U.S.-Pakistan

Centers for Advanced Studies in Water

Final Report 2014 - 2019

Cooperative Agreement No. AID-391-A-15-00004

USAID FROM THE AMERICAN PEOPLE

THE UNIVERSITY OF UTAH WATER CENTER

Contents

Acronyms

ACIAR	Australian Centre for International Agricultural Research
AOR	Agreement Officer Representative
BoG	Board of Governors
CA	Cooperative Agreement
CAS	Center for Advanced Studies
CCNY	The City College of New York
CMP	Course Mentoring Program
CSU	Colorado State University
EnvEng	Environmental Engineering
FAR	Faculty Activity Report
GCISC	Global Change Impact Studies Centre
GEP	Gender Equity Policy
GIS	Geographical Information System
GoP	Government of Pakistan
GoS	Government of Sindh
HEC	Higher Education Commission, Pakistan
HID	Hydraulics, Irrigation, and Drainage
ICARDA	International Center for Agricultural Research in the Dry Areas
IWRM	Integrated Water Resources Management
LA-PAM	Linear Anionic Polyacrylamide
LoP	Life of Project
M&E	Monitoring and Evaluation
MEL	Monitoring, Evaluation & Learning
MS	Masters of Science
MSI	Management Systems International
MUET	Mehran University of Engineering and Technology, Jamshoro
NGO	Nongovernmental Organization
NIAB	Nuclear Institute for Agriculture and Biology
NUST	National University of Sciences and Technology
NRSP	National Rural Support Program
NUST	National University of Sciences and Technology
P&D	Planning and Development
PCMD	Panjwani Center for Molecular Medicine & Drug Research
PCSIR	Pakistan Council of Scientific and Industrial Research
PCRWR	Pakistan Council for Research in Water Resources
PhD	Doctor of Philosophy
PI	Principle Investigator
PKR	Pakistani Rupee
RDF	Rural Development Foundation
S&T	Sustainability and Transition
SDGs	Sustainable Development Goals
SDG 6	Sustainable Development Goal 6 – Clean Water and Sanitation
SEP	Student Exchange Program
SID	Sindh Irrigation Department
SIDA	Sindh Irrigation and Drainage Authority
SOP	Standard Operating Procedure
TA	Technical Advisor
TOC	Theory of Change
TVC	Technology and Venture Commercialization
UEPL	United Energy Pakistan Limited
UNLV	University of Nevada, Las Vegas
UNR	University of Nevada, Reno
U.S.	United States
USAID	United States Agency for International Development
USD	U.S. Dollar
USPCASW	U.S.-Pakistan Center for Advanced Studies in Water
UU	University of Utah
WASH	Water, Sanitation, and Health Sciences
WSIP	Water Sector Improvement Project

What Started as a Project Became a Family

Established at the Mehran University of Engineering and Technology (MUET) with technical assistance from the University of Utah (U) and key partners Colorado State University (CSU), University of Nevada, Las Vegas (UNLV), and City College of New York (CCNY), the USAID-funded U.S.-Pakistan Center for Advanced Studies (USPCASW) project was a life-changing experience for those that contributed to or were touched by its activities. This final report summarizes the project approach, activities, successes, missed opportunities, and lessons learned. It serves to document the completed project and provide insight, ideas, and inspiration for all readers.

Critical to understanding this project and its impact on people is the philosophy taken toward implementation and ultimately the underlying outcome that defines USPCASW. In December of 2014, I traveled to Pakistan for the first time with my colleague, Dr. Tariq Banuri. During this trip, we cemented in our minds and the minds of our partners, Project Director Dr. Bakhshal Lashari and his team at MUET, that this effort was to be a lifetime commitment. Together with Dr. Aslam Chaudhry, **we established the mentality of approaching activities and engagement as a sustained program**. This mindset from the start was embraced by the original team and all those that were involved during the project. All were committed to the importance and urgency of the cause. As our team started to travel to Pakistan and deliver the activities, their dedication was palpable. The USPCASW faculty, staff, students, and stakeholders - and Mr. Hafeez Samo and our USAID colleagues - equally bought into this spirit. Over time as our partnership grew into a friendship our activities evolved to be approached more collaboratively.

Ultimately, **the time invested and passion of the effort forged us into the USPCASW family**. As we move forward, we will persevere, individually and together, in our cause of advancing higher education to deliver impactful education, research, and training to help Pakistan achieve water sustainability. In this next phase our efforts may be less intense, but they will be equally as impassioned.

Steve Burian
Project Director

Dr. Steve Burian receiving the 2019 Sitara-i-Imtiaz from the President of Pakistan, His Excellency Dr. Arif Alvi in recognition for his efforts and the impact of the entire USPCASW team on higher education in Pakistan.

"The best approach to any sustainable development program doesn't come from the outside-in but works to empower individuals to solve the challenges facing their own local communities."

- Steve Burian, Project Director

Executive Summary

Summary

In Pakistan, water is the foundation of communities, culture, and commerce. At the heart of sustainable development is access to clean water and sanitation, protected water quality and ecosystems, equitable water management, and efficient water use. To progress toward water sustainability, Pakistan faces a daunting challenge. According to UNICEF, as of 2017 128 million people lacked improved drinking water sources contributing to the death of a child every 10 minutes. Municipalities and industries generally discharge wastewater directly to water bodies or in rare cases provide insufficient treatment. Water loss from source to house, industry, or farm field is substantial. It has not been accurately measured, but estimates place it at 50% or more. Service interruptions are regular, the sparse and undertrained workforce is unable to operate and maintain systems, and institutions are unable to respond to customer needs or finance systems for sustainability. Policies at the national, provincial, and local levels are not coherent, specific, or enforced. Adding to the complexity is rapid population growth, unplanned urbanization, aging infrastructure systems, climate change, and the variability of problem intensity by location and time.[1]

Water sustainability in Pakistan is possible. The key is to create the local communities of practice that can home grow the myriad of adaptable solutions needed to address the vast array of local and national problems. Higher education is uniquely positioned to develop a workforce and deliver the research necessary to generate and implement these community-engaged water solutions.

The U.S.-Pakistan Center for Advanced Studies in Water (USPCASW) is the seminal step leading higher education to serve as the catalyst for communities, industry, business, and government working together to design and implement water solutions locally and nationally. Established at the Mehran University of Engineering and Technology (MUET) with technical assistance from the University of Utah (U) and team of partners, including Colorado State University (CSU) and the University of Nevada at Las Vegas (UNLV), the Center was launched in 2014 with financial support from USAID, and guidance from the Higher Education Commission (HEC) of Pakistan. The project established the governance structure and operating procedures of USPCASW, introduced critical interdisciplinary educational programs and approaches, established facilities and environment for learning and research, built the capacity of the Center's personnel, and strengthened networks supporting the research-policy-practice interface.

Similar to solving water problems, the successful approach to creating USPCASW required the U-led team to develop a shared vision, diverse and creative team of experts, adaptable strategies, an engaged local community, and resilience. USAID provided the framework of five components and numerous illustrative examples to guide the U-led team. The U-led team enthusiastically embraced the opportunity to work with MUET and USAID. The team took a system view of higher education in Pakistan to design a holistic strategy for establishing USPCASW. Further, the team sought to develop a model of an applied research center that could flourish not only at MUET but at other higher education institutions in Pakistan. This was not easy since the necessary community, business, political, and financial support to nurture a research center addressing a grand challenge did not and still does not exist in Pakistan. The success of the project therefore is measured on two levels. One is meeting the USAID targets representing a well-functioning research center. The second is broader systemic change of higher education.

The goals of this final report are to (1) synthesize the inputs, outputs, and impacts of the project activities to document the effort and present ideas seeding future efforts and (2) provide a summary of reflections and lessons learned to help advance higher education capacity building and in particular the translation of applied research to tangible benefits. Five years of intensive day-to-day efforts delivered thousands of activities, outputs, and impacts. This

1 Source of data WHO/UNICEF JMP (2019) Progress on household drinking water, sanitation and hygiene 2000-2017 and UNICEF web site: https://www.unicef.org/pakistan/wash-water-sanitation-and-hygiene-0.

report cannot capture them all. Rather the report highlights key insights, linkages, and discoveries as it summarizes the key components of the project. Complementing the final report are hundreds of detailed reports, journal papers, presentations, and policy briefs and the produced learning materials, operating procedures and policies, and visual documentation of events and activities. Some of this supplementary material is referenced in this report, while additional information is available through USAID's Development Exchange Clearinghouse (DEC) or upon request. The hope is this documentation and materials repository serves as a legacy for USAID, HEC, the U-led team, and others in the development community to build on and advance higher education's role in achieving sustainable development in Pakistan and around the world.

"This project is about providing practical and affordable solutions to improve water quality and make Pakistanis healthier"

– Professor Pat Shea, Biology, U

Introduction

Background

In 2014, the United States Agency for International Development (USAID) in collaboration with the Higher Education Commission (HEC) of Pakistan launched an initiative to establish Centers for Advanced Studies (CAS) in three areas—Water, Energy, and Agriculture and Food Security. These Centers were designed to support Pakistan's economic development by strengthening the capacity of Pakistani universities to respond to changing public and private sector needs for applied research and skilled graduates in the above referenced sectors.

The CAS program connected four Pakistani universities with three U.S. universities with expertise in the above disciplines. The U.S.-Pakistan Center for Advanced Studies in Water (USPCASW, or simply "the Center") was established at the Mehran University of Engineering and Technology (MUET) at Jamshoro, and the University of Utah (U), USA, was selected to provide technical assistance to MUET in strengthening the Center's technical and institutional capacities to address water sector issues and challenges[2].

Historically, Pakistan's water sector has been confronted with serious issues and challenges. These included: poor water governance, increasing water scarcity, declining storage capacity, old and inefficient infrastructure, high water pollution, lack of access to safe drinking water, groundwater mining, high water leakages in the distribution system, and low water productivity, among others. These issues are becoming more complex with high population growth rate and changing climate. Public sector institutions, by and large, have failed to address these challenges due to weak institutional capacities, while informed decision-making has been severely constrained by lack of high quality, evidence-based analysis and information (or applied research).

The Center aimed to address these challenges by (i) providing access to higher education in water-related disciplines for promising students of limited means or from disadvantaged groups, (ii) improving the quality and relevance of water curricula to emerging market needs, (iii) strengthening the working relationship between researchers and industry to support applied research, (iv) enhancing the capacities of faculty in innovative teaching and applied research, and (v) driving innovation, competitiveness and economic growth in the water sector. Finally, like other centers established under the CAS initiative, the Center was expected to form public-private partnerships and interest-specific networks that would bring together the best minds in academia, government and the business community to support the implementation of Pakistan's sustainable development agenda.

The cooperative agreements (CAs) between the USAID and the U and MUET were signed in December 2014, and project implementation began in January 2015. Total project cost under the CA between USAID and MUET was 14.782 million USD, and between USAID and the U was 9.999 million USD; both agreements were for a period of five years. Separate funding (approximately 5 million USD) was managed by USAID directly for building construction.

2 The Center for Energy was established at the National University of Science and Technology (NUST), Islamabad, and University of Engineering and Technology (UET), Peshawar, while the Center for Agriculture and Food Security was established at the University of Agriculture, Faisalabad. Arizona State University and University of California-Davis were selected to provide technical assistance to the Energy Centers and Agriculture and Food Security Center, respectively.

"I am from Hunza, Gilgit currently doing MS in Water Resources Management at USPCASW. The exchange visit improved my technical writing, communication, and professional skills. I got the opportunity to learn fundamental and advanced hydroinformatics concepts using multiple software tools. The most exciting moment was exploring new places and interacting with people from different cultures in the United States."

-Uzma Jabeen USPCASW Exchange Scholar

Program Goal

The overall goal of the CAS program was to substantially improve the capacity of Pakistani higher education institutions to find innovative solutions to some of Pakistan's greatest development challenges through (i) applied research[3], (ii) graduates who are better prepared to meet the needs of industry, government and their communities, (iii) partnerships, (iv) workforce training, and (v) contributions to policy dialogue.

Objectives

The CAS program had five key objectives to be met through the three different CAS projects (in food security/agriculture, energy, and water):

- Deliver relevant and innovative research to meet the needs of clients in industry, civil society, and government;
- Improve CAS curriculum relevance and quality, strengthen the use of effective teaching methods, and upgrade graduate degree and certificate programs and research;
- Strengthen engagement between CAS universities and their stakeholders in the public and private sectors to support optimal linkages between supply and demand for CAS research, policy engagement and skilled graduates;
- Increase access for talented, economically and/or culturally disadvantaged students, as defined by HEC, to high quality educational opportunities in the disciplines of food security/agriculture, energy and water; and
- Establish governance structures, fundraising and other elements of administrative capacity to support CAS sustainability at each university.

