Oklahoma Water Resources Center
Annual Review – CY2020

Extension SWOT Analysis

Strengths

- Strong connection to Extension Specialists and other faculty with water-related responsibilities
- Frequent communication with Extension leadership
- OWRC Program Specialist has strong connection and understanding of 4-H
- Strong Communications, Education and Outreach Staffing and Capabilities via Director, Assistant Research Professor (Education), Program Specialist, Communication Specialist, Technical Writer
- Growing newsletter distribution and social media presence
    - 1,300 persons on the e-newsletter distribution list (an increase of nearly 20%)
    - 529 persons like our Facebook page, a 37% increase
    - 906 Twitter followers, a 27% increase
    - 224 Instagram followers, a 190% increase
    - 765 YouTube subscribers, a 36% increase

Weaknesses

- Not well connected with county educators
- Not well connected to West or Northeast District Offices
- Website is outdated
- Insufficient time for Director to pursue new opportunities
- No full time Extension faculty/staff at OWRC focused on developing/delivering programs
- Few Extension programs or materials developed or delivered

Opportunities

- Significant need/opportunity for better understanding of OK water resources identified by statewide survey and development and delivery of new water Extension programs:
    - Well Owner Network in conjunction with Mississippi State, Auburn, and others
    - Riparian Education Program in conjunction with state (OCC), federal (NRCS), and other (GRDA) agencies in Oklahoma, as well as working with nearby states (TX and NM)
    - 4H2O Curriculum in conjunction with Dr. Kevin Allen
- Partnership opportunities via strong connection to other Water Resources Research Institutes throughout U.S., industry groups (Farm Bureau, Panhandle Ag Irrigators), and growing relationships with others (Lugert-Altus Irrigation District, OK Cattlemen's Association)
- Sustained/expanded support for irrigation (Oklahoma Master Irrigator Program) and other programming via strong connections to state (OCC, OWRB) and federal (NRCS, ARS) agencies

Threats

- Water not a priority identified by community forums
- Funding sources for new education programs are limited
- State agencies and cities are carrying out education programs Extension is better suited to lead

Research SWOT Analysis:

Strengths

- Great relationships with water research faculty across OSU
- Frequent communication with Experiment Station leadership
- Three OWRC faculty focused on research and new proposal development
- Growing number of water research faculty
- Growing water research portfolio within OWRC
- Submission of 27 funding applications in 2020 requesting >$33M

Weaknesses

- Startup funding support for Research Specialist (Mansaray) ends this FY
- Director time will allow only limited pursuit of new opportunities
- Low number/percentage of proposals funded in 2020 (4 of 27; 15%)
- Low number of publications (5) for OWRC in 2020
- Staff distributed throughout Ag Hall & limited physical space for growth of staff
- No funds to bring groups (internal or external) together to have collaborating events

Opportunities

- Strong connections to state (OCC, OWRB) and federal (NRCS, ARS) water/natural resource agencies, industry groups (Farm Bureau, Panhandle Ag Irrigators), and growing relationships with Lugert-Altus Irrigation District and OK Cattlemen's Association
- Strong connection to other Water Resources Research Institutes throughout U.S.
- Expected significant opportunities with new administration for climate change research
- Potentially added funding for USGS 104b program (potential increased allocation to ~$200K)
- Opportunities for new funding via Congressionally directed spending in partnership with:
    - ARS Hydraulic Engineering Research Unit
    - Ogallala Aquifer states
- Potential for expanded opportunities with watershed monitoring/assessment via:
    - New ARS Agreement
    - Utilize remote sensing, GIS, and data science to develop decision support tools for water resource management
- Expanded expertise at OSU via new water resource faculty
- Rapidly expanding network via EPSCoR program
- Increasing collaborative opportunities via improved communications with WRAB members

Threats

- OWRC reaching (or exceeding) limit on matching (needed for ARS, USGS projects)

Teaching SWOT Analysis:

Strengths

- Strong connection to undergraduate and graduate Environmental Science Programs and College of Education
- Dr. Mansaray has great interest in teaching
- OWRC faculty serving on 10 student committees
    - 3 students Colston
    - 2 students Mansaray
    - 5 students Wagner
- Provided financial support for 12 students
    - 1 BAE GRA (USDA-NIFA)
    - 1 NREM GRA (Berry Professorship)
    - 1 ESGP GRA (OCC/GRDA)
    - 1 Env Sci UG (USGS 104b)
    - 1 HORT GRA (USGS 104b)
    - 1 HORT UG (USGS 104b)
    - 3 CEAT GRAs (USGS 104b)
    - 2 COE GRAs (NSF)
    - 1 UG at OU (USGS 104b)

Weaknesses

- No time or funding for teaching currently

Opportunities

- Strong network with Faculty and researchers from other universities (University of Oklahoma, Cameron University, Northeast State University, University of Kansas, Texas A&M University, University of Nebraska, University of Wisconsin - Eau Claire, University of Idaho) to exchange teaching experience and ideas for collaborative graduate student research
- Working with the WRAB to identify/facilitate internship opportunities & capstone projects

Threats

- No known threats

2021 Departmental Goals

The overarching goals of the OWRC are to achieve:

1. Greater engagement among water community
2. More informed & engaged public and water community addressing water issues
3. Increased resources for water research, extension, and education
4. Expanded and more diverse workforce preparation
5. New solutions through applied research and co-production of knowledge

Key activities in 2021 to achieve these goals include:

