CONSERVE

A Center of Excellence at the Nexus of Sustainable Water Reuse, Food, and Health

YEAR 1 ACHIEVEMENTS

(March 2016 - February 2017)

THE CONSERVE TEAM

Amy R. Sapkota (University of Maryland School of Public Health): Dr. Sapkota, the CONSERVE Project Director, is an environmental microbiologist with 15 years of experience developing, refining and applying culture- and molecular-based methods for the detection and quantification of bacterial pathogens in environmental media, including water, air, food and soil.

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CONSERVE AT A GLANCE

CONSERVE: A Center of Excellence at the Nexus of Sustainable Water Reuse, Food, and Health was established in 2016 through a $10 million grant from the United States Department of Agriculture (USDA) National Institute for Food and Agriculture (NIFA) Water for Agriculture Challenge Area program to the University of Maryland School of Public Health. The long-term goal of the Water for Agriculture Challenge Area program is to "solve critical water resource problems in rural and agricultural watersheds across the United States". Within this framework, CONSERVE employs a systems approach to evaluate the availability (quantity and quality) of nontraditional irrigation water sources (e.g. recycled water, brackish water, return flows) that could be used to help agricultural producers conserve groundwater; identify the socio-behavioral, economic and regulatory factors that impact the use of these sources; and develop, implement, and evaluate on-farm water treatment technologies for the safe and successful use of nontraditional irrigation water. We then share this new knowledge with agricultural and non-agricultural communities, and employ experiential education to teach, train, and inspire future leaders.

OUR CONSERVE MISSION

To facilitate the adoption of transformative on-farm treatment solutions that enable the safe use of nontraditional irrigation water on food crops.

There are multiple unique strengths to CONSERVE. First, we have an exemplary and diverse team of researchers, extension specialists and educators from two U.S. regions: the Mid-Atlantic and the Southwest. Our team also includes partners from Israel's Arava Institute for Environmental Studies (an international leader in agricultural water reuse), and we continually seek to partner with water reuse leaders from academia, government, industry and non-profit sectors. Our proven collaborative capacity speaks well for the success of CONSERVE and will allow us to maximally leverage existing resources. Our focus on the Mid-Atlantic and Southwest regions highlights two diverse climates that are in different stages of need for nontraditional irrigation water sources. Specifically, the Mid-Atlantic is currently not experiencing serious water shortages, and the integration of new irrigation water sources and emerging on-farm water treatment technologies at this time represents a proactive approach to agricultural water security. In contrast, the Southwest region is experiencing severe water shortage crises, and thereby represents a need for reactive solutions to water insecurity.

This report provides an overview of the progress of CONSERVE throughout our first year of funding.

OUR CONSERVE VISION

A national resource bringing together research, outreach, and education to effectively reduce the nation's agricultural water challenges that are exacerbated by climate change.

Characterizing the Availability and Quality of Nontraditional Irrigation Water Sources

Mapping Nontraditional Irrigation Water Sources

CONSERVE researchers have gathered data on all wastewater discharging facilities in four states within our focus area: Arizona, California, Delaware and Maryland. The data from Arizona and California have been uploaded to a new geospatial (mapping) platform developed by CONSERVE researchers. The platform not only contains data on nontraditional irrigation water sources but also includes other data such as cropping activity, hydrology, and soil layers. This novel geospatial platform will support the development of a decision support system that can be used by farmers to evaluate whether it is feasible for them to consider using nontraditional water sources to irrigate food crops.

Characterizing the Quality of Nontraditional Irrigation Water Sources

CONSERVE researchers have completed extensive water sampling in four states: Arizona, California, Delaware and Maryland. Samples have been tested for a suite of microbial, chemical and physical parameters. Total genomic DNA extractions on all water samples that have been collected in the Mid-Atlantic region have been completed and both 16S rRNA and metagenomic sequencing results are being analyzed. Salmonella isolates recovered from these samples have been sent for whole genome sequencing in collaboration with the FDA GenomeTrakr Program. In terms of viral and protozoal work, CONSERVE plans to generate the largest database in the world on the removal of enteric viruses and parasites in recycled water for food crop irrigation. This information can be used to 1) reassess current standards for treatment; and 2) complete microbial risk assessments for targeting removal levels needed for irrigation of food crops.