Project Components

In order to achieve these objectives, the CAS project in water was initially organized around 5 key components: governance, curriculum reform, applied research, exchanges and scholarships, and sustainability. However, during project implementation our team learned that a different organization of activities, outputs, and outcomes is better aligned with the project objectives as well as more indicative of the way in which the project was actually conceptualized. Therefore, this report maps the original objectives onto the following key components, forming the organizational structure of the report:

(i) governance and sustainability,
(ii) applied research,
(iii) education and training,
(iv) partnerships, and
(v) gender equity and social inclusion.

Partnering Institutions

Four institutions partnered to establish the Center at MUET: the USAID, the HEC, the MUET, and the U.

3 "Applied research" refers to research that has broader impacts beyond academia. In particular, it refers to research that aims to solve on the ground problems affecting people's lives.

The role of each partner is outlined below and given in detail in their CAs and memorandums of understanding (MOUs).

- USAID provided the necessary funding to both Pakistani and U.S. universities for establishing the Center, including funds for its teaching and research infrastructure development, scholarship program, research, and capacity development of faculty and staff through an exchange program. This support complemented several other USAID-funded ongoing higher education initiatives to maximize the overall economic impact of U.S. assistance to Pakistan.
- HEC, as the Government of Pakistan entity, was principally responsible for funding, overseeing, regulating, and ensuring the quality of the higher education supported in this initiative in order to pilot a sustainable model for market-driven technical education in Pakistan. In this regard, it chaired the National Steering Committee responsible for monitoring the progress and coordinating the activities of all three CAS projects. MUET was the major recipient of financial and technical assistance, since the Water Center is housed at its premises. Succeeding sections and chapters provide details of activities MUET has implemented in line with the provisions of the Cooperative Agreement (CA) signed with USAID.
- MUET was the major recipient of financial and technical assistance, since the Center is housed at its premises.
- The U provided technical assistance to MUET in implementing all components of the project with special emphasis on improving the quality of deliverables as per the provisions of: (i) CA signed with USAID, and (ii) a MOU signed with MUET. In provision of its technical assistance, the U mobilized the expertise and support of the following four U.S. universities: Colorado State University (CSU) -- which served as the largest partnering U. S. university, along with the University of Nevada, Las Vegas (UNLV), City University of New York (CUNY), and the University of Nevada, Reno. (for a complete list of all team members, see Annex 1).

Theory of Change and Monitoring, Evaluation & Learning

The theory of change (TOC) driving the technical and strategic approach to project implementation evolved through the course of the project. The initial theory of change was that through USAID's funding and the technical assistance activities led by the U, the **human capital, social capital, physical capital,** and **financial capital** of USPCASW would be enhanced (outputs), which would create a nationally and internationally recognized Center that met the applied research and professional workforce development needs of the public and private sectors (outcomes), and that would continue post-donor funding to contribute to water security for Pakistan (impact). The specific contributions to improved water security might be thought of as enhancing Pakistan's **natural capital**. This theory drew heavily on the Five Capitals Model, developed by Forum for the Future, in which natural capital refers to natural resources and processes; human capital refers to knowledge and skills; social capital refers to trust, relationships, and networks; physical (manufactured) capital refers to buildings, infrastructure, and technology; and financial capital refers to money available for investing in the other capitals. In the context of this project:

- Human capital generating activities included the degree programs, training workshops, and exchange programs to develop faculty and student capacities in both technical and soft skills.
- Social capital generating activities included networking events, such as executive seminars, that brought together key stakeholders from academia, government, business, and civil society. It also involved establishing social institutions (both formal and informal) for good governance to achieve organizational excellence.
- Physical capital generating activities included the construction of a new building to house the Center and its laboratories, classrooms, offices, etc. It also included the establishment of a library and information management tech-

nologies.

- Financial capital generating activities included external grant writing, provision of consulting services, collaborations with the private sector, and fee-based workshops for water professionals seeking additional training.

In generating sufficient capital stocks across these four capital types, the teams would prepare the Center to thrive post-USAID funding.

Linking to the 2030 Sustainable Development Agenda

Early in the project, it was decided that the achievement of water security for Pakistan should be linked explicitly to the UN Sustainable Development Goal for Water (i.e., SDG 6). Such a linkage would not only give concrete targets (there are six) for the Center to organize its activities around, but it would also position the Center for participation in national and global policy dialogues about the SDGs, which would elevate the reputation of the Center and help foster new partnerships. An adaptive learning process was designed to use feedback from quantitative and qualitative methods to help ensure activities were contributing to this outcome. Figure 1 illustrates this initial theory of change.

Using this theory of change, the project's activities were mapped onto the four building block capitals in order to identify gaps in terms of attention and resources being used for activities to generate human, social, physical, and financial capital.

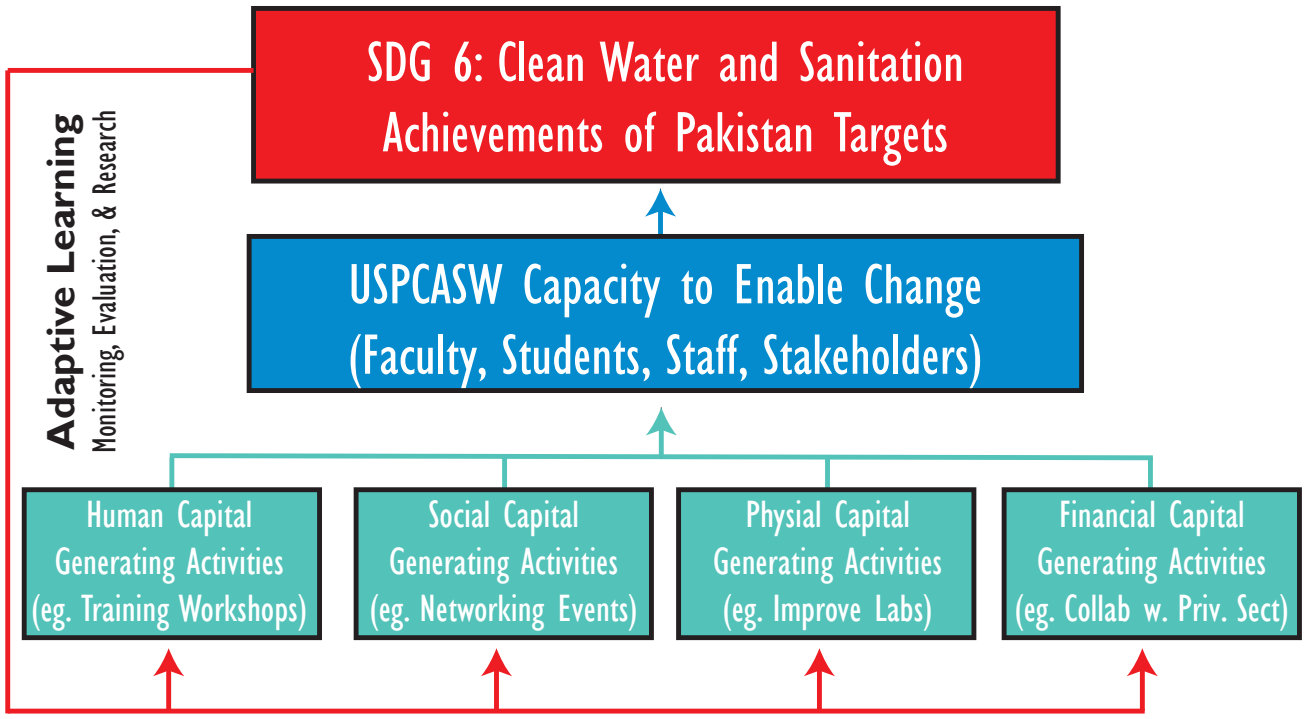


Figure 1. Initial theory of change

Theory of Change Evolution

Over time, however, the U-led team came to understand through its adaptive learning approach to

monitoring, evaluation, and learning (MEL), that this theory of change was incomplete. The TOC did not sufficiently emphasize the importance of a community of practice. The difference between a "network" and a "**community of practice**" is that the latter is oriented intentionally around real-world applications, or "practice." Networks tend to be for building social capital, but not necessarily putting that social capital to use in an applied way. Conceptualizing networks and partnerships in terms of a community of practice simultaneously emphasizes the egalitarian nature of the partnerships and also orients people to the purpose of *practice*.

A second limitation of the initial theory of change was that it conceptualized the development process in a linear input-output fashion, i.e., it presented a technical assistance model whereby planned activities delivered by experts produced development outcomes. It lacked a clear recognition that institution building included cultivating an organizational culture based on shared values – and that these **shared values** must include **collaboration and trust**. Although collaboration and trust are elements of "social capital," social capital was initially treated primarily in terms of formal networks and partnerships rather than interpersonal relationships. Trust earned through meaningful collaboration where the international partner had some "skin in the game" emerged during implementation as especially important for transformative, reciprocal learning relationships that generated significant increases in human and social capital. These increases in human and social capital included not only technical skills but also important professional skills and attitudes like research integrity and accountability.

Consequently, the U-led team in collaboration with MUET partners reconsidered how capacity development could be best achieved in this context. The result was a revised theory of change in 2018 that explicitly incorporated a set of **guiding principles**. This revised TOC shifted from a linear cause-and-effect model to a synergistic and dynamic one that put collaboration at its core. As a result of this revision, project outcomes were improved because – as will be shown in subsequent chapters – the most significant, transformative experiences in terms of capacity development emerged when people from each team (U.S.-based and Pakistan-based) worked together to accomplish shared goals.

Professor Scott Benson works with MUET faculty and students to sample for antibiotic resistant bacteria in Pakistan

Results-Based Performance Management Framework

For meaningful development outcomes, a robust TOC must be accompanied by sound MEL practices. A results-based performance management framework combined with critical reflection was seen as integral for ensuring continual course corrections and adaptations to steer project activities towards those that would lead to greater impact.

Human development is complex, and the MEL approach involved mixed methods and data triangulation so that multiple objective and quantitative metrics were tracked as well as subjective and qual-

itative information used for identification of gaps, challenges, and strengths. In addition to the quantitative targets that were mandatory to report, we used a tracking system for inputs (e.g., activities such as grant writing workshops) leading to key outputs (e.g., external grants received). This table, which was updated and reported on a quarterly basis, included remarks from the M&E Specialist to guide management decisions about how to do course corrections and allocate resources in the future. This adaptive management[4] approach proved useful for ensuring that a project of this complexity was able to achieve many successes across several domains (research, education, gender equity, etc.).

Overview of Report

Given the evolution of thinking around the process of effective capacity development that occurred during the project, this final report should be taken as a learning product itself. Indeed, this report is indicative of the kind of deep, critical reflection the U-led team regularly engaged in as part of its approach to MEL. Following an impact highlight page, the report is organized such that each main section identifies the major activities, outputs, outcomes, and impacts. Each section also includes reflections on challenges, constraints, missed opportunities, and most importantly, lessons learned. Highlights and case studies provide specific examples that illustrate impact or the process through which impact was created and achieved. The report concludes with higher level learnings that will be useful to future university partnerships for capacity building of higher education institutions in developing countries. A collection of annexes provides supporting details and documentation, including a list of additional project reports (Annex 2).