- Meet individually and collectively with Water Research Advisory Board members, key water faculty in OK (OSU, OU, TU, ECU, NEO, etc.), and Water Centers in surrounding states regarding collaborative opportunities *(Goal 1)*
- Organize collaborative events to discuss water research/education (OSU Water Symposium, Governor's Water Conference, socials) *(Goal 1)*
- Revamp website and continue expansion of social media engagement *(Goal 2)*
- Support youth-focused and community science, as well as irrigation Extension programs *(Goal 2)*
- Advocate for increased funding for OWRC and Water Research (NIWR) *(Goal 3)*
- Facilitate the submission of >18 funding applications *(Goal 3)*
- Work with the WRAB to identify internship opportunities, senior design projects, and ideas for REU projects *(Goal 4)*
- Serve on a minimum of 8 graduate student committees *(Goal 4)*
- Utilize remote sensing, GIS, and data science to develop decision support tools for water resource management *(Goal 5)*
- Assess and improve grazingland water quality *(Goal 5)*
- Advance knowledge about informal science and diverse participation in STEM *(Goal 5)*

See the Water Center's Strategic Plan for details regarding activities planned in 2021 to reach these goals (attached).

Promoting a culture of diversity, equity and inclusion (DEI)

How do you define diversity, equity and inclusion in your department?

- Although I know the official definitions for these terms, I thought it would be better to provide my perspectives regarding how I do my job. I primarily think of diversity in terms of a person's background, viewpoints, and perspectives. This diversity can come in many forms. I primarily think of inclusion in terms of the value that each person brings a team. The greater the diversity, the greater the opportunity for new insights and breakthroughs. This is imperative in advancing research and achieving new breakthroughs.

How do you learn about issues associated with DEI?

- Listening. University training. Books.

What are the immediate challenges and long-term goals in your department with respect to DEI? Are there areas associated with DEI in which you want to grow or enhance in your department?

- I feel that we have a very strong and diverse team. As we grow, I look forward to continuing growing our diversity. "Expanded and more diverse workforce preparation" is a key goal of the Water Center. We will seek to achieve this goal via a variety of approaches including increasing our engagement with tribes, encouraging diverse applications to our 104b grant program, increasing diversity within our media outlet and conferences, and working to expand our collaboration with the Center for Sovereign Nations and OK-LSAMP program.

How can DASNR administration better support these efforts in your department?

- I can't think of anything we need

Fiscal management

The OWRC currently manages 22 accounts (see next page for details on each account) including:

- 1 startup account remains which terminates at the end of June 2021. $12,000 remaining unencumbered in the startup account will be used to purchase field equipment and supplies.
- 2 multi-state Hatch project accounts that do not currently have a balance.
- 7 grant accounts. 4 have negative balances of which 3, corrections are underway to move salaries to other accounts (2-OWRC Block, 1-USGS Admin) and 1 is negative due to delay in arrival of funding from NSF. 3 are being spent as scheduled.
- 2 block accounts. Carry-over will be used to provide continued support for Research Specialist in FY22 when Startup support ends.
- 3 M&O accounts are typically used to support travel for the OWRC Director and faculty/staff to meetings and conferences. Any carryover will help support field research activities.
- 1 professorship account which will be used to support 1 MS student, partially support 1 PhD student, and lab analysis of stormwater samples (which could exceed $20,000/year)
- 5 F&A accounts with a combined balance of $27,240 will be used for bridge funding for Colston & to support summer salary for GIS analysis of VF data.
- 1 cost-share account which provide match for the OWRC portion of the USGS 104b grant

Training

Training	Wagner	Beck	Hickerson	Mansaray	Colston	Meek
OSU Title IX Training	√	√	√	√	√	√
Foster and Promoting a Culture of Diversity and Inclusion at OSU	√	√	√	√	√	√
OSU Clery Act training	√	√				
OSU FERPA Training					√	
OSU Performance Review Training		NA	NA	NA	NA	NA
Quarterly Safety Training	√	√	√	√	√*	√

*completed 4 for 2020 in 2021

Honors and Awards

None

Prioritized Faculty/Staff Requests

See supplied form

Water Center Departmental Summary as of 02/28/21

Chart	Fund Code	Title	Balance Forward	Maint Allocation	Transfers In/Out	YTD Expenditures	Encumbrances	Balance w/o Encumbrances	Balance w/ Encumbrances
1	151205	F&A Recovery - Colston	-	-	-	-	-	-	-
1	151235	Wagner Startup	10,462	32,976	-	21,690	9,381	21,748	12,366
Chart 1 Total			10,462	32,976		21,690	9,381	21,748	12,366
2	150700	Water Center Admin	3,960	8,000	-	5,761		6,199	6,199
2	150705	Future Challenges Animal Prod.	-	-	-	-	-	-	-
2	150739	Center - F&A Water Center	-	-	8,160	-	-	8,160	8,160
2	150794	Water Center Block	25,609	28,950	(805)	11,566	7,166	42,187	35,020
2	150797	F&A Recovery	-	-	14,508.38	-	-	14,508	14,508
2	430705	Future Challenges Animal Prod.	-	-	-	-	-	-	-
2	450425	Berry Professorship	64,880	36,662		23,302	3,410	78,240	74,830
2	450700	Water Center Admin	4,318	-	-	694	-	3,624	3,624
2	450739	Center - F&A Water Center	1,645	-	-	-	-	1,645	1,645
2	450797	F&A Recovery	2,925	-	-	-	-	2,925	2,925
2	454700	2-561860 Water Center Admin	(0.01)	-	805	805	-	(0.00)	(0.00)
2	541310	Watershed Plan for Lk Hudson	107,980			100,780	11,141	7,199	(3,942)
2	544360	Development of OK-HAWQS	132,195			71,773	61,664	60,421	(1,242)
2	561860	USGS 104b - Admin	11,191			587	3,727	10,603	6,876
2	561870	USGS 104b - Tech Transfer	61,144			54,051	7,624	7,092	(531.96)
2	581560	OK-LSAMP Phase VI	71,452			78,001	12,580	(6,549)	(19,129)
2	581570	Rural Libraries	394,914			217,336	117,958	177,578	59,620
Chart 2 Total			882,216	73,612		564,659	225,272	413,839	188,566
3	162714	Water Center	683	5,000	169	2,221	-	3,631	3,631
3	162776	Water Center Block	22,136	-	-	11,787	7,297	10,349	3,052
3	527120	Sustaining Ag thru Adaptive Mgt	40,000	-	-	30,486	1,965	9,513	7,547
Chart 3 Total			62,819	5,000	169	44,495	9,263	23,494	14,231
Grand Total			955,499	111,588	170	630,844	243,917	459,081	215,165