Developing Innovative Treatment Technologies to Improve the Quality of Nontraditional Water Sources Used to Irrigate Food Crops

Zero-valent iron (ZVI) biosand filtration

Based on the ZVI biosand filtration projects that CONSERVE researchers have conducted over the past 15 years, a list of water quality parameters that are deemed critical to (short- and long-term) ZVI performance have been identified. These include dissolved oxygen, pH, redox potential, acidity (or base buffering capacity), ionic strength, dissolved and total organic carbon, free and combined chlorine, dissolved and total iron concentrations, and turbidity. These data helped to inform the first CONSERVE greenhouse-based ZVI biosand filtration study that was carried out in year 1 where treated municipal wastewater was filtered and used to irrigate lettuce.

Preliminary results are quite promising with regard to the removal efficiencies for generic E. coli and the tested antimicrobials.

UV and ozone-based technologies

CONSERVE researchers are also evaluating treating reused water with ozone combined with microbubbles. To date, very early studies have seen a reduction of pathogenic E. coli in wash water reused 5 times and then treated with ozone.

17 field sites sampled in the Mid-Atlantic and Southwest (wastewater treatment plants; water reclamation irrigation sites; vegetable/beverage processing sites that discharge wastewater/ recycled water; and farms using pond water, non-tidal freshwater, tidal freshwater and tidal brackish water for irrigation)

1764 samples collected, processed, and analyzed for microbial, chemical and physical parameters

239 Salmonella isolates Whole Genome Sequenced by FDA GenomeTrakr Program

Understanding the Factors that Influence the Adoption of Nontraditional Irrigation Water Sources

Social, Behavioral and Economic Factors

Throughout the past funding year, over 1,600 adult subjects in the U.S. and Israel have participated in six economic experiments examining consumer preferences for foods grown with traditional vs. nontraditional irrigation water sources. The research aims to understand consumer perceptions of nontraditional water sources by measuring the amount of money consumers are willing to pay (WTP) for produce and products grown with crops irrigated with traditional well water compared to recycled grey, black, brown, or industrial water and other types of nontraditional irrigation waters. Over the course of the first year, consumer preferences for 17 different products have been examined, including: strawberries, blueberries, spinach, broccoli, olive oil, olives, dried olives, grapes, grape juice, raisins, baby carrots, almonds, seaweed salad, seaweed snacks, seaweed noodles, red wine and white wine.

Legal, Regulatory, and Policy Frameworks

The CONSERVE team of legal experts has been conducting research on the extent to which state water laws create barriers to more efficient water use and regulations governing the treatment and use of nontraditional sources of irrigation water. Research is near completion on the laws of Maryland, Virginia, Delaware, and California.

1,400 adult subjects participated in five economic experiments in the U.S. examining consumer preferences for foods grown with traditional vs. nontraditional irrigation water sources

202 adult subjects participated in economics experiments in Eilat Israel examining consumer preferences for foods grown with traditional vs. nontraditional irrigation water sources

4 states researched to compile the existing laws detailing water reuse for irrigating food crops (Maryland, Virginia, Delaware, and California)

Communicating the Message: Outreach and Extension

The CONSERVE Extension specialists have developed a needs assessment for growers in the Mid-Atlantic and Southwest. The assessment is designed to help the extension team understand growers' existing 1) knowledge of nontraditional irrigation water sources and on-farm water treatment technologies; 2) perceptions surrounding nontraditional waters; and 3) understanding of the laws associated with the use of these sources on food crops.

The Extension team has also established Extension Advisory Panels in the Mid-Atlantic and Southwest that will work with CONSERVE to provide information on how best to deliver extension programming.