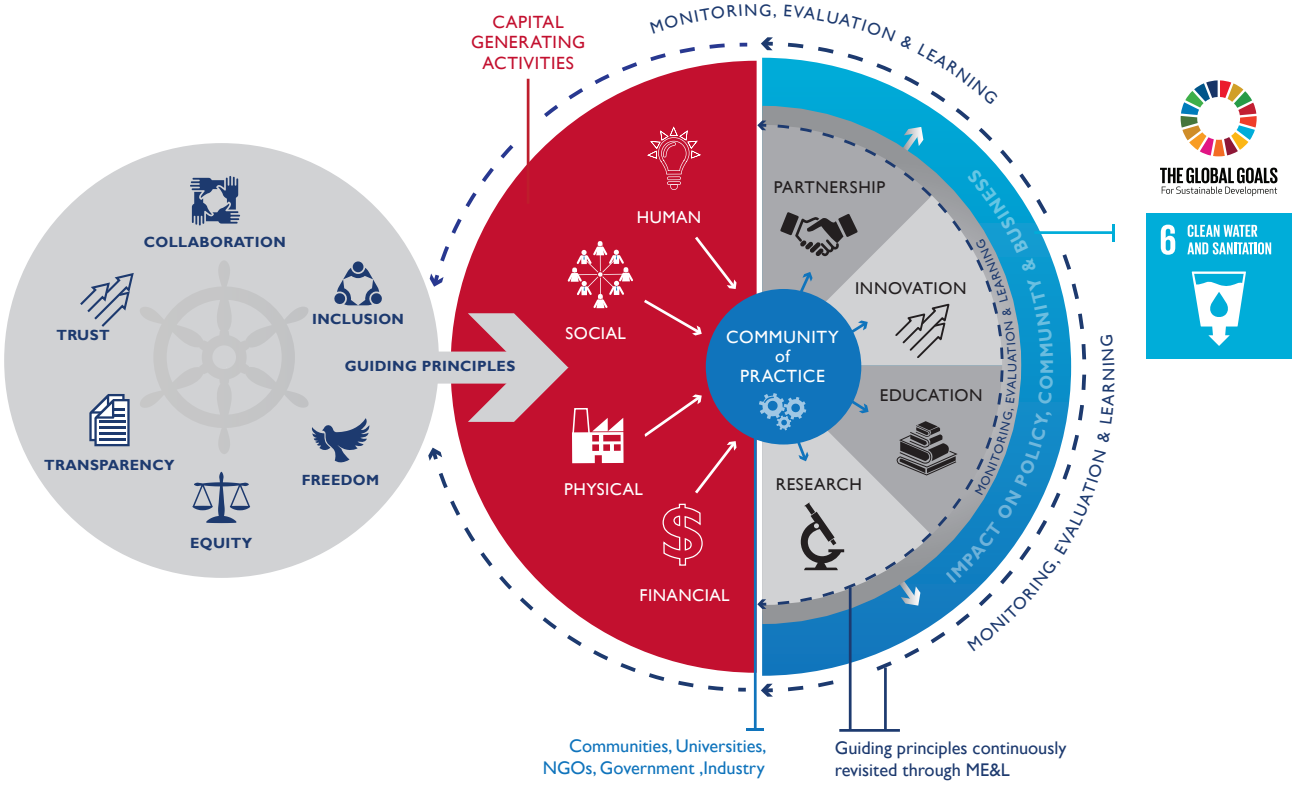


Figure 2. Revised theory of change.

4 According to USAID's ADS 201.6, adaptive management is "an intentional approach to making decisions and adjustments in response to new information and changes in context." The point is not to change goals but rather to change the path used to achieve them if doing so would help achieve them (see https://usaidlearninglab.org/lab-notes/what-adaptive-management-0).

"Conceptual and computational tools are essential to understand and improve water systems, but there is no substitute for getting out and working with the real thing in the field"

- Dr. Tim Gates, Professor of Civil and Environmental Engineering, CSU

Impact Highlights

Top 3 Impacts

Impact #1
Establishment of a fully operationalized and sustainable U.S.-Pakistan Center for Advanced Studies in Water (USPCASW) at Mehran University of Engineering and Technology (MUET)

- Thriving applied research and education programs with strong participation of women
- 1 new building with classrooms, offices, and state-of-the art laboratories
- 7 postgraduate degree programs benchmarked against international standards
- 170 research publications, including 88 in international journals
- Approximately 2.5 million USD generated to support the Center's activities and vision

Impact #2
Transformational learning experiences for USPCASW students, faculty, staff, and leadership

- 167 faculty, student, and staff exchange visits to U.S. universities (U, CSU, UNLV), leading to skills improvement in applied research, communication, collaboration, and global competence
- Increased self-efficacy and empowerment to set one's own goals and achieve them
- Broadened interdisciplinary perspectives and strengthened critical thinking
- Exposed visitors both to the U.S. – and to the Center in Jamshoro, Pakistan – to new ways of thinking and doing that contribute to sustainable development
- Center itself "graduated" from recipient of training assistance to provider of training services

Impact #3
Strong partnerships between USPCASW and industry, government, and civil society to apply research, build local capacity, and advance water security for Pakistan

- Dissemination of policy-relevant research findings to stakeholders through seminars and briefs
- Stakeholder involvement strengthened from "engagement" to "co-creation"
- Training partnerships with government departments (e.g., Irrigation, HEC)
- 80 internships hosted by 29 different organizations
- 29 projects funded by government, industry, and NGOs for applied research and capacity building

CURRICULUM

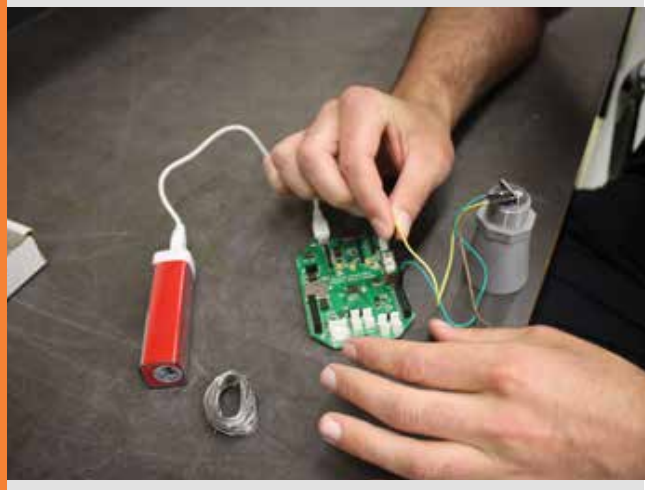
7 New Degrees

32 New Courses

APPLIED RESEARCH

170 Papers Published

333% Increase in Papers



15 Policy Dialogues

8 Policy Briefs

30 Grants Awarded

SUSTAINABILITY

$2.5 million USD Funds Raised

29 External Grants Received

3x Increase of External Grants

11 MOUs Signed

EDUCATION & TRAINING

75 Graduates

217 Active Students

1 in 7 Graduates Pursuing PhD in US

167 Exchange Visits

36% Female Students

29 Organizations Hosting Internships

Priority Recommendations for Future CAS Programs

Governance and Sustainability

1. Establish conditions for strengthening ownership of center among faculty, staff, and students
2. Identify initially and reinforce continuously the critical best practices for leaders, faculty members, staff, and students
3. Survey market, engage stakeholders, and build community of practice from start to finish
4. Develop shared vision, define impact to align with vision, pursue impact with all activities
5. Draft *Sustainability and Transition Plan* in first year and revise annually
6. Create endowment and implement fundraising strategies immediately after project launch

Applied Research

1. Identify core capacities, develop focal research areas, and foster teams to fit
2. Use start-up mentality to cultivate client-driven research ideas
3. Co-create and collaboratively conduct research projects with stakeholders and potential clients
4. Build research capacity with twinning built through sustained interaction and parallel research investigations
5. Develop global strategy to assess areas for improvement and ability to adaptively manage research capacity building

Education and Training

1. Assess baseline capacities and design interventions to address pipeline and workforce transition needs
2. Design coherence and alignment into curriculum and workforce training programs driven by stakeholder input
3. Plan research exchange experiences to build self-efficacy, global competencies, and resilience within the framework of courses, skill building workshops, and research training
4. Deliver capacity building programs in a continuous way with matrix mentoring, bridging intensive workshops, learn-by-doing projects, boot camps, and coaching

Partnerships

1. Identify and recruit partners with intentional strategy to build mutually beneficial relationships
2. Cultivate personal relationships to establish and sustain professional partnerships
3. Dedicate staff and faculty members to manage activities, networks, and events to target, catalyze, and grow partnerships

Gender Equity and Inclusion

1. Develop advocates among males to support female empowerment, Sindhi's for empowering those from outside the province, and so on
2. Elevate cultural competence among the technical assistance and capacity building team
3. Incorporate strategies to reduce implicit bias by making selection processes, grading, and other evaluations blind to names at the very least
4. Design programs to build self-efficacy, confidence, and resilience of underrepresented groups and maintain the reinforcement of these principles throughout capacity building program even if conditions seem to be improved

"One of the big successes of this project was the improvement of institutional capacities above baseline at MUET to manage a center."
- Dr. Aslam Chaudhry, Professor of Economics, Chief of Party, U

Governance and Sustainability

Key Accomplishments

- Establishment of a functioning Center for Advanced Studies with high capacities for graduate education, applied research, and professional training
- Institutionalization of good governance policies and practices (i.e., SOPs)
- Enhanced mindset of collaboration, practical impact, and pursuing excellence
- Secured external funding for research, consultancies, and capacity building of 1 million USD
- Secured external funding of 1.45 million USD from Government of Sindh for Women's Hostel
- Regularization (and thus retention) of faculty
- Comprehensive *Sustainability and Transition Plan* approved by Center, Board of Governors, and MUET Syndicate

Objective

The project objective to "*establish governance structures, fundraising and other elements of administrative capacity to support CAS-W sustainability*" was met through the governance and sustainability components. In an organizational setting, "governance" and "sustainability" go hand-in-hand. Good governance provides the basis for fostering organizational sustainability, while the latter points out the shifts and adjustments needed in the governance models to align these better with emerging market conditions. Therefore, this report integrates these two project components into a single chapter. What follows is a brief listing of the activities implemented in support of the governance and sustainability components. The actions are divided for organization purposes, but for some of the actions it is difficult to draw a line whether these fall under the governance or sustainability component.

Governance Actions

The project initiated numerous administrative and management processes and implemented regulatory and technical actions to support successful implementation. The most important actions are summarized below.

Establishment of a project management unit (PMU): Establishing the PMU served as an umbrella activity supporting many other actions implemented under this component. In general, the PMU supported day-to-day troubleshooting, assessed progress and impact, addressed implementation challenges, and supported the strategic planning and visioning process. The PMU assumed the key role in designing and instituting several governance instruments, mechanisms and protocols for improving the decision-making, planning and implementation of programmatic activities, strengthening student–faculty relations, and interacting with the relevant stakeholders. The PMU consisted principally of the Project Deputy Director (Chief of Party) and the Technical Advisor (Highlight Box 1) with one support staff, and these key personnel interfaced directly and frequently with the MUET PMU and the U Project Director and Administrative team based at the U. A management unit was also set up at CSU, the largest partnering U. S. university. The Project Director and the CSU Project Manager held routine coordination meetings throughout the course of the project.

Establishment of the Project Executive Committee: A core project team was established at the U to coordinate all major project activities, both those at the U and those at MUET. The team included not only project-based staff but also university faculty and senior staff who provided guidance and creative input into the design of activities, strategic planning, critical assessment of activities, and interaction across activities. This "Executive Committee" (see Annex 3) met weekly and proved to be an invaluable source of ideas and troubleshooting.

Establishment of the Senior Advisory Board: At the project outset, a high-level advisory board comprised of U senior administrators and Pakistani technical experts and thought leaders was formed to facilitate institutional level project support and infusion of contextual understanding of Pakistan (see Annex 4). The support of the Senior Advisory Board (SAB) was most instrumental in the first three years of the project as activities were forming and launching. A visit of SAB members to Pakistan in 2016 raised the perception of commitment of the international partner and fostered sustained interaction with federal agencies. During the transition phase of the project, the continued support of the SAB aided sustaining U involvement with the USPCASW.

Development of standard operating procedures (SOPs): The Center started its operations working with the MUET SOPs and, in some cases, drew guidance from the rules and regulations established by the HEC. But over time it started to develop its own SOPs and this work continued throughout the

project life. [5] These SOPs ranged from simple student admission standards to more complex issues such as faculty retention and promotion policies, evaluation of academic programs and faculty performance, research grant award process, criteria for selecting students for the exchange program, and procurement of goods and services (see Annex 5 for list of SOPs). Some of these SOPs were project-bound (e.g., selection SOPs for the exchange program), but others were adopted by the Center for ongoing use (e.g., laboratory SOPs, student handbook [6]). The goal of codifying policies and procedures was to improve consistency, efficiency, and transparency – and in the case of lab SOPs, to improve safety and data quality and reliability.

Planning and organization of technical events: The Center organized 15 high-profile conferences

HIGHLIGHT 1: The PMU at Jamshoro

Much will be conveyed in this report about the activities of dozens of U.S.-based faculty and staff in support of this project. However, the U-led team also had a Project Management Unit (PMU) based at MUET. The U PMU's Chief of Party/Deputy Director, Dr. Aslam Chaudhry, was one of the three initial project conceptualizers and leaders – along with Project Director Dr. Steve Burian and Associate Director Dr. Tariq Banuri.

After retiring from 23 years working with the United Nations, Dr. Chaudhry decided to return to his home country to contribute to USPCASW as its "head coach" so to speak. He was in residence at MUET for the first two years of the project, providing day-to-day guidance and support to the Center's PMU and faculty. This high-level mentorship – as well as targeted technical assistance to the senior management, especially the USPCASW Project Director, Dr. Bakhshal Lashari – mattered a great deal for building the governance institutions that are fundamentally important for long-term sustainability of the Center.