Oklahoma Water Resources Center
2021 Strategic Plan

Core Purpose

- Plan, conduct, or otherwise arrange for competent applied and peer reviewed research that fosters—
    - improvements in water supply reliability;
    - the exploration of new ideas that—
        - address water problems; or
        - expand understanding of water and water-related phenomena;
    - the entry of new research scientists, engineers, and technicians into water resources fields; and
    - the dissemination of research results to water managers and the public.
- Cooperate closely with other colleges and universities in the State that have demonstrated capabilities for research, information dissemination, and graduate training in order to develop a statewide program designed to **resolve State and regional water and related land problems.**
- Cooperate closely with other institutes and other organizations in the region to increase the effectiveness of the institutes and for the purpose of promoting regional coordination

Core Values

- Our role is to **serve** Oklahomans, and particularly the water research and management community, with **warm professionalism**.
- The Water Center maintains high **adaptability** in order to be **responsive** to the State's needs.
- We are committed to **continuous learning** and **growth** and believe **creativity and innovation** are key to ensuring safe, secure, and sustainable water resources.
- We are **dedicated to both the natural resources and people of Oklahoma**, aiming to inform and inspire responsible and sustainable use of the State's water and natural resources.
- We are steadfast in our commitment to **data integrity and accuracy,** and **responsible and actionable science**.
- The Water Center is a place of shared success where we focus on **engagement, outreach** and **highlighting others'** efforts and successes.
- To that end, we are **passionate and persistent** in our pursuit of opportunities for **cooperation, collaboration, connection**, and **teamwork** to solve Oklahoma's most critical water resource issues.
- Finally, we aspire to **increase diversity and inclusion** of those participating and served in our journey to a safe and sustainable water future.

Vision

Safe, secure, and sustainable water resources for all

Mission

Empowering informed decision making and enriching understanding of the state's most critical water management issues through engagement, education and actionable science

Goals

Goal 1 - Greater engagement among water community

Objective 1.1 – Better engage OSU and other state water faculty

- Meet individually and collectively with key OSU departments (BAE, PaSS, NREM), programs (OK-LSAMP), and water faculty throughout OSU to enhance collaboration (Kevin)
- Organize on-campus events to engage faculty and ultimately establish a Water Research Community of Practice (Kevin, Tracy, Abu, Nicole)
    - Organize a social event each semester (Fall/Spring/Summer) (Kevin, Tracy)
    - Host OSU Water Symposium biennially beginning in Spring 2022 (Kevin, Tracy)
        - Hold in conjunction with World Water Day (Kevin, Tracy)
        - Develop program to allow a mix of faculty presentations and involvement-based sessions designed to enhance faculty awareness of water research across OSU and facilitate collaborative research (Ali)
        - Include a poster contest for students and involvement (Ali)
- Meet with Water Faculty from OU, TU, ECU, NEO, and elsewhere (Kevin, Tracy)
- Spotlight and engage researchers from across Oklahoma via OWRC media and events (videos, newsletters, lectures) (JoMarie)
- Co-host a panel with OSU faculty about student data education needs as part of the 'Water and Natural Resource' series as part of the Council for the Advancement of Digital Research and Education (CADRE) (Nicole, Kevin)

Objective 1.2 – Deepen partnerships with state and federal agencies, industry partners, and stakeholders to assist water management efforts in Oklahoma

- Schedule virtual meetings with each Water Research Advisory Board member to:
    - Discuss ways to improve the impacts of the Oklahoma Water Resources Center to ensure that OWRC is addressing the most critical water needs of the state.
    - Learn how we can better serve WRAB organizations by providing needed research, educational resources and facilitating connections with water faculty throughout the state.
    - Receive input on how to enhance the experience of WRAB members and discuss ways to better utilize WRAB meetings for advising Water Center efforts and enhancing collaboration not only with the Water Center and university researchers, but also among the members. (Kevin, Tracy)
    - Summarize results for use in identifying future research directions and engaging faculty with agencies

- Spotlight and engage partners from across Oklahoma via OWRC media and events (videos, newsletters, lectures) (JoMarie)
- Serve on Oklahoma Clean Lakes and Watersheds Association Board (Kevin, Abu)
- Continue work to build on existing networks to increase engagement in water quality issues in Oklahoma and deepen partnerships with water management and related groups, particularly the OCC, OWRB, USDA-NRCS, USDA-ARS, Grand River Dam Authority, ODEQ, Native American Tribes, the Bureau of Reclamation, and ag groups (Farm Bureau, Cattlemen's Assoc., OPAIA).
    - Achieve this through greater communication and engagement with these groups and quick follow-through on discussions
- Co-host a panel with water professionals about open access water data as part of the 'Water and Natural Resource' series as part of the Council for the Advancement of Digital Research and Education (CADRE) (Nicole, Kevin)