3	high level advisory panels established (the CONSERVE Advisory Committee, the Mid-Atlantic CONSERVE Extension Advisory Panel, and the Southwest CONSERVE Extension Advisory Panel)
27	conference presentations by CONSERVE team members
9	articles published by or featuring CONSERVE team members
>580	adults participated in our grower-based needs assessment from Arizona, California, Colorado, Delaware, Florida, Maryland, Missouri, New Jersey, New York, Pennsylvania, Texas, Virginia, West Virginia
>20	extension conferences, workshops, outings and county meetings

61 CONSERVE scholars from 7 different institutions supported by CONSERVE funds and working toward CONSERVE goals (20 Undergraduate students, 21 graduate students, 6 post-doctoral fellows, 14 technical staff)

9 law, business, economics and public health students, including CONSERVE scholars, journeyed through Israel to study water reuse and learn about how the Arava Institute is working towards improving water access for communities in the West Bank

Inspiring the Next Generation of Leaders Engaged in Sustainable Water Reuse on Food Crops

CONSERVE educators have begun to develop K-12 curriculum on several levels. Team members have determined that irrigation water is less studied and taught than other aspects of water. While the water connection to food is made in some educational materials for children, a broad-based approach does not seem to exist. The CONSERVE educational curriculum will focus on two problems of water in agriculture, including too much water and too little water. The goal is to bring together concepts that are currently used to teach students with new materials including case studies, videos, graphics, and virtual laboratories.

During Year 1 of CONSERVE funding, the Media Productions team conducted design sessions to craft communication strategies for an overview video about CONSERVE topics and to identify issues of audience, message, and areas of sensitivity (such as potential consumer attitudes regarding foods grown with recycled water). CONSERVE has also begun to develop educational materials that can provide educator question prompts to establish understanding, make connections to self, and encourage critical thinking.

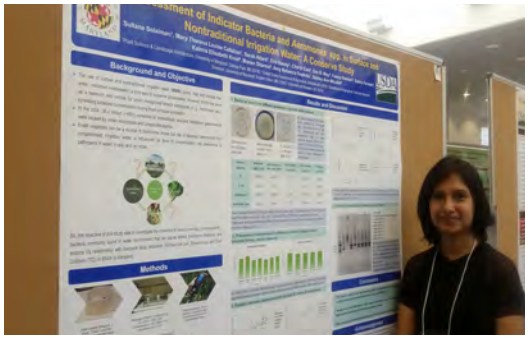
CONSERVE Team Working in the Field

Above Left and Right: CONSERVE Scholars sample water at Mid-Atlantic sites.

Bottom Left: Conducting surveys in Israel to examine consumer acceptance of food grown with nontraditional water sources.

Bottom Left: CONSERVE scholar at USDA-Beltsville Agricultural Research Center meeting.

Bottom Left: CONSERVE Scholars leading research, education and outreach at Maryland Day.



Top Left: Southwest Extension team providing outreach to growers and conducting needs assessments.

Top Right: CONSERVE collaborators working together at annual in-person meeting.

CONSERVE Team Working in the Field


Dare to be first.
University of Delaware
Dare to Experiment!

CONSERVE Year 2 plans are ambitious, including:

- A GIS database of nontraditional irrigation water sources in Maryland and Delaware.
- The completion of the most comprehensive database to date on enteric pathogens (bacteria, viruses, and protozoa) and chemical contaminants in nontraditional irrigation water sources that could be used for food crop irrigation.
- An assessment of water treatment needs for reused water sources to ensure the safety of irrigated food crops for human consumption.
- Data on factors that impact consumer response to food irrigated with reused water.
- A report that will answer the initial question of what do growers feel and know about reused water resources.

- Active learning-based educational modules on nontraditional water sources and curricula designed using specific principles.
- A diverse, transdisciplinary group of young scholars poised to either gain acceptance to graduate school or compete for jobs.
- The first cohort of CONSERVE Summer Interns (undergraduate students who will intern in CONSERVE-funded labs around the US).
- The first CONSERVE multimedia educational video.
- The first CONSERVE scholars socio-environmental data analysis workshop.
- The continuation of regular water sampling schedules.
- The continuation of consumer and grower assessment data collection and analysis.
- The initial research to establish a laboratory-scale ZVI filter that can be implemented into a field setting.
- Expansion of peer reviewed publications, conference presentations, and communications vehicles.
- CONSERVE on social media outlets Facebook and Twitter.

CONSERVE

Sustainable Water Reuse~Food~Health

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