The PMU also included the role of Technical Advisor, which was filled by Dr. Sajjad Ahmad (UNLV) for the first year of the project. His rapport with the USPCASW PMU, faculty, and students was important for establishing the tone of the partnership. Later, in mid-2017, Dr. Jeffery Ullman (U) joined the team as Technical Advisor for two years in residence at MUET. He provided on-demand feedback and guidance to students and faculty working on designing research projects, preparing journal articles and grant proposals, and improving their research skills.

In each phase of the project – inception, growth, impact, and transition and sustainability – a different approach to the PMU technical assistance was needed. The U-led team evolved this approach in a collaborative way with MUET with the constant being the mission visits and the continuous support of Dr. Chaudhry and Dr. Ahmad.

5 For several features, the standards set for the Center (for example, attendance, grades etc.) were higher than those applicable at MUET level.

6 The 2018-2020 USPCASW Student Handbook is available for download at http://water.muet.edu.pk/wp-content/uploads/2019/03/Student-Handbook-2018-20.pdf (as of 3-6-2020). The handbook is a comprehensive collection of policies regarding gender equity, degree program requirements, exam policies and procedures, academic integrity and plagiarism, student internships, research funding for students, and more.

and policy seminars to engage stakeholders (Annex 6) as well as 18 technical training workshops and diploma courses (Annex 7). The faculty and staff were coached in conceptualizing, developing and organizing these events. This activity not only contributed towards capacity building of faculty and staff, but also helped in promoting the Center's image and credibility and advancing stakeholder engagement in its operational activities.

Improving communication: The project launched several activities to strengthen communication both within the Center and with the stakeholders. These included: (i) launching a website to inform stakeholders and the general public about the Center's activities—this website continuously evolved over the project life [7], (ii) initiating web-based information systems to improve communication between management, faculty and students (see Annex 5), and (iii) instituting wide-ranging initiatives to improve communication with stakeholders (see the other chapters in this report for details).

Ensuring the Center's operational autonomy: Actions were taken in terms of seeking approvals from the Center's BoG and University Syndicate to maintain the Center's operational autonomy. This will mean two things in moving forward. First, the Executive Director will be responsible for all administrative and financial actions pertaining to the Center's operations without any interference from the university's management and financial office. Second, as a "National Center" it can recruit faculty and enroll students from all over Pakistan as per its SOPs. A number of governance instruments have already been put in place which will help in ensuring operational autonomy during the transition period.

A critical aspect of sustainability was the training of staff to manage administrative functions of USPCASW.

Sustainability Actions

Sustainability actions included mechanisms and drivers that should enable the program to maintain its momentum and quality with a focus on addressing three challenges: financial challenge--generating sustained streams of funding to continue the Center activities in a post-donor funding scenario; technical challenge--enhancing the confidence of personnel and the quality of the programs launched during the project life in such a way that they continue to influence and respond to market needs; and social challenge--engaging the stakeholders to provide sustained input into research and curricula activities. Sustainability activities addressed one or more of these challenges.

The project's theory of change posited that investments in activities to generate human, social, physical, and financial capital could lead to sufficient capital stocks for the Center to draw upon for sustainability in the post-USAID scenario. The exact threshold at which it could be declared that there are "sufficient capital stocks" to ensure sustainability is not known; however, it is clear that through a suite of activities, there has been substantial improvements across all types of capital.

Creating a culture of excellence: This activity was considered vital for securing the Center's long-term sustainability. So conscious efforts were made to bring together faculty, management, students and staff to instill and energize the philosophy of what "excellence" means in an academic and research setting. These efforts included promoting collegiality and respect, creating research teams, recruiting new

7 See water.muet.edu.pk.

and/or adjunct faculty with expertise in cross-cutting areas, developing a shared vision of success, implementing good management practices, promoting gender equity, and creating a work environment conducive to the professional growth of new faculty. This effort was led by the U Chief of Party (see Highlight Box 1) and reinforced during missions with the presence of high-caliber international faculty; the purpose behind these efforts was two-fold: (i) to gradually raise the performance/expectations bar, and (ii) to empower the faculty in making academic and research decisions.

Capacity development of faculty and staff: Technical and institutional capacities developed under the project will be key to sustain the Center's academic and research programs in the long-run. Major activities in this regard are described in each of the Chapters that follow. Efforts to sustain the capacity development included organizing and sharing learning materials used in workshops and trainings, providing self-guided learning related to writing, teaching, and statistical analysis, and training the trainers.

Sustainability of the academic program: The Center launched MS and PhD degree programs in four and three disciplines respectively. The technical assistance provided in launching these programs included is described in the Education and Training Chapter. The faculty were trained and engaged collaboratively in curriculum review and streamlining, and teaching assessment. The faculty, heads of academic degree areas, and the Deputy Director overseeing academic programs were given training on regular annual curriculum reform processes to evolve and modernize the programs and continuously improve teaching into the future. U.S.

Sustainability of the research program: Support to the applied research component was provided using a framework organized around the six targets of SDG 6. This instilled a shift in research thinking—guiding the faculty to pursue research that would contribute to solving on the ground problems. Operational activities covered under this component are described in the Applied Research Chapter. To support sustainability of research excellence, SOPs were provided, learning materials used in grant writing workshops were shared, and relationships were built to sustain collaborative research projects through pursuit of funding.

HIGHLIGHT 2: Sustainability and Transition Plan

In order to ensure that the Center would be sustained post-USAID funding, a hundred-page *Sustainability and Transition Plan* (S&T Plan) was prepared by the teams.

It included:

- self-assessment and critical reflection about what had been achieved, what gaps remained, and what steps could be taken to ensure that the quality of education and research does not regress in the absence of international donor funding and technical assistance;
- consideration of issues relating to governance, financial sustainability, curriculum development, applied research, capacity building, networking and partnerships, and technology development and commercialization; and
- an implementation plan for the transition period.

The S&T Plan was approved by the Center's Board of Governors in 2019.

Networking and partnerships: The Center was supported in launching several initiatives and partnerships for strengthening collaboration with the academic, research and policy making institutions and civil society organizations. Coaching developed capacity to continue to organize stakeholder events, conduct meetings for strategic partnerships, sustain committees for fostering partnerships. In addition, in the *Sustainability and Transition Plan*, the structure of USPCASW was organized to include a director-level position to maintain and grow partnerships. The TORs for that position were provided to USPCASW.

Meeting the funding challenge: An endowment

fund was established [8] and it has grown over a period of time. The Center can now use the returns yielded by this fund to meet the most pressing financial needs. Also, the faculty hired under project funds had been regularized, meaning their costs would now be covered through the regular MUET budget, and the Center will not have to raise resources for this purpose. Also, the faculty had been trained in writing research proposals to attract funding from external sources, and by offering market-driven training courses for a fee.

Supporting the transition: The Center was supported in initiating the process for recruiting new leadership, and in the preparation of a comprehensive *Sustainability and Transition Plan*. This plan contained proposals for the new organizational structure, TOR for various functional units, business plan for the next five years, and sustainability agenda for securing the Center's long-term sustainability (see Highlight Box 2). The Center was also helped in securing necessary administrative approvals of these actions from the Center BoG and University Syndicate.

Major Results and Outcomes

Implementation of the above-mentioned governance and sustainability actions have resulted in realizing the following major outcomes.

- The USPCASW as an institution has become fully functional. It has the necessary capacities and infrastructure to offer academic degree programs, conduct applied policy research, and deliver workforce development training.
- The Center has accumulated sufficient management and operational experience informed by several monitoring and evaluation reports—all of which will be very useful in future visioning processes and strengthening key features of the implementation strategy.
- There is an increased recognition among the faculty, students, staff, and senior MUET management that good governance is perhaps the most important factor for driving long-term success of the Center, and creating its ownership among faculty, students and other stakeholders.
- The curriculum reform and aligning of the research agenda with the SDG framework had positioned the Center to be a leading center of excellence in the country to address water sector challenges through higher education and interdisciplinary research.
- There is more appreciation among the faculty for working as part of the research groups to be able to undertake multi- and inter-disciplinary research, and writing successful research proposals.
- The Center has graduated from being the recipient of the capacity building assistance to supporting other institutions in their capacity building, especially in the areas of teaching and applied research.

Table 1. External funding (in PKR millions) generated from different sectors – from local to global scale – for research, training, and consultancies.

	Business/Industry	Government	NGO/Civil Society	Grand Total
International	0.000	10.041	7.160	17.201
Joint (National & International)	0.000	50.000	0.000	50.000
National	5.416	28.349	8.803	42.568
Provincial	0.000	56.632	0.250	56.882
Grand Total	**5.416**	**145.022**	**16.213**	**166.651**

8 The Center established an endowment fund to receive funds from different sources to which MUET has already committed a sizable contribution—especially through channeling back the tuition fees received from the project. The administrative overhead charged for research contracts and consultancy services will continue to contribute to the growth of the endowment fund.

- There is an increased awareness in the academic, research and policy-making circles with regard to the Center's capacities in addressing water sector issues and challenges. These need to be further complemented through intensive advocacy and outreach efforts.
- Several of the partnerships and networks formed during the project life both at the national and international levels have started to yield benefits in terms of supporting the Center in advancing the implementation of its work program.
- Industry-academia linkages have been strengthened especially with reference to defining client-driven research needs.
- The Center has started to attract research and consultancy funding from different sources (business/industry, government, and NGO/civil society), including commercialization of its services. (167 million PKR / approx. 1 million USD; see (Table 1 and Annex 8 for details).
- The Government of Sindh (GoS) has demonstrated serious commitment to the mission of the Center. The GoS gave 1.45 million USD to build a hostel for women on MUET campus, and it has supported research and internship activities (see Annex 8 and Annex 9).
- The Center's graduates who are presently pursuing higher degrees abroad have expressed strong commitment to work for the Center upon return—a very hopeful factor for its sustainability.
- The Center has adopted a *Sustainability and Transition Plan* (Highlight Box 2) to guide and steer its future operations.

Implementation Challenges and Constraints

The project implementation encountered several interrelated administrative, management and technical challenges and constraints. These are summarized below, but not in any order of importance or priority.

Governance-related constraints at project implementation included: absence of SOPs, centralized decision-making, lack of advanced planning, poor communication, weak collaboration among faculty, limited stakeholder engagement (especially with the private sector), anemic student mentoring, and absence of procedures and processes for evaluation of faculty and staff. With the implementation of governance reforms, however, the situation improved.

The geographical location of the Center made it difficult to attract strategically-relevant and qualified faculty, consultants and students from major urban areas. This constraint was partly alleviated by offering attractive incentive packages. Continuing with these incentives will however not be possible in the post-donor funding scenario. It remains to be seen whether the Center, and MUET in general, has succeeded in establishing a sufficient reputation and positive work environment for research excellence such that high caliber faculty and students are retained and further recruited.

The newly hired faculty had limited technical capacities in research, teaching, and student mentoring. For several of them, it was their first experience to work in an academic and research setting. On the other hand, the senior faculty had limited exposure to innovative teaching methods and applied policy research. Over time sufficient capacities have been cultivated such that the Center is expected to sustain its operations.

For the first 2 years, the Center had to rely on borrowed teaching and research infrastructure where lab, internet and other communication facilities were very limited, thus making it difficult for the students, faculty and management staff to coordinate their interaction and activities (see Case Study 1).

Operating and maintaining laboratories became a challenge as the instruments were installed. SOPs were developed and put in place. A safety culture was encouraged, but difficult to establish especially among the students.

CASE STUDY 1:
Physical and Social Infrastructure Matter for Development

Critics of infrastructure development projects argue that donor money is too often used to construct buildings that then go unused and unmaintained. However, the reality is that physical infrastructure does matter – and human and social capital development without sufficient attention to physical capital development will result in poorer outcomes.

The original CAS agreements did not include budget for new infrastructure. However, the available infrastructure at MUET was completely inadequate to support state-of-the-art laboratories. Fortunately, USAID agreed and separate funding was allocated for the construction of the USPCASW building, and construction was completed in summer 2017.

In terms of project implementation, the change from pre-building to post-building was very significant. First, with the new building and lab facilities, high level research could now be realistically undertaken on site. Second, the new building created a designated space for students, faculty, and staff of the Center such that a sense of community was strengthened. Third, the building's physical autonomy enabled some other forms of autonomy – for example, the Center's cafeteria was the only place on MUET's campus where men and women could eat together. Fourth, the fact that the Center has its own auditorium for speakers and events has facilitated its role as convener of policy dialogues.

Maintaining the physical infrastructure is a major concern for sustainability of high quality research. Therefore, the U-led team provided laboratory training and guided the development of laboratory SOPs to ensure that the MUET faculty, technicians, and students would have good governance procedures to continue to operate and maintain the labs post-project.

The Center's advocacy and outreach efforts were seriously constrained by limited communication capacities to effectively disseminate research results. As a result, the useful research work done at the Center could not be placed in the public policy-making domain. This challenge had two dimensions. First, the management underestimated the value and power of communication. Second, the faculty had limited capacities to translate research reports into policy briefs and then share those reports with the relevant stakeholders.

In the absence of any background study or established process for academia-industry linkages, it was difficult to connect the academic and research programs to the market needs. As such, the adjustment process continued throughout the project life through stakeholder consultations and a market survey implemented in 2018.

Several partnerships with public and private institutions were formed, but the management lacked the will and capacities to sustain these initiatives. Similarly, follow up to the recommendations emerging from high profile seminars and conferences remained extremely weak.

It is worth noting that the reform process to address the above-noted implementation challenges in the early years remained slow because of several historical and administrative reasons. Over time, however, the situation improved as a result of implementing various governance instruments, administrative processes and issue-specific initiatives. The fine-tuning of the management processes should continue in the post-donor funding scenario, especially in the following areas: (i) decentralizing administrative authority to functional units (and empowering them with required resources), (ii) enhancing quality and timing of decision-making, (iii) improving communication among faculty, staff and management within the Center, (iv) strengthening collaboration with

external partners, (v) promoting transparency, and the culture of advanced planning, (vi) adapting good management practices, and (vii) enforcing SOPs in their true letter and spirit.

Missed Opportunities

The above review of governance and sustainability actions suggested that notable progress was made in achieving the intended project objectives despite several implementation challenges. However, the progress could have been more noteworthy if opportunities created by the project were not missed. These are pointed out in the preceding sections in one way or the other (and also in each of the following chapters), but are summarized below to draw lessons and guidance for shaping the future implementation strategy.

Aligning CAS programs: The USAID and HEC missed the big opportunity of bringing together the strengths of three CAS programs to advance the implementation of the WEF nexus for sustainable development. Each of the programs took its own trajectory and there was hardly any coordination among them on issues of common concern and interest, such as climate change, gender equity, technology development, SDGs, entrepreneurship, and public-private partnerships. In other words, an opportunity for pursuing interdisciplinary and cross-sector research was missed. The meetings of the National Steering Committee were unproductive and failed to provide any strategic guidance to the three Centers and their implementing partners.

Defining impact: One of the most significant missed opportunities was the failure to establish a stronger team orientation around what "impact" would look like, if achieved. To some extent this was due to an over-reliance on USAID's indicator selection as a guide towards meaningful impact. Indeed, there was a great deal of focus (especially at MUET) on doing the activities and producing outputs (particularly those that were mandatory targets in the CAs) such that at times these actions may have detracted from pursuing quality and achieving more meaningful impact. The primary example of this was the pursuit of a set target of graduates (250) rather than the outcome (well-prepared graduates working as agents of change in the water sector). A focus on the latter would have produced fewer graduates but perhaps would have created a bigger ripple effect that could help transform the water sector – especially if the quality could be maintained post-project (see Case Study 2).

Launch training unit: The training needs for the water sector professionals at all levels are huge, and remained unmet. The Center – despite possessing the necessary technical capacities to deliver on this function – has not been able to hire a training coordinator, establish a training unit, and thus tap this market in a systematic manner. This opportunity has a tremendous potential for generating technical goodwill and funding to support the Center's operations.

Earlier compilation of sustainability plan: It would have made more sense to prepare the sustainability plan in the first or second year of the project rather than attending to this in the final project year. It would have provided the opportunity to monitor sustainability benchmarks each year and take corrective actions to stay on course. Similarly, implementing the market study at the start of the project would have allowed the Center to design and align its academic program with the market needs from the very beginning.

Lessons Learned

What follows is a brief summary of the lessons learned which can serve as a useful reminder for

steering the Center into its next phase of life.

Continuing with the proven best practices matters: Several of the successes achieved so far could be attributed to the best practices and incentives initiated during the project life (these for example included scholarships for students, opportunities for training in the U.S., free accommodation for female students, research grants, graduate seminar series, FAR, etc.). Continuing with these practices will remain extremely important in attracting good students and faculty, and rewarding those doing good work. In the absence of donor funding, sustaining some of these incentives will be difficult but not doing so will threaten the Center's national impact and sustainability.

Focus on impact creation matters: The Center had met most of the quantitative and qualitative targets agreed in the CA (Annex 10) [9], but it is not always clear how the achievement of these targets has contributed towards solving real-world problems or impacted the performance of the water sector through policy change or improved water resources management through technological development. Future monitoring efforts should therefore focus on devising ways to assess impact in terms of outcomes and their quality, especially in terms of "broader impacts" (for a discussion of MEL efforts, see Annex 11 and 12; see also Highlight Box 3).

Another reason that there was not a stronger linkage between actions and impact is surely an artifact of the academic context. For academics, "impact" is conceived of in terms of high citation rates of research publications in prestigious journals. "Broader impacts" are those that extend beyond academia into the broader community – and they can be seen as secondary to the primary impact via publications. Therefore, the real development challenge is how to shift the academic mindset and incentive structure so that broader impacts play a more central role in how academics perceive their roles and measure their success. Our team supported this shift through the introduction of industry-academia co-creation workshops and grants, among other activities. Nonetheless, one lesson learned was to design and implement a more intentional strategy to support broader impacts from the outset. And more broadly, systemic change in the HEC is needed to foster faculty interest in targeting and achieving tangible impacts. Again, a set of indicators from USAID that explicitly focused on broader impacts would have helped for this project (see Case Study 2) [10].

Making academic and research programs market-driven matters: Aligning the Center's research and academic program to the market needs will be critical for its long-term sustainability. The Center's existing program, as it stands today, cannot be claimed to have met this condition. In this regard, undertaking periodic market surveys and organizing expert group meetings can provide useful guidance. Priority attention should be given to examining the market feasibility of IWRM and WASH degree programs. Also, the Center should continue strengthening its capacity building efforts to remain relevant and competitive in the market.

Conditions for strengthening ownership matter: Creating Center ownership remained a challenge during the project life because either the management was too centralized or employees were not clear about the organizational goals and the strategy to achieve those goals. It appeared that the buy-in from the faculty and students was not because they appreciated the core values and principles around

9 The U and MUET formally requested five modifications to the CA on September 4, 2018. Two of these requests were to change targets in the CA. The target for the number of exchanges was requested to be changed from 250 (50 in U CA, 200 in MUET CA) to 150; the target for the number of graduates was requested to be changed from 250 to 175 (with an additional 75 students enrolled in degree programs). Rationales/justifications for these requests were given. Prior communication with the AO indicated that targets listed in cooperative agreements were not as "hard" as for contracts, but the implementing partners requested a formal modification – but no action was taken by USAID. Ultimately there were significant, non-budgetary constraints that limited achievement of the original targets within the LoP. In 2019 the teams requested a no-cost extension in order to meet these targets; this request was not approved. MUET returned approximately 2 million USD to USAID.

10 USAID had assigned one indicator to USPCASW to report on the "number of academic research initiatives whose findings have been replicated, applied or taken to market" (PIRS 4.2.3-c). However, the way this was operationally defined included a kind of "loophole" for academics because it included new research publications based on USG-supported research. In other words, the 167 publications produced by the Center far exceeded the project target of 50. What would have been helpful would have been a separate target that focused on "broader impacts" beyond academia.

which this Center was established. Instead, they might have valued more the high salary packages and other facilities made available to them through the project funds. In going forward, this culture and mindset needs to change—an environment must be created that encourages participatory decision-making towards achieving a shared vision, and promotes collective ownership of successes and failures (see Case Study 2).

CASE STUDY 2: Moving Development Beyond Project-Based Thinking

The challenge with project-based development like the USAID CAS program is that the beneficiaries and implementing partners too often perceive it as a project.

This "project-based-thinking" is problematic for establishing a sustainable institution, i.e., "the Center." Rather than conceptualizing these kind of development projects as time-bound agreements to produce certain quantitative deliverables, the focus should be on what it takes to build the governance structures – and perhaps more importantly, the organizational culture – that will persist post-project not only to operate and maintain the system but to push it further towards excellence.

This kind of shift in thinking could be facilitated by USAID if it awarded "projects" as explicitly "start-up" or "seed" funding. A strategic business plan should be required as part of the first year of such a project – indeed it could even be part of the initial proposal – and refined annually. In some ways, the sustainability plan submitted to USAID served this purpose, but the feasibility and precision of the plan was never tested, and progress in achieving sustainability was not assessed.

It would also help if donors viewed "MEL" as not only for the purposes of a time-bound project but as something to be incorporated into the long-term strategic plan of the Center. In other words: donors could require the institutionalization of a comprehensive MEL system that *would be maintained post-project* as a tool to support sustainable excellence in education and research at the institutional level.

Although the U and MUET M&E Specialists drafted such a tool, it was never "owned" by the Center in a meaningful way, and it was never institutionalized in full, although certain elements were adopted (e.g., tracking alumni outcomes rather than deferring to MSI to do it).

In hindsight, it would have been more effective to conceptualize this framework from the outset as distinct from M&E for the project and viewed instead as a quality assurance system to be institutionalized as good long-term governance of the Center. Similar institutional metric systems have been adopted by universities in the U.S. and elsewhere (see UC Davis for example, https://leadership.ucdavis.edu/strategic-plan).

As the Center transitions into its post-USAID phase, it may find it useful to revisit, revise, and implement such a framework for ongoing adaptive management purposes. Future USAID higher education institution-building projects would likely benefit from using this kind of framework to "establish a Center" rather than merely "complete a project."

Concluding Thoughts

The water sector in Pakistan is confronted with many challenges which are becoming ever more complex due to increasing water demands and threats posed by climate change. The Center has started to address some of these challenges, but it will require time, continuity, perseverance, and determination to make progress.

The three most critical governance and sustainability challenges during the post-donor funding scenario will be: (i) how leadership and the organizational processes can continue improving the quality of academic and research programs with diminishing or no international technical support, (ii) in the absence of internal funding for small research grants, how will the Center's collective strength and reputation be sued to faculty members remaining engaged in research, and (iii) how to mobilize the resources required for sustaining the existing level of operational activities?

These challenges are surmountable and several factors provide a basis for this optimism. The faculty, management and staff have already gained sufficient experience and training in implementing the Center's core activities with regard to teaching, research, advocacy, and training. They are prepared to be leaders and to support leaders in advancing the governance and sustainability initiatives. A *Sustainability and Transition Plan* (see Highlight Box 2) is also in place that can serve as a very useful resource to address the existing and emerging challenges. There is an increased understanding among all the relevant stakeholders about the services that can be offered by the Center and their respective standards. With new leadership in place, these standards are only expected to get better.

Currently, a handful of the Center's faculty members and graduates are studying abroad to obtain PhDs in water-related disciplines. Most of these will be completing their PhD degrees in the next two years and some of them have expressed their willingness to return and work for the Center. They will bring with them the latest culture of research, teaching, and student mentoring, thus providing a boost toward elevating existing capacities. Finally, the HEC

HIGHLIGHT 3: Monitoring & Evaluation for Institutional Development

The U M&E Specialist (Dr. Mercedes Ward) and the MUET M&E Specialist (Mr. Shahid Panhwar) worked closely together throughout their time with the project. Given Mr. Panhwar's extensive background in M&E and Dr. Ward's background in anthropology – and in particular, the study of formal and informal governance institutions using ethnographic methods – they were in positions to learn much from each other.

In addition to M&E, they worked together to try to develop and institutionalize systems for quality assurance within the Center that would be sustained post-project. This work shifted their administrative work from strictly M&E to institutional development. Indeed, Dr. Ward took the role of Institutional Development Advisor in 2018; and Mr. Panhwar visited the U in 2018 to learn more about effective systems for faculty performance evaluation, student job placement, alumni relations, and more.

Most importantly, the strength of their relationship allowed them to have honest conversations about what was working and not working with the project. These critical reflections provided them with valuable insights about how to "do development better" or how to "incentivize excellence" that they then could turn into recommendations for their respective teams.

has recently launched several initiatives to support applied research in different sectors, including the water sector. The grants to be awarded under these initiatives are expected to be relatively large in financial size, thus a great opportunity for the faculty to tap these resources.

Given that the U signed another MOU with MUET to continue the partnership for another five years, it is expected that there will be further collaboration in research, education, and training between U.S.-based faculty and Center faculty. The year 2020 will be an exciting transitionary period for the Center during which all of the training and experience acquired under the integrated approach to capacity strengthening will be put to use.

"I learned how to measure streamflow and water quality real-time while on the exchange visit to the University of Utah. Working with graduate students and staff I studied flow and water quality relationships in Red Butte Creek near to the University of Utah. I hope to apply flow monitoring in Pakistan to improve water management."

- Tarique Aziz USPCASW Exchange Scholar

"Hands on learning of research methods, side-by-side with experts in the field, is the most effective educational model."
- Dr. Jennifer Weidhaas, Professor of Civil and Environmental Engineering, U

Applied Research

Key Accomplishments

- Organized several stakeholder consultations to set up Center's research priorities and agenda
- 30 research projects completed with funding from USPCASW grants (total 76.62 million PKR / 500,000 USD)
- 27 externally-funded research and consulting projects awarded to the Center (total 124.4 million PKR / 800,000 USD)
- More than 150 completed student research projects, with another 100 in progress
- More than 165 peer-reviewed publications between 2015-2019, with more forthcoming in 2020
- Recommendations derived from applied research disseminated to stakeholders and clients, including Government of Sindh, NGOs, and industry partners

Objective

The project objective to "*deliver relevant and innovative research to meet the needs of clients in industry, civil society, and government*" was met through the Applied Research component. The results and outputs expected from this component included generating researcher and research team capacities, building laboratory and computational facilities, orienting researchers to practical problems, linking researchers to stakeholders from the public and private sectors, and aiding the improved translation of research outputs to implementation. Through project activities, the applied research was expected to increase in quality, productivity, relevance to societal needs, and become self-sustaining with external funding and ultimately support evidence-based policy recommendations and preparation of a cadre of skilled water professionals, contributing to water security for Pakistan.

Actions

Numerous actions were taken to develop and strengthen applied research capacity to address societal needs. For organizational purposes, these actions are presented in five categories: stakeholder engagement, collaboration, capacity building, implementation, and impact (Figure 3).

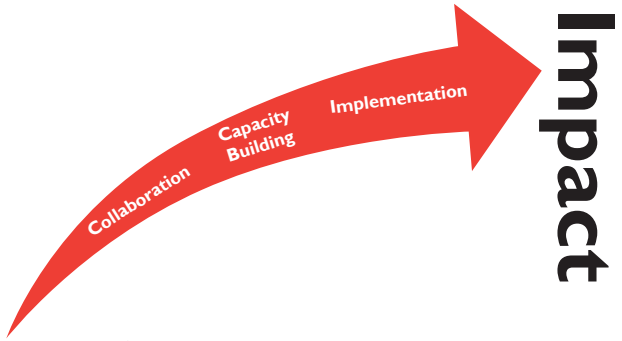


Figure 3.The process through which research capacity is built for impact

Stakeholder engagement: Interacting with stakeholders and receiving their feedback throughout the project was a critical element to establish the applied research program and in particular to embed research priorities in the curriculum (e.g., SDGs), build research partnerships, design training programs, and link to internships and employers. The U-led team supported the Center to facilitate 15 stakeholder events, with at least one organized major event during 10 of the 23 training missions that were conducted from June 9, 2015 to December 11, 2019 (Annex 13). A strategic approach was taken to identify stakeholders likely to align with USPCASW research, which led to targeted efforts at connecting with stakeholders in Jamshoro, Hyderabad, Karachi, Islamabad, and Balochistan. These efforts aimed to strengthen the reputation of the Center within the province but also, importantly, across the country.

Collaboration: Missions in 2015 and 2016 included workshops designed to build research teams, such as developing the USPCASW research agenda and thematic research groups. Workshops included brainstorming research concept notes around the SDG 6 targets. Faculty members were encouraged to self-select into the research groups that interested them and self-organize their respective teams around the suggested themes of water governance and sustainable development, clean water infrastructure and technologies, water informatics and decision support, and sustainable agriculture water management. Specific workshop activities included developing research maps, reviewing graduate student research proposals and project progress, and writing collaborative research concept notes.

Through this process, three "flagship" projects were designed in year 1 with scopes requiring several investigators:

1. MUET Clean Water Project. The big idea was to design a new water system for MUET that would include test beds for research in water treatment technologies, sensors and observa-

HIGHLIGHT 4: Using SDG 6 as a Framework for Research Collaboration



With guidance from the U-led team, small research teams eventually emerged around each SDG 6 target. Some particularly successful teams in terms of grants and publications include the following:

- **SDG 6.1** – Nanotechnology to Improve Access to Clean Drinking Water. Dr. Krista Carlson from U developed a strong partnership with Dr. Sara Hassan from MUET to develop nanotechnology-enabled water treatment approaches and devices.
- **SDG 6.2** – Characterization and Surveillance of Antibiotic Resistant Bacteria. In advancing the MUET clean water flagship project, Dr. Mahar from MUET built strong collaborations with Dr. Ramesh Goel, Dr. Jennifer Weidhaas, and Dr. Jim VanDerslice at the University of Utah. This led to establishment strength in microbial tool research capacity at USPCASW used to characterize the Hyderabad water system, develop disinfection techniques, and design a surveillance protocol.
- **SDG 6.3** - Industrial Wastewater Treatment. Dr. Zubair Ahmed, Dr. Tanveer Ghadi, and Dr. Mahar worked with Dr. Jennifer Weidhaas to design industrial wastewater management pilot tests and advance eco-efficiency concepts among industries in Karachi.
- **SDG 6.4** – Canal Sealing to Improve Canal Water Delivery Efficiency. Dr. Munir Babar from MUET worked closely with Dr. Tim Gates from CSU to design and implement projects to test use of polymers for canal sealing in Sindh Irrigation Department canals.
- **SDG 6.5** – Climate Change Impacts on Indus River Flows. Dr. Ghulam Hussain Dars from MUET had a successful collaboration with Dr. Court Strong at the University of Utah to develop and apply tools for downscaling climate projections in Pakistan accounting for several complicating factors in the complex terrain of the northern areas.



tions or system states, customer use metering, and demand management interventions. This project was also supposed to illustrate the concept of using the campus as a "living lab" to support hands-on learning to improve campus sustainability. [11]

2. Indus River Decision Support. This flagship project aimed to address the need to incor-

11 This concept of using the university campus as a kind of "test bed" for sustainability innovations has gained significant traction at universities around the world. Some U.S. examples can be found at the University of Illinois at Urbana-Champaign (https://sustainability.illinois.edu/research/campus-as-a-living-laboratory-research-campus-sustainability-working-together/); Harvard University (https://green.harvard.edu/series/living-lab); and Duke University (https://sustainability.duke.edu/academics/campus-lab), among many others.

porate climate resilience thinking into the management of the Indus River. Key components were downscaling climate projections, compiling geospatial and remote sensing data sources, and developing water management and systems models. Similar to project 1, the singular goal was not to design an operational system, but rather to apply the research tools to answer questions helping aid policy and practice.

3. Pakistan Water Development Report. Following the example of the World Water Development Report, the idea for this flagship project was to synthesize literature related to the SDG 6 targets, link USPCASW researchers to others in Pakistan, and establish the Center as a leading national water center capable of providing policy-relevant research and guidance.

Several other research collaborations between the U-led team and USPCASW faculty were initiated during this period (for example, see the joint projects for SDG 6 targets in Highlight Box 4).

Capacity building: With ideas and collaborative teams generated, the next step was to develop the physical and human capital necessary to carry the projects forward. Unfortunately, the USPCASW laboratories and computational resources were not initially available to the research teams due to the building construction not being completed until mid-2017. Therefore, prior to the building's completion, much of the needed research was conducted using the facilities of other departments at campus, while simultaneously undertaking activities in preparation for launching research, including selection and procurement of lab equipment, planning and design of safety and operating procedures, and training of laboratory technicians, faculty, and students through exchange visits to the U and CSU. Once the USPCASW building and six research labs (Highlight Box 5) were established in summer of 2017, escalated efforts were made in the form of workshops to provide hands-on training to faculty members, lab technicians, and students.

In addition, to support the research life cycle, more than 50 workshops, micro-trainings, and boot camps were conducted during 23 missions (Annex 13 and Annex 14) covering the following topics: ideas generation, grant writing, experiment design, statistical methods, research administration and management, writing journal articles, and writing policy briefs. The research training was further complemented by the support provided by the Technical Advisors to individual faculty on demand basis especially in the areas of writing grant proposals and journal articles.

HIGHLIGHT 5: The New USPCASW Laboratories & Other Facilities

The new USPCASW building is an energy- and space-efficient three- story building (ground + 2) comprised of a total covered area of 54,721 square feet. It includes the following facilities:
Six Research Laboratories (for lists of equipment, see water.muet.edu.pk):

1. Hydraulics Lab
2. Soil & Water Analysis Lab
3. Advanced Water & Waste Water Quality Control Lab
4. Pilot Scale Water & Waste Water Treatment Lab
5. GIS & Remote Sensing Lab
6. Computer & Software Lab

Other Facilities:

1. Library equipped with more than 4,000 books and journals
2. Six class rooms
3. Lecture Theater Hall (Auditorium)
4. Lounges (1 designated for women and 1 for faculty)
5. Conference room
6. Cafeteria
7. Male and female washrooms on every floor
8. Courtyard
9. Faculty offices
10. Administration offices
11. Research Scholar and other support staff offices

The 18 faculty exchanges and 148 student exchanges to U, CSU, and UNLV were also designed to provide research training. Visitors were provided supervision by hosting professors and, if relevant for their research areas, may have been embedded in a research lab. The visitors developed a specific research training plan aligned with their research interests/project (for details, see Education and Training chapter).

Implementation: Once the basic building blocks (capacities, partnerships, resources) for advancing the research agenda were in place, the focus shifted to the implementation of actual research projects. The seed grant programs were launched in late 2015 (first awards made in 2016) and were designed to support research aligned with the SDG 6 targets and USPCASW's guiding principles: gender equity, transparency, and impact. The seed grants – originally called "small" grants – also aimed to fund projects that would lead to further projects of a larger scale; hence the shift from calling them "small" grants to "seed" grants. In addition to the national requests for proposals (RFPs), there was a special RFP for industry-academia collaborative projects (a.k.a., "client-driven" projects). The seed grant programs were all designed and implemented collaboratively with MUET. For example, the U-led team provided rigorous peer-reviewers with relevant expertise to evaluate the grant proposals received according to a clear and transparent set of criteria. All together the 28 seed grants plus two additional "directed strategic grants" totaling 76 million PKR (approximately 0.5 million USD) were awarded from the MUET budget (Table 3; Annex 15). The "directed strategic grants" were to carry out projects for: (i) a market survey (with IPSOS, a consulting firm) to align the Center's academic and research program with the market needs, and (ii) a set of baseline studies to support the Agency for Barani Areas Development (ABAD), Government of Punjab, in preparing the socioeconomic development plan for the barani areas.

Finally, other directed strategic grants were given from the U-led team's budget specifically to support U.S.-based faculty and students participated in the USPCASW seed grant projects as well as to support research undertaken by the students as part of the exchange program (Annex 16).

Table 2. Summary of research seed/small grant funding.

Call Number	Number of Projects	Total Approved Grant Amount (PKR)
1st	6	13.85 million
2nd	7	20.82 million
3rd	17	41.95 million
	Total	76.62 million

Impact: Within the academic community, the typical targets for impact are research journal articles and citations. However, the CAS program aimed for broader impacts beyond the academic community. This included aiming to influence practices and policies leading to improved water security. One specific avenue for impact encouraged by the CAS program was technology and venture commercialization.). Several research projects were carried out as "parallel investigations", with field and/or laboratory studies carried out in both Pakistan and the U.S. This approach was quite effective, building institutional capacity by engaging colleagues on both sides of the development process to address problems of mutual concern to both countries. Reciprocation between the parallel investigations in Pakistan and the U.S. expanded insights by allowing evaluation and refinement of research methods in different settings and provided a platform for collaborative learning and exploration among both Pakistani and U.S. faculty and students.

Creating impact from an academic research project requires a set of ingredients i.e., an idea addressing a stakeholder need, an engaged stakeholder, an effective researcher, and a follow-through process by the researcher to transfer research product to impact. To this end, the U-led team supported the creation and expansion of the Center's research and stakeholder networks; strengthening of partnerships with the industry, government, and NGOs; and capacity development of faculty to write high quality journal articles and policy briefs, and understand how their research can be effectively communicated to broader audiences and/or be taken to the market. These efforts were further complemented by a summer entrepreneurship student exchange program (described in the Education and Training chapter) that

focused on building entrepreneurial capacities of students within the context of water-development nexus. Synergistic activities were initiated by MUET to promote entrepreneurship awareness and bridge the academia-industry gap.

Major Results and Outcomes

The research activities produced many outputs and outcomes, e.g., research journal articles, grant proposals, external funding, etc. In this report the emphasis is on highlighting the impact of the project on the research productivity and quality of

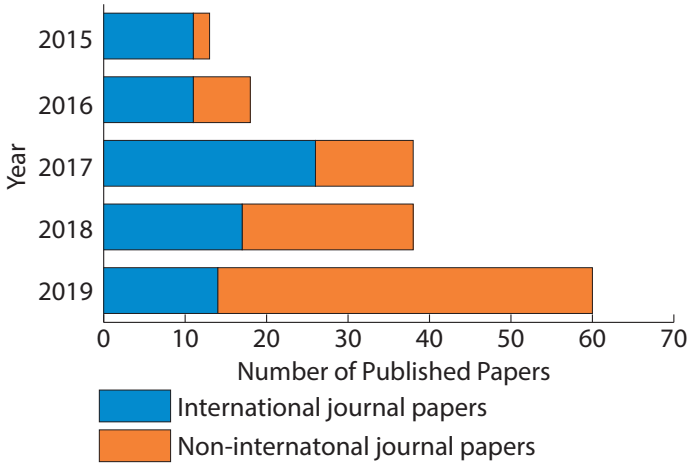


Figure 4. The average number of publications per faculty member per year, showing averages before and after joining the Center. (Note: The average number of publications per year before joining the Center was based on the same number of years as the faculty member had been affiliated with the Center. For example, if a faculty member had been with the Center for three years, then the publication record for the previous three years was used for that faculty member.)

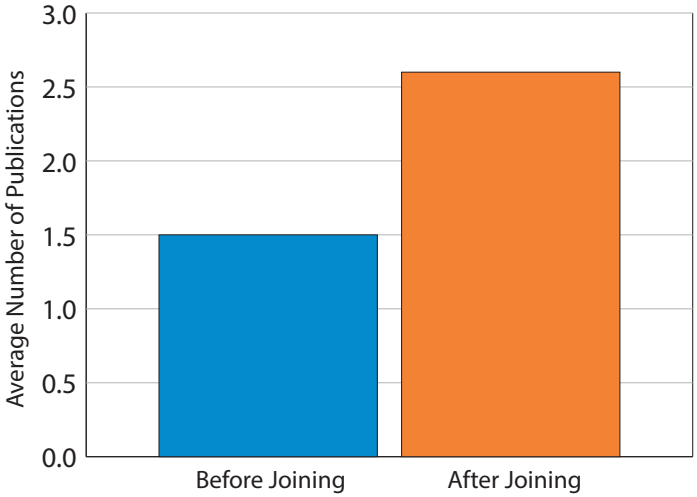


Figure 5. The total number of peer-reviewed publications produced by USPCASW researchers (2015-2019) in international and non-international journals.

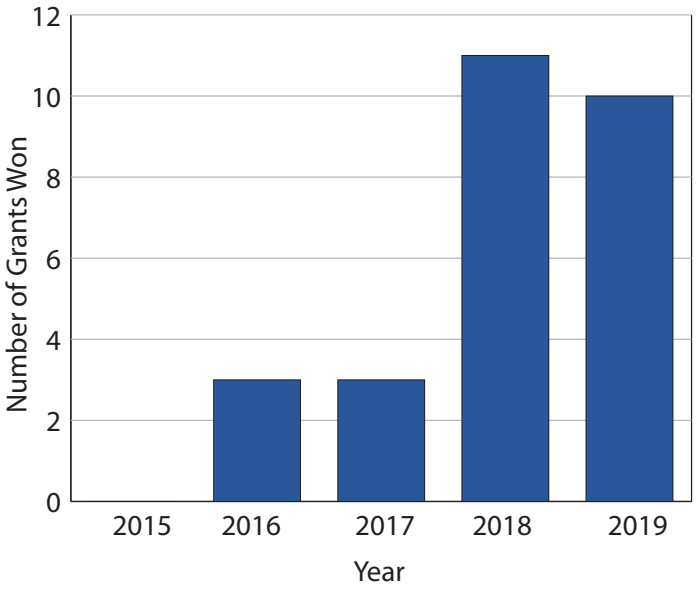


Figure 6. The total number of external grants for research and consulting projects won by USPCASW researchers (2015-2019).

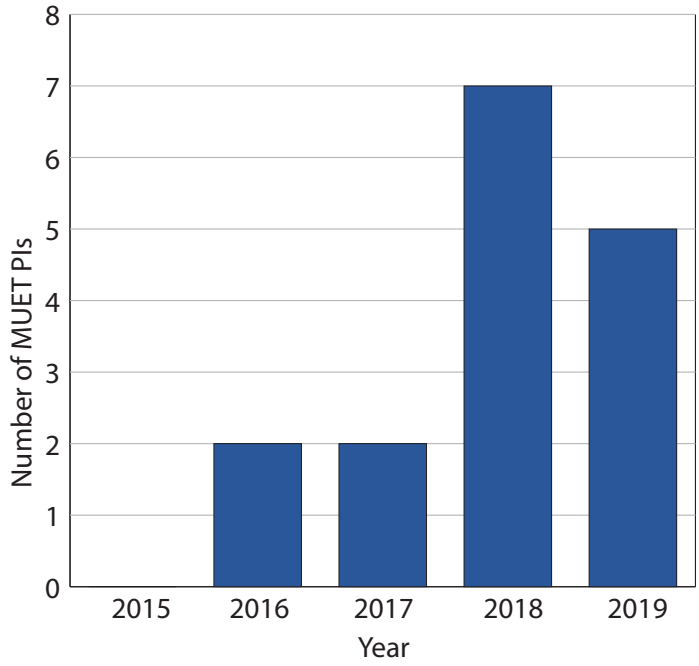


Figure 7. The total number of MUET faculty PIs that won external grants each year for research and consulting projects (2015-2019). Total number of faculty PIs on external grants is 10 (i.e., some faculty won multiple awards).

USPCASW.

The most important measure of academic research productivity remains the publishing of peer-reviewed articles. In this regard, there were several improvements:

- Publication productivity of the Center increased (i.e., more publications per year) from 2015 to 2019 (Figure 4).
- Taken together, the USPCASW faculty achieved a 70% increase in the average number of publications they produced per year, when compared to their respective productivity prior to joining the Center (Figure 4), although there was substantial variation, with a few not succeeding in publishing at all
- There was an improvement in the quality of the journals in which faculty published (i.e., relatively more publications in international journals; Figure 5)

In total, 167 peer-reviewed research publications (Annex 17) produced by Center's faculty, students, and alumni, plus several additional papers produced by U.S.-based researchers (i.e., without MUET co-authors) through their directed strategic grants (Annex 16)

30 research projects were completed under the USPCASW seed grants program (Annex 15). Project final reports are in the process of publication by the Center (for links to project reports as they become available, see http://water.muet.edu.pk/research/research-grant-projects/).

27 externally-funded research and consulting projects to the Center (Annex 8)

A trend towards an increasing number of external grants won per year by the Center (Figure 6) and a trend towards an increasing number of faculty winning external grants (Figure 7) indicate that faculty capacity for submitting and winning grants has been strengthened

More than 150 completed student research projects (i.e., theses and dissertations), with another 100 in progress

Several new technologies in prototype testing stage (e.g., Highlight Box 6)

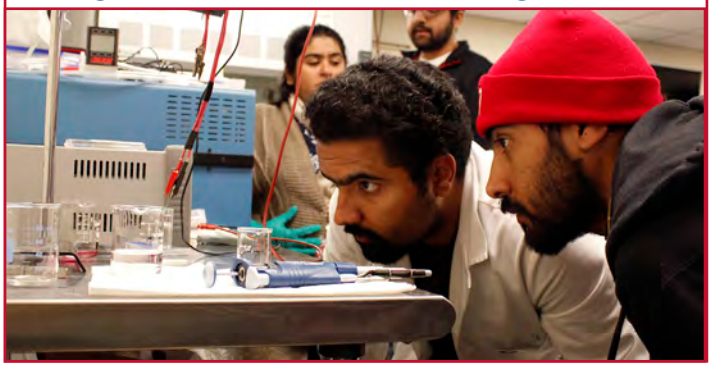
HIGHLIGHT 6: Technology Innovation

Professor Krista Carlson (U) and Hammad Malik (alum of USPCASW Master's program and U Exchange program; current PhD student in metallurgical engineering at the U) are working together to create a nanostructured water-purifying device.

They developed several prototypes at the U, and Malik tested the latest in the field in Pakistan during a U training mission in 2019. They hope to eventually commercialize the product and provide an affordable solution for drinking water purification at not only the household level but also for 100-unit apartment complexes.

For more information, see:
https://water.utah.edu/2018/12/19/point-of-use-nanotube-technology-shreds-waterborne-pathogens/

For another example of students working on developing a prototype, see
https://water.utah.edu/2019/11/04/getting-smart-about-water-monitoring/



At least 7 drafted policy briefs based on findings from applied research projects (Annex 18)

In addition to these metrics, there were important qualitative outcomes. For example, a central accomplishment was a greater degree of stakeholders' trust on Center's capacities. This trust and shared understanding of research priorities led to funded research projects, research collaborations, students' internships in partnering institutions, and providing training services to clients. Some notable examples included Center's contributions to the development of the National Water Research Agenda in collaboration with PCRWR; research partnerships with the Karachi industries; training partnership with the Sindh Irrigation Department, and advocacy and outreach partnership with the NGOs. Furthermore, recommendations derived from the completed applied research projects were disseminated to relevant stakeholders and clients, including the Government of Sindh, NGOs, and industry partners through seminars, workshops and policy briefs.

Implementation Challenges and Constraints

Implementation of the research program in general – and especially the actions and initiatives listed above – was confronted with several challenges and constraints. The result was that many of the planned initiatives fell short of delivering on their original high expectations to varying degrees. A summary of these challenges and constraints is provided below.

Limited technical capacities remained a major constraint almost throughout the project life which affected research impact both in terms of publications and real-world problem-solving. Out of the five faculty members assigned to work with the project in the beginning, two were assigned with the management and administrative functions, and those who were hired after the project launch (6 in total) did not have PhD degrees. These non-PhD faculty members had limited research experience and skills, and combined with no teaching experience, this greatly limited their ability to make rapid research contributions. [12] Therefore, similar to the physical capital constraint, the human capital constraint also limited the productivity of these early career faculty members, especially in the first two years of the project.

The fact that the research thrusts of many of the Center's faculty members were not well-defined at the outset of the project (or those faculty members were not yet hired) was a key challenge with ramifications for the entire project. In particular, it resulted in the development of generic lab facilities, narrow hiring of faculty expertise, and slow establishment of research partnerships.

The lack of operational research laboratories until the midpoint of the project was a significant challenge. Once facilities were available, the faculty and students still needed hands-on training, SOPs and safety protocols. Additional time was needed to develop lines of research well-suited to the lab facilities and equipment available.

Slow procurement processes – and decline of requests for equipment purchases by USAID – further delayed the launch of some research projects. In the case of USAID's decline of request for purchase of lab equipment to support the WASH program, this decision essentially created competition among faculty and students for limited lab resources; this gap in lab capacity was not surmountable during the project life. Ultimately, research that utilized the labs and equipment at full strength only occurred during the last two years of the project.

The Center had a weak capacity to create a national level perspective (about how the Center could contribute towards addressing water challenges) and

12 Indeed, in general the expectations held for the junior faculty members were not relaxed even though they were themselves PhD students. In the U.S., it would be unreasonable to expect PhD students to teach different classes each year, write grants for external funding, be principal investigator leading a research program capable of producing high quality research publications in international journals, supervise Master's degree students, and perform departmental service activities. That these assistant professors generally rose to the challenge is a testament to their hard work and commitment, with support from the U-led team.

foster national level partnerships in support of this perspective. Despite attempts to build this capacity, the Center's leadership struggled on this front. Within the Sindh province, the Center was able to build strong research partnerships and created an impact through collaborations with the Sindh Irrigation Department, Sindh Irrigation and Drainage Authority, Government of Sindh Planning and Development Department, NGOs, Karachi Industries, and PCRWR. However, there were also research partnerships with the Global Change Impact Studies Centre, LUMs, ABAD in Punjab; but these had much less impact and produced no external funding.

The U-led team was challenged to identify ways to stimulate collaborative research in a context in which there was limited institutional support and incentives for collaboration. This included the fact that there was no incentive structure to reward collaboration, and typical research grants (e.g., HEC) primarily provided sufficient funding for the individual PI rather than the whole project team. Furthermore, there was a lack of cross-discipline engagement at MUET or between institutions, as well as a lack of collaborative research experience and interest (which presumably relates to the lack of incentives – although during the project life, sufficient resources were available to create an incentive structure had the Center's leadership had the vision and will to do so).

The flagship projects were too large in scope and conceived before the strengths and interests of the USPCASW faculty members were fully defined. Consequently, there was never any meaningful ownership of the flagship projects by the faculty at the Center, and despite several attempts to "pivot" the projects to align them better with what might be feasible and successful, the only project with any research products produced was the Indus River Decision Support. This project produced a few papers, but it never generated the kind of impact on actual water management that it had envisioned.

The Center did not have sufficient expertise in the social sciences and policy fields. This gap could not be filled through partnering with other departments on campus since MUET lacked any social sciences departments; indeed, MUET is a university for engineering and technology. This severely limited the kinds of interdisciplinary projects that could be implemented, and it limited the translation of research into policy briefs for stakeholders. [13] To develop interdisciplinary projects, the Center needed an interdisciplinary team. MUET could have collaborated with other institutions such as Sindh University, Tandojam University, IBA etc. but never tried this for three reasons: (1) no aptitude for collaboration (noted above) and sharing of resources, (2) limited capacities to think big—only engineering approaches, (3) limited connections with experts outside of their fields, and (4) lack of vision and political will. Ultimately, it also may have distilled down to lack of motivation/incentives to drive this collaboration.

At the outset there was minimal culture of collaboration among faculty within the Center. So much effort was put into creation and strengthening of the research teams as noted above, but without success. Blame can be shared among the leadership, faculty, and the U-led team.

Alignment of the research agenda with the SDG framework started to receive attention only from 2017 onwards. It was delayed because of the need to build basic faculty and student capacities, establish labs, and develop research ideas.

Missed Opportunities

Delivering national impact: There was an opportunity to develop a national level research perspective and create an impact in the areas of irrigation, municipal water and wastewater, industrial wastewater management, sustainable development and climate impacts on water systems. Research was done in

13 The role of the M&E specialist evolved to be an Institutional Development Advisor who, in 2019, was able to devote some attention to facilitating the translation of research to impact. This led to a workshop focused on writing policy briefs that produced 8 draft briefs (Annex 15). In hindsight, what was needed was more attention sooner.

partnership with stakeholders in the Sindh province, but the opportunity to connect with similar departments and industries in other provinces was missed. Some efforts at collaboration were made (e.g., the ABAD project) that would have strengthened the national profile, but a more strategic use of the seed grants was a missed. For example, the Energy Center at NUST used its seed grants intentionally to link NUST with other institutions. [14]

Increasing research collaboration: Since, the value of research collaboration to catalyze ideas, stimulate innovation, and raise quality are well known, the U-led team sought to overcome the constraints to research collaboration within each PIs research group, within USPCASW, at MUET, and across institutions in three ways: first, by introducing the faculty to the ideas of research group organization and management within the framework of SDG 6 targets and facilitating the culture of team building; second, by creating flagship research projects that required multiple investigators; and third, by incentivizing collaboration through research seed grants. However, there was a missed opportunity to develop problem-based, strongly interdisciplinary teams. [15] In some respects these kinds of teams are best organized once researchers have developed strengths in their own respective fields, but in other respects organizing a team around a concrete community problem can tap into intrinsic motivation for collaboration to generate public good (i.e., solve real-world problems). Whether this would have stimulated more impactful outcomes is unknown because it was not tried.

Impacting policy: The U-led team's focus on academic publications took precedence over policy impact. Therefore, it is unsurprising that there was significant output and outcomes in terms of academic research. However, there was a missed opportunity to put greater emphasis on creating community impact through policy research. Although the industry-academia workshop and targeted seed grants helped shift this prioritization, the emphasis was primarily on seeking external funding for institutional sustainability rather than real-world impact per se.

Lessons Learned

Research life-cycle matters: In the U.S., most research projects funded through the National Science Foundation have 3-5 year timelines. These projects are awarded based upon the existing capacities of the researchers and their institutions and available facilities. The structure and timeline of the CAS program would have worked if the existing capacity of the faculty and infrastructure at the launch of the project were at an appropriate level. The need to build the human capital and physical capital prior to launching research projects meant that – given that research projects need 2-3 years to reach maturity and produce meaningful results – the projects that were begun in 2017 are on schedule for translation to policy briefs and broader impacts in 2020. That is the current status of the research projects at USPCASW: on the verge of impact. One additional project year would have given the teams sufficient time to work through an entire research cycle together. Future USAID projects should pay closer attention to the baseline capacity of specific universities [16] before determining goals, targets, and timelines.

Research agenda-setting matters: Although the early work to establish research teams from the top down according to themes or SDG 6 targets may not have achieved the level of success desired, it did lead to sharing among the faculty, building of collegiality, and a platform for building capacity for executing large stakeholder driven applied projects, including their translation to practice. Bringing in stakeholders' inputs to set the research agenda was critical, how-

14 This example also illustrates the missed opportunity of having closer communication, collaboration, and idea-sharing among the different CAS.

15 Here "strongly interdisciplinary" refers to bringing together very diverse fields – such as environmental engineering and sociology – whereas "weakly interdisciplinary" refers to bringing together allied fields like mechanical and electrical engineering.

16 For example, the baseline research capacity of MUET and NUST were significantly different by all accounts – yet the project agreements did not differ in terms of timelines for deliverables.

HIGHLIGHT 7: Collaboration Leads to Gates Foundation Grant

Following from research initiated through the USPCASW seed grant program – and developed through mission visits to MUET – Drs. Windy Tanner and Jim Vanderslice were awarded a Gates Foundation Grand Challenges Explorations Grant in 2019.

They will continue to work with their MUET collaborators, Drs. Jamil Ahmed Soomro and Ayesha Tajammul to investigate pathways through which antimicrobial resistance is transferred within communities, with particular focus on the bacterium Salmonella typhi in order to address an outbreak of highly drug-resistant typhoid in the Hyderabad area.

For more about this research, see:

- Researchers Sample Sinks and Latrines in Pakistan to Map Paths of Antibiotic Resistant Bacteria
- USPCASW Reserchers Receive Gates Foundation Grand Challenges Explorations Grant

ever, and doing this in an increasingly one-on-one sort of way (rather than through large town hall style elicitation events) proved to be especially effective. This approach yielded meaningful results in the form of specific client-driven research projects.

Client-driven research matters: The concept of a client-driven research project evolved in year 3 of the project, and was immediately successful in linking faculty research to stakeholder needs, getting stakeholder collaboration and funding interest, and leading to increased enthusiasm for research. The approach to the client-driven projects was one of "co-creation" so that the academic researchers could ensure the research would deliver novel findings that would interest the academic community even as it met the client's needs. Ultimately, the client-driven approach led to better projects but was less effective at leading to funding from the clients.

Sustained interaction matters: The results of this 5-year effort indicate that research capacity building is best accomplished in a continuous way bridging intensive workshops, coaching, learn-by-doing collaborative activities, and guided independent learning. Many collaborations were successfully established after faculty exchange visits to the U.S. partner research laboratories and field research sites. These initial relationships were further nurtured by visits from the U.S. collaborators to the Center as part of the mission training programs and were strengthened and sustained by student exchange visits to the U.S. researchers' labs. This model of continuous engagement at multiple levels – personal, training, research partnerships, and co-mentoring of students – was found to be valuable for developing successful research collaborations and strengthened research capacities that will sustain beyond the project (for example, see Highlight Box 7). [17]

Adaptive management matters: Throughout the project, there was a concerted effort to identify weaknesses and gaps not only in MUET's capacity but in the U-led team's approach to capacity devel-

17 At the time of writing (March 2020), several research partnerships are ongoing even though project closeout was mid-December 2019. Additional publications and grant proposals are forthcoming in 2020.

opment. By learning and adapting, the team was able to achieve better outcomes. For example, when specific gaps in writing journal articles or statistical analysis were noted, specific micro-training, boot camps, and workshops were arranged. When research teams were noted to be lacking functionally or lacking spirit of cooperation, team structures and ways to form were evolved leading to working with individuals or smaller teams. This was especially evident in the Applied Research component (see Case Study 3), but also other components. For example, when advancing the research agenda was noted to be constrained by administrative and management issues, interventions were introduced through the governance component.

Concluding Thoughts

Strengthening research capacity in a context in which there are few incentives for those who push themselves to excel beyond basic, minimum research expectations was incredibly challenging. The successes that were experienced in the applied research component could not have been achieved without the enthusiasm of the MUET faculty and support from the leadership to aim for excellence and to be open to learning – even as senior faculty – from foreign colleagues who may or may not have understood much about the Pakistani context at the outset. Similarly, the willingness of the U-led team members to learn about Pakistan and its water challenges was fundamentally important for the kind of reciprocal learning and trust-building that was necessary to establish meaningful collaborative relationships.

The interactions with stakeholders were similarly important – and the quality and potential for impact of the research improved as the relationships with stakeholders shifted from the generic/superficial to substantive. This shift was facilitated through intentional interventions by the U-led team, and future projects should consider adopting a similar "co-creation" research design process to align academics with client needs for applied research.

"I'm from Gilgat-Baltistan, the northern part of Pakistan. During my visit to the University of Utah I was able to work with Professor Jennifer Weidhaas from Environmental Engineering and Professor Shelley Minteer from Chemistry to study microbial fuel cells. I was given access to the best laboratory facilities for my research, which helped me to produce publishable papers. The experience inspired me to pursue a PhD."

— Iram Sifat, exchange scholar USPCASW

CASE STUDY 3:
Managing Adaptively to Advance Applied Research

The U project management team originally envisioned the three "flagship projects" as significant routes towards building research capacity and reputation for the Center. However, after two years of effort, these projects had yielded only incremental advances from smaller projects that had been carved out of them. In other words, they had failed to deliver on the original visions at the levels anticipated.

The management team learned several lessons from this experience:

1. Projects should be co-created with key stakeholders to ensure impact.
2. Projects must have sufficient local ownership to be successfully shepherded through the various challenges that will emerge.
3. Scope of a project must match the capacity of those involved.

Fortunately, the flagship projects turned out to be useful for building research teams and identifying ways to strengthen capacities for large, multi-investigator projects.

Importantly, the flagship project experiences led the U-led team to pivot from the original flagship model to focusing on cultivating smaller teams working on particular SDG 6 target areas, each with defined U.S. collaborators.

These smaller teams with more direct U.S. collaborator support performed better because they could target realistic funding sources, more readily utilize a learn-by-doing approach, and better facilitate the transfer of tacit knowledge needed for project management through the stronger interpersonal relationships that thrived in the context of smaller projects.

In this way, the U-led team learned and adapted its original approach in order to find the most effective way to achieve the goal of improved capacity for impactful, high quality research.

"The deep discussions between MUET and our team produced new ways to think about structuring curriculum and teaching to the next generation of students."
- Professor Mike Barber, Chair, Civil and Environmental Engineering, U

Education and Training

Key Accomplishments

Curriculum

- 4 MS and 3 PhD degree programs benchmarked against international standards – of these, 3 are unique degrees in Pakistan
- 32 new or revised semester-length graduate courses
- 217 active students and 75 graduates (292 total students from 2015-2019)
- 50 out of 75 graduates either employed or pursuing PhD
    - 20 graduates pursuing PhD: 4 in Pakistan, 11 in U.S., & 5 in other international programs
    - 30 graduates employed (24 of them employed in the water sector)

Exchanges

- 167 completed faculty, student, and staff exchange visits to the U.S.
- Human capital improvements across 8 capacity domains (e.g., applied research skills, communication skills, etc.)

Training

- 23 training missions to USPCASW, representing 813 days of personnel time and effort, and leading to improvements in teaching, mentoring, research, and governance
- Collaborated with MUET to develop and deliver several training programs for professionals, including for the Sindh Irrigation Department
- Helped the Center in graduating from recipient of training assistance to provider of training services

Objective

The project objective to "*improve CAS curriculum relevance and quality, strengthen the use of effective teaching methods, and upgrade graduate degree and certificate programs and research facilities*" was met through the Education and Training component. The results and outputs expected from this component included a cadre of highly qualified graduates prepared to work as water professionals in the public and private sector and pursue advanced degrees at top tier programs around the world. To achieve this, improved curriculum aligned with market demands as well as better course design and teaching methods involving project-based and experiential learning pedagogies