Objective 1.3 – Build collaborations with surrounding states and across the U.S. to address regional and national water issues of importance to Oklahoma

- Continue providing leadership for the Ogallala Water CAP project (Kevin)
- Work with Ogallala Aquifer states to organize the 2021 "Ogallala Aquifer Summit" (Kevin)
- Meet individually with the Water Resources Research Institutes in Kansas, Arkansas, Nebraska, Texas, New Mexico, and Colorado to identify and develop programs to address key regional water resource issues (Kevin)
- Engage with the *National Collaborative for Food, Energy, and Water Education* (NC-FEW) to advance education research & educational programming grounded in the FEW-Nexus (Nicole)
- Work with the National Drought Mitigation Center at the University of Nebraska to promote citizen science drought monitoring programs (Nicole)
- Serve as President-Elect of the National Institutes on Water Resources
    - Plan and moderate 2021 NIWR Annual Conference (Kevin)
- Serve as Past-President of the Universities Council on Water Resources
    - Meet with OSU UCOWR delegates annually (Kevin)
- Serve on the Ag Science Committee of EPA's Science Advisory Board (Kevin)
- Pursue opportunities to serve as an active member in at least one national water organization – e.g., AWRA, AGU, NALMS (Abu, Kevin, Nicole)

Goal 2 - More informed & engaged public and water community addressing water issues

Objective 2.1 – Expand the reach and impact of OWRC Communications

- Improve OWRC communications by developing & implementing a communications plan (JoMarie)
- Produce a high-quality annual report (JoMarie)
- Revamp and consistently brand OWRC's website, newsletter (*Currents*), and social media (Facebook, Twitter, Instagram, YouTube) to broaden and expand the audiences for and impacts of OWRC's media products
    - Expand audience for newsletter, social media, and other media outlets by 10%

        - Expand list of collaborators and stakeholders to include staff from agencies and tribes, water suppliers, municipalities, and other water managers (Abu, Kevin)
        - Update internal and external water faculty lists (Tracy, Abu)
    - Increase social media engagement (0.02 currently to 0.05)
    - Increase posting frequencies to three to four times a week
    - Involve faculty more, as well as other water facilities, in newsletter and other media releases (Ali)
- Enhance YouTube presence
    - Record presentations if possible to post
    - Partner with professors to record a lecture on a water topic and post (some of our most popular videos are this)
    - Video updates on projects/research going on
    - Day in the life of a water researcher/manager (we can start small with a day in the life of say our grad student or Abu, then if it works well, another teacher or professor)
- Revise and better communicate OWRC's mission, vision, goals and objectives
- Develop popup banner for reuse research and other research areas for display at conferences and other events
- Collaborate with DASNR to enhance the Water Center's website via DASNR's new structure to better communicate information on OWRC projects, affiliated researchers, and benefits/outcomes for Oklahoma's citizens and water resources (JoMarie)
    - Update FAQs to include COVID and new knowledge/information on water resources in Oklahoma (Abu)
    - Develop education content for teachers, parents, and extension (JoMarie)
- Work with other outlets to publicize OSU's water research including participating department and college media, publications of the OSU Vice President for Research (VPR) and university, Extension newsletter, and relevant internal and external multi-media outlets (JoMarie, Tracy)

Objective 2.2 – Expand OWRC's public outreach and engagement through citizen science, increased educational opportunities, and stakeholder facilitation

- Connect with Extension ANR District Directors to identify water education needs across OK and develop strategy for providing (Kevin, Tracy)
    - Partner with Extension to disseminate info (Abu)
    - Extension podcasts (Abu)
- Support youth-focused and community science programs to broaden public engagement in water and environmental monitoring (Nicole)
    - Host an annual Citizen Science Expo for the general public, spotlighting precipitation, drought, and other water-related citizen monitoring opportunities (Nicole, JoMarie)
    - Collaborate with Blue Thumb and CoCoRaHS to promote and advance opportunities for citizen science in k-20 and informal learning settings (Nicole)
    - Meet with 4H and other extension educators to identify new opportunities
    - Expand participation in the Spotty Rain Campaign by connecting OWRC and peer WRRI resources/scientists/products with rural librarians and communities (Nicole)
        - Sign Spotty Rain up for Hootsuite to track metrics to improve social media standing and grow reach (JoMarie)

- Work to assist the state in conservation and management of water resources through stakeholder engagement (Kevin)
    - Conduct stakeholder engagement to support the OWRB in development of the State Water Plan
    - Facilitate stakeholder involvement in OWRB efforts to assess the Ogallala Aquifer

Objective 2.3 – Facilitate the full launch of the Master Irrigator Program

- Work closely with the Panhandle Irrigators and other ag groups, state and federal agencies, and BAE and PaSS faculty to launch Oklahoma's Master Irrigator Program.
- OWRC will assist with:
    - Team meetings to keep program development on schedule
    - Curriculum development
    - Recruitment of participants
    - Securing incentives for participants including:
        - Soil moisture probes
        - Increased ranking for EQIP funding
        - Potentially targeted cost-share funding for graduates to help in implementing improved management learned during the training.
    - Funding applications for USDA-NRCS and USDA-NIFA grants, and State funds

Objective 2.4 – Present at, organize, sponsor, and host water resources conferences

- Plan, organize, and co-host the Oklahoma Governor's Water Conference and Research Symposium (Kevin, Tracy)
- Present, sponsor and/or exhibit at the Oklahoma Irrigation Conference, Oklahoma Clean Lakes and Watersheds Association, Oklahoma Association of Environmental Education, and other relevant water resource conferences in OK
- Work with the OWRB, OU, TU, PWWG and OSU researchers to organize a Produced Water Research Symposium
- Deliver presentations in Oklahoma and elsewhere on the Water Center, ongoing water research at OSU, and critical water issues in the State and region including the following conferences: OCLWA, OKGWC, SGP Limnology conference, ESRI and UCOWR (Abu), as well as regional library association and STEM teacher conferences (Nicole)

Goal 3 - Increased resources for water research, extension, and education

Objective 3.1 – Provide grants to support high priority water research at universities throughout Oklahoma via the USGS 104b and 104g programs

- Advocate for increased funding for OWRC and Water Research (NIWR)
- Engage WRAB team members to solicit potential additional funds to the 104(b) grant program
- Finalize 2021 USGS 104(b) grant application
- Issue Project Years 2022 104(b) RFP
- Facilitate Water Research Advisory Board Meetings to identify key water resources issues and select faculty and student projects to receive seed grants

Objective 3.2 – Build teams of faculty and collaborators and facilitate funding applications

- Organize, facilitate, and assist interdisciplinary teams in developing research plans and programs to address key water challenges in Oklahoma including:
    - Marginal water treatment and reuse (including produced water)
    - Improving irrigation efficiency
    - STEM education on water
    - Formal and informal science learning
    - Others as opportunities arise (climate change, drought management, etc.)
- Track funding opportunities to support research efforts, including State funding (e.g., water-related agencies, private sector, tribes), federal grant programs (e.g., USGS, USDA, NSF, NAS, NASA, DoD, USBR, USACE), and international funding opportunities (e.g., USAID, World Bank, private donors) (Kevin, Abu, Nicole)
- Facilitate engagement of agency project officers to help prioritize research efforts to better align with funding program and agency needs, leading to higher funding success rates.
- Seek opportunities to serve on review panels as possible to learn more about grant programs (i.e. NSF, NOAA, USDA, USGS, NASA) (Abu, Kevin, Nicole)
- Support research teams with stakeholder engagement, budget development, obtaining internal/external reviews of proposals, and project management once funded
- Facilitate the submission of >18 funding applications including:
    - At least six 104(g) and one CASC proposal for Oklahoma (Abu, Kevin)
    - International: USAID, NASA (SEVEIR): Data infrastructure for transboundary water management
    - Education and Outreach: USDA HEC, NSF Data Science Corps, NSF AISL (Nicole)
    - USDA-NIFA SAS & Foundational grants, NSF, and NRCS (Kevin, Abu)
    - USAID/UNESCO – Water Information Network for the Manor River Basin (Abu)
- Compile proposal reviews and assess opportunities for improvement and resubmission (improve on rejected proposals, develop new ones)

Objective 3.3 – Support student research through grants and scholarships

- Provide grants to support student research via USGS 104(b) and other grants (Tracy, Kevin, Abu)
- Submit proposals (e.g., USDA HEC and USDA WAMAS) in collaboration with water programs in other universities to support student research and education (Nicole, Kevin, Abu)
- Seek funding to establish a Water Scholars Program and Mentor Network for undergraduate research (Nicole)
- Finalize the case for support for water scholarships and advocate for donor support (Kevin, JoMarie)

Objective 3.4 - Identify expertise needs and advocate for new water faculty/staff positions

- Conduct institutional data analysis about student enrollment in water courses and related degree programs (Nicole)

Goal 4 - Expanded and more diverse workforce preparation

Objective 4.1 - Support student research, internships, and career opportunities

- Work with the WRAB to identify internship opportunities, senior design projects, and ideas for REU projects (Nicole)
    - Prepare an annual spring newsletter spotlight of WRAB summer internships (Tracy, JoMarie)
- Maintain water-related Job Board for the state, and nationally (JoMarie, Kevin)
- Serve on Advisory Committee of OSU Environmental Science Program (Kevin)

Objective 4.2 - Enhance learning opportunities for faculty and students

- Serve on a minimum of 8 graduate student committees (Abu, Kevin, Nicole)
- Pursue opportunities to teach, provide seminars, and guest lecture in water related courses (Abu)
- Pursue opportunities within 4-H to coordinate water related workshops (Tracy, Nicole)
- Host 1 seminar per semester to discuss cutting-edge water research, research needs, and collaborative/funding opportunities (Abu, Kevin, Tracy)
- Support student chapters of water and environmental organizations
    - Serve as advisor and increase participation in the Oklahoma Clean Lakes and Watersheds Association student chapters (Abu)
- Provide Blue Thumb training for new student monitors at the beginning of every semester (Abu)

Objective 4.3 – Develop networks for promoting diverse participation in water education

- Host webinar series about increasing the capacity for Native American participation in K-20 STEM education in Oklahoma and beyond (Nicole)
- Serve on the Task Force for the National American Indian Science and Engineering Fair (NAISEF)
- Work with tribal nation afterschool programs to design climate change activities and promote STEM college and career pathways
- Presentation to OKLSAMP faculty about increasing capacity for diverse participation in water education and research (for EPSCoR & OWRC) (Dr. Wagner)
- Present to education stakeholders at meeting like the Oklahoma Council for Indian Education, the Southwest Oklahoma STEM Alliance, and teacher professional development events

Goal 5 - New solutions through applied research and co-production of knowledge

Objective 5.1 - Utilize remote sensing, GIS, and data science to develop decision support tools for water resource management

- HAB detection - Work with the City of Stillwater, GRDA, USGS, North Central HABS group, and faculty at OSU, Baylor, OU, and elsewhere to understand and manage Harmful Algal Blooms (Abu)
    - Publish at least 1 manuscript
- Water quality – Work with USGS, SCCASC, NASA, and faculty at OSU, TAMU, OU, and elsewhere to develop and test a space-air-ground decision support tool for forecasting and detecting changes in water quality, water quantity, and water distribution in the landscape (Abu)

    - Take a training course in machine learning and data science (Abu)
    - Publish 2 publications
- Work with the Oklahoma Conservation Commission to facilitate development and expanded use of the Oklahoma - Hydrologic and Water Quality System (OK-HAWQS) model to expedite water quality modeling to support research, watershed planning, and other water resource management efforts in OK (Kevin, Abu)
- Work with USDA-ARS to implement "Development of Engineering Tools, Design Guidance Documents, and Computational Software for Monitoring, Inspecting, and Rehabilitating Aging Dams" (Kevin, Tracy)

Objective 5.2 – Assess and improve grazingland water quality

- In collaboration with NREM, Texas A&M, and BAE, and with support from the Berry Professorship and NSF EPSCoR, assess edge-of-field runoff water quantity and quality related to landuse and management
    - Publish at least 2 manuscripts (Bacteroides paper and Lake O' the Pines)
- In collaboration with ANSI and Vence Corporation, and with support from Kevin start-up funds, EPA grant funds, the OCC, and USDA-NIFA Multi-State Research Project S1032 (Animal Production Systems: Synthesis of Methods to Determine Triple Bottom Line Sustainability from Findings of Reductionist Research), assess virtual fencing technology and its impact on grazing management, animal health, and ecosystem services
    - Publish at least 1 manuscript (Preliminary findings of VF trials)

Objective 5.3 – Improve water quality monitoring and watershed management

- Engage with the Chickasaw Nation's Department of Environmental Services, Oklahoma Conservation Commission, Grand River Dam Authority, Bureau of Reclamation, and others regarding initiating **development and implementation of watershed-based plans** (Abu, Kevin)
- Develop international relationships (e.g., Sierra Leon, OU's WaTeR Center) to **assist water resource management efforts in developing countries** (Abu)

Objective 5.4 – Assess Oklahoman's perceptions regarding water resource issues (Kevin)

- Utilize Berry Professorship to support PhD student analysis of results of the 2018 survey the public's perceptions, attitudes, and learning preferences on water issues in Oklahoma
- Submit 2 manuscripts for journal publication assessing 1) changes between 2008 and 2018 and 2) regional variability in the results
- Convey survey results via presentations at state and national conferences
- Implement findings to enhance OWRC outreach and education efforts

Objective 5.5 – Advance knowledge about informal science and diverse participation in STEM

- Develop library programs, partnerships, and support media that encourage public participation in research science (Nicole)

OWRC Thematic Reports – 2021

Improving Oklahoma's Irrigation Efficiency

Successes over the last year

Strong collaboration among Oklahoma Cooperative Extension Service, Oklahoma Agricultural Experiment Station, Oklahoma Farm Bureau, Panhandle Irrigators, Oklahoma Water Resources Board, Oklahoma Conservation Commission, Oklahoma Water Resources Center, Ogallala Water CAP, the irrigation industry, and the USDA-Natural Resources Conservation Service led to expanded opportunities to learn about improving irrigation water use efficiency.

This collaboration set the stage for launching the Oklahoma Master Irrigator program in early 2021. In 2020, the High Plains Irrigation/Water Management Assistant Extension Specialist (Dr. Sharma), hired by PaSS utilizing Reinvesting in DASNR funds, led the development and delivery of the program. Dr. Sharma not only worked with OSU faculty, he formed and worked closely with a Producer Advisory Committee to develop the training curriculum to ensure that the program met the needs of the producers attending. The Oklahoma Water Resources Center (OWRC) worked with the collaboration to ensure needed resources and incentives were in place for the successful delivery of the program. The OWRC worked with the NRCS to provide additional points to EQIP contracts of graduates of the Master Irrigator program. The OWRC worked with the OWRB to secure funding ($50,000) for outfitting a mobile irrigation lab for the Panhandle and irrigation scheduling technology for on-farm demonstrations. The OWRC was able to secure additional funding ($40,000) through the USDA-NIFA funded *Sustaining Agriculture through Adaptive Management Resilient to a Declining Ogallala* to support a student for the Mobile Irrigation Lab and provide funding for food, materials, and travel for the Master Irrigator program. Additionally, OWRC worked with the OWRB and OCC to provide funding (up to $50,000) for soil moisture sensors for Master Irrigator program graduates via local conservation districts. The program will be expanded in 2021 to the Southwest region of Oklahoma.

Gaps or Areas Needing Investment

a. Facilities and Laboratories
    i. Plans for renovations
        1. Expansion of SDI at Altus and installation of irrigation scheduling technology
        2. Upgrade pivots and install irrigation scheduling technology at Goodwell and other research stations with center pivots
    ii. Accomplished renovations or major equipment purchases
        1. Unknown
b. Personnel
    i. Faculty Expertise
        1. Continued salary support for Sumit Sharma
    ii. Staff support
        1. Technician(s) to support mobile irrigation lab and farm demos
    iii. Graduate student recruitment
        1. Students to support mobile irrigation lab and farm demos

Collaborations

a. Associated Research Centers and Institutes
    i. Plant and Soil Sciences
    ii. Biosystems and Agricultural Engineering
    iii. Water Resources Center
    iv. Research and Extension Centers (see below)
b. Current and planned use of OAES stations, facilities or OCES supported facilities
    i. Which stations or facilities
        1. Southwest Research and Extension Center
        2. Oklahoma Panhandle Research and Extension Center
        3. McCaull Research and Demonstration Farm
    ii. FRSU staff support
        1. Cameron Murley
        2. Skeate Beck
        3. Mike Schulz
c. County and Area Extension Staff
    i. County Extension Educators in major irrigation counties (i.e. Texas, Cimarron, Beaver, Jackson, and other counties)
d. Agencies, NGO's, Commissions, etc.
    i. Oklahoma Farm Bureau
    ii. Panhandle Irrigators
    iii. Oklahoma Water Resources Board
    iv. Oklahoma Conservation Commission
    v. Lugert-Altus Irrigation District
    vi. USDA-Natural Resources Conservation Service
    vii. Irrigation industry

A single integrated Impact Statement for the Program Area (also sent electronically).

a. Issue:
    - Crop irrigation, which is the number one water user in Oklahoma, is threatened by growing demands and declining supplies.
b. Response/Action
    - A multi-disciplinary team consisting of faculty from OSU's Plant and Soil Sciences, Biosystems and Agricultural Engineering, and Water Resources Center (Drs. Jason Warren, Sumit Sharma, Saleh Taghvaeian, Robert Frazier, Seth Byrd, Kevin Wagner) is working with key partners to test and demonstrate irrigation scheduling tools (soil moisture sensors and irrigation schedulers) and efficient irrigation systems (bubbler nozzles, VRI, and SDI), conduct irrigation system evaluations (mobile irrigation lab), expand adoption and improve management of drought resistant crops (cotton), and provide needed training opportunities on the use of irrigation technologies (TAPS and Master Irrigator).

c. Results/Output
    - The team has found that soil moisture sensors and irrigation schedulers are effective tools for improving irrigation efficiency, cotton can be a viable crop for conserving water if managed properly, and significant water and energy savings can be achieved through implementation of mobile irrigation lab recommendations. Furthermore, efforts have resulted in a groundswell of support for irrigation research, demonstration, and Extension education programs.
d. Public Value Statement

    When you support testing, demonstration, training and incentives on irrigation technology, participants will be more likely to adopt these new technologies, which leads to increased on-farm water use efficiency, and sustained agricultural production and water supplies benefitting counties throughout western Oklahoma.

Marginal Water Treatment and Reuse

Successes over the last year

The project titled *Socially Sustainable Solutions for Water, Carbon and Infrastructure Resilience in Oklahoma* was selected for funding by the NSF EPSCoR program providing over $2 million in funding (including almost $1 million for OSU) to develop innovative engineering technologies and modeling schemes for more effective marginal quality water reuse. The Oklahoma Water Resources Center led the water reuse focus area team in developing the proposal and launching the project. In November 2020, the Director of the Water Center was selected to lead the OK NSF EPSCoR Program. With the funding from NSF, this team, comprised of engineers and scientists from OSU, OU, and SWOSU, will work to:

- Improve passive treatment of contaminants in wastewater effluent & stormwater runoff
- Improve removal of nitrogen and CEC from stormwater and wastewater effluent via active treatment utilizing biological and chemical processes
- Enhance removal of hydrocarbons from produced water
- Enhance use of produced water for enhanced oil recovery
- Optimize water augmentation strategies considering public needs/perceptions and system efficiency, sustainability, and resilience

The Water Center continues to work to advance produced water research as well. The OWRC worked with the OWRB to coordinate a session during the Produced Water Working Group (PWWG) meeting focused on produced water research where researchers from OU and OSU presented high level overviews of their research. This program generated lots of interest among the entities involved in the PWWG. As a result, the OWRC is working to organize a monthly seminar series this spring for researchers from OSU, OU, and TU to present their research.

Gaps or Areas Needing Investment

a. Facilities and Laboratories
    i. Plans for renovations
        a. To support produced water research, the following needs have been identified: 1) vacuum pumps, heat exchangers, compressors, and a pool boiling setup for desalination; 2) a liquid chromatograph with tandem mass spectrometers for water analysis; and 3) dedicated space for onboarding, storing, and handling wastewater in order to advance reuse technology development.
    ii. Accomplished renovations or major equipment purchases
        a. None
b. Personnel
    i. Faculty Expertise
        a. None
    ii. Staff support
        a. Staff support needed is yet to be determined

iii. Graduate student recruitment
    a. Significant graduate student support will be required to advance this research. Through the EPSCoR program, multiple students are being at least partially supported.

Collaborations

a. Associated Research Centers and Institutes (on- and off- campus)
    i. Microbiology
    ii. Chemical Engineering
    iii. Civil and Environmental Engineering
    iv. Petroleum Engineering
    v. Physics
    vi. Biosystems and Ag Engineering
    vii. Geology
b. Current and planned use of OAES stations, facilities or OCES supported facilities
    i. Which stations or facilities
        a. None currently, but the South Central Research Station could be engaged in the future
    ii. FRSU staff support
        a. None currently
c. County and Area Extension Staff
    i. None currently
d. Agencies, NGO's, Commissions, etc.
    i. USGS, ODEQ, OWRB, Bureau of Reclamation, Groundwater Protection Council, Oklahoma Corporation Commission, Industry

Impact Statement

a. Issue
    i. Oklahoma's water demands are projected to increase 600,000 acre-feet per year between 2007-2060 (OWRB 2012). Reliable water supplies are needed to provide for these demands while meeting the state's goal of capping freshwater use to 2010 levels. However, freshwater supplies are declining due to reservoir sedimentation and groundwater overdraft, and increasingly vulnerable to weather variability. Concurrently, volumes of oil and gas 'produced water,' municipal wastewater, and stormwater are increasing with continued oil and gas development and urbanization. Further, disposal of produced waters has been correlated to seismicity, potentially impacting infrastructure and resulting in energy production curtailment in some regions. The challenge is finding a mix of solutions that allow Oklahoma's diverse array of marginal quality waters be economically treated for beneficial use to address water scarcity, waste disposal, and infrastructure risk, while supporting continued energy production and economic growth.

b. Response/Action
    i. The quality of Oklahoma's marginal quality waters can be improved by developing and deploying a chemical, biotechnological, hydrological, engineering, and sociological principles, with a focus on expanding opportunities for marginal quality water reuse. Reuse of marginal quality waters (including produced water, stormwater, and municipal wastewater) has the potential to provide substantial quantities of water for the industrial, energy, agricultural, and municipal sectors, making communities and economies more resilient to increasing weather variability.
    ii. Through discovery and advancement of innovative treatment technologies, we are working to find solutions to the complex competing interests and social, scientific, engineering, and economic issues restricting greater marginal quality water use.
c. Results/Output
    i. We are in the early stages of this research program, but have secured significant resources to advance this research which is highly supported by the public, state agencies, oil and gas industry, and Oklahoma's Congressional delegation.
d. Public Value Statement

When you support research and development of economical wastewater treatment technologies, participants (i.e. municipalities and industries) will be more inclined to adopt these technologies, which leads to reduced reliance on freshwater sources and disposal of wastewaters, and will benefit Oklahoma by providing greater water security for the state, its citizens, and its industries.

Harmful Algal Bloom Detection and Response

Successes over the last year

A strong collaboration has been established to support research efforts to improve our understanding of the formation and early warning indicators, as well as the management of cyanobacterial Harmful Algal Blooms (cHABs) in the Southern Great Plains. The partnership includes the Oklahoma Water Resources Center, various departments on campus, the Grand River Dam Authority (GRDA), Oklahoma Water Resources Board (OWRB), Oklahoma Conservation Commission, the City of Stillwater, the Kansas Department of Health and the Environment (KDHE), the University of Kansas Field Station, the North Central Region Water Network's Algal Bloom Action Team; and the USGS Water Mission Area.

OSU's capacity for conducting research on cHABs has been significantly enhanced through the development of optical predictive models for HABs in the Grand Lake watershed, routine water quality monitoring in Lake McMurtry, developing an alarm index for HABs in small inland water bodies, and plans to install a pilot aeration diffuser system to impede growth of cHABs in Lake McMurtry. We are collaborating with our partners to utilize machine learning to develop a space-air-ground data integration framework for forecasting and timely detection of HABs in inland water bodies.

This collaboration and increased capacity have brought us close to establishing a cHABs mitigation research group in the Southern Great Plains, and enhanced submission of grant proposals to USGS, the Climate Adaptation Science Center, NASA, and the cities of Stillwater and Perry.

Gaps or Areas Needing Investment

a. Facilities and Laboratories
    i. Plans for renovations
        1. None
    ii. Accomplished renovations or major equipment purchases
        1. None
b. Personnel (Campus, Area, and County)
    i. Faculty Expertise (including appointment split)
        1. None
    ii. Staff support (including appointment split)
        1. None
    iii. Graduate student recruitment
        1. Students to support water quality sampling

Collaborations

a. Associated Research Centers and Institutes
    i. Environmental Science Graduate Program
    ii. Biosystems and Agricultural Engineering
    iii. Water Resources Center
    iv. Integrative Biology
    v. Geography
    vi. Mechanical and Aerospace Engineering

b. Current and planned use of OAES stations, facilities or OCES supported facilities
    i. Which stations or facilities
        1. None
    ii. FRSU staff support
        1. None
c. County and Area Extension Staff
    i. None
d. Agencies, NGO's, Commissions, etc.
    i. Grand River Dam Authority
    ii. The Cities of Stillwater and Perry
    iii. Oklahoma Water Resources Board
    iv. Oklahoma Conservation Commission
    v. The Kansas Department of Health and the Environment
    vi. The University of Kansas Field Station
    vii. USGS Water Mission Area
    viii. North Central Region Water Network

A single integrated Impact Statement for the Program Area (also sent electronically).

a. Issue
    - Recreation in lakes, which is a major activity in Oklahoma, is threatened by increasingly frequent cHABs events.
    - cHABs have a toxin called Microcystin which poses health risk to people and animals. In addition to recreation, most of the susceptible reservoirs are used as drinking water sources.
b. Response/Action
    - A multi-disciplinary team consisting of faculty and researchers from various OSU departments (Drs. Abu Mansaray, Kevin Wagner, Scott Stoodley, Andy Dzialowski, Hamed Gholizadeh, Jamey Jacob, and Ali Mirchi) is working with key partners to develop and test a cHABs alarm index, and develop and test cHABs mitigation strategies.
c. Results/Output
    - The team has advanced development of an early warning system as well as cHABs management strategies.
d. Public Value Statement

    When you support development of early warning systems and mitigation strategies for cHABs, drinking and recreational waters will be sustained, better managed, rendered safe for human and animal consumption, and will benefit Oklahoma and the Southern Great Plains.