Year	Actual
2016	1

Output #9

Output Measure

- Number of certificate of completion

Year	Actual
2016	79

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage decrease in the risk of factors of foodborne illness.
2	Number of participants gaining awareness, knowledge and skills in Food Handling techniques.
3	Number of participants scoring a required minimum of 70% on post test and national examination.

Outcome #1

1. Outcome Measures

Percentage decrease in the risk of factors of foodborne illness.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Each year, roughly one out of six Americans get sick; 128,000 are hospitalized; and 3,000 die from foodborne illness (Academy for Nutrition and Dietetics, 2016). Foodborne illness is a major problem throughout the country, and even here in Washington, DC. More than 200 diseases are spread through food (World Health Organization, 2016). With 5,500+ food establishments in the District of Columbia alone, the need for intelligent, passionate, and dedicated Certified Professional Food Managers is urgent. There are only 22 sanitarians, two administrative staff, two supervisors, one program manager, and one food technologist employed by the District of Columbia. Thus, the Certified Professional Food Manager course is necessary to continue to train qualified individuals to help monitor and ensure food safety.

The Certified Professional Food Manager Course is taught by Paul Brown Jr. It is a vital program in the District of Columbia that helps residents get the certification and confidence needed to gain employment in commercial food operations. One student, Delores Robinson, in August 2016 stated that she was able to remember almost everything the instructor said word for word. Further, she stated that she got her pay day because of your class. It also helps to safeguard that the food that is being served to the public and residents of the District of Columbia, is safe and free from physical, chemical and biological contamination. The course is a three day, 16 hour course which delves into basic food safety and sanitation, and how to make sure employees, facilities, and food products are food-safe compliant. It runs from 9:00am -4:00pm each day, and culminates with students taking a nationally recognized exam from Prometric. The course is taught regularly throughout the year at the University of the District of Columbia and we also work with a couple of partners throughout the city as well. The areas of focus in the city have been wards 5, 7, and 8. The vast majority of students tend to be African American and women.

What has been done

The course helps students get food manager certification by taking and passing a National Exam,

which is good for five years. We also help them by giving the students some practice tests to get ready for the National Exam. We give them a pre-test before we start teaching to see what they know before any lessons are taught. A post-test to see what they have learned from the lessons taught and from studying independently at home. Finally, we have a DC Food Code exam which explains the rules and regulations for food managers working in the District of Columbia. We focus our CPFM course on teaching basic food safety and its principles. We use the book, NSF HealthGuard Professional Food Manager Certification Training Version 6.0, as a guide to delve into the important aspects of food safety, foodborne illness, the food facility, pest management, and the principles of food safety. This certification is helpful to anyone who would like to take the course, but is vital to those seeking employment in food service. It aids those working in commercial kitchens, restaurants, fast food, daycares and schools or those who are looking to go into business for themselves. This usually happens through the increasingly popular mobile food facilities (food trucks), bed and breakfasts, and catering businesses. This certificate is a requirement to work in commercial food settings or where food is being served to the public. It allows for upward mobility for those already employed in lower level food service.

Results

From fiscal year 2015 to fiscal year 2016, test scores have been fairly static. The only dip we saw was in the National scores. The average pre-Test score was down from fiscal year 2015, the average score was 62, in fiscal year 2016 the average score was 61, still up from FY 2014 when it was 59. In fiscal year 2015, the average Post-Test score was 89, in fiscal year 2016 the average post-test score stayed the same at 89. It is still up from FY 2014 when the average post-test score was 79. Lastly, the average National Exam score in fiscal year 2015 was 91, the average National Exam score in fiscal year 2016 was 85. It is down from FY 2015, but still up from FY 2014 when the average National Exam score was 79. The passing grade for the National Exam is 70, so there will be continued emphasis on independent learning and studying at home, and learning and studying of the materials and curriculum presented in the classroom. While we had a good year, there is always room for improvement. We had 97 people to take and pass the National Exam. Twenty-one (21) of those students were male, so 21.65% of students who took and passed the National Exam were male. For Fiscal Year 2017, it is our plan to target and have more males take and pass the course to become Certified Professional Food Managers. The percentage we would like for Fiscal Year 2017 would be 35-40% of the students male. Also, we aim to raise the average scores on the National Exam. We will attempt to go more in-depth in the lessons on the subject of food safety, as well as making the lessons more clear and easy to understand.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of participants gaining awareness, knowledge and skills in Food Handling techniques.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of participants scoring a required minimum of 70% on post test and national examination.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	79

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Each year, roughly one out of six Americans get sick; 128,000 are hospitalized, and 3,000 die from foodborne illness (Academy for Nutrition and Dietetics, 2016). Foodborne illness is a major problem throughout the country, and even here in Washington, DC. More than 200 diseases are spread through food (World Health Organization, 2016). With 5,500+ food establishments in the District of Columbia alone, the need for intelligent, passionate, and dedicated Certified Professional Food Managers is urgent. There are only 22 sanitarians, two administrative staff, two supervisors, one program manager, and one food technologist employed by the District of Columbia. Thus, the Certified Professional Food Manager course is necessary to continue to train qualified individuals to help monitor and ensure food safety.
The Certified Professional Food Manager Course is taught by Paul Brown Jr. It is a vital program in the District of Columbia that helps residents get the certification and confidence needed to gain employment in commercial food operations. One student, Delores Robinson, in August 2016, stated that she was able to remember almost everything the instructor said word for word and that she got her pay day because of the class. Tt also helps to safeguard that the food that is being served to the public and residents of the District of Columbia, is safe and free from physical, chemical and biological contamination.

What has been done

The course is a three day, 16 hour course which delves into basic food safety and sanitation, and how to make sure employees, facilities, and food products are food-safe compliant. It runs from 9:00 am - 4:00 pm each day, and culminates with students taking a nationally recognized exam from Prometric. The course is taught regularly throughout the year at the University of the District of Columbia and we also work with a couple of partners throughout the city as well. The areas of focus in the city have been wards 5, 7, and 8. The vast majority of students tend to be African American and women. The course helps students get food manager certification by taking and passing a National Exam, which is good for five years. We also help them by giving the students some practice tests to get ready for the National Exam. We administer a pre-test before we start teaching to see what they know before any lessons are taught. A post-test to see what they have learned from the lessons taught and from studying independently at home. Finally, we have a DC Food Code exam which explains the rules and regulations for food managers working in the District of Columbia.
We focus our CPFM course on teaching basic food safety and its principles. We use the book, NSF HealthGuard Professional Food Manager Certification Training Version 6.0, as a guide to delve into the important aspects of food safety, foodborne illness, the food facility, pest management, and the principles of food safety.

Results
97 people took and passed the National Exam. Twenty-one (21) of those students were male, so 21.65% of students who took and passed the National Exam were male. 100% of he students passed the national exam.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Government Regulations
- Other (Change in program procedures)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Pre-test, post-tests, and a national exam were administered.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
600	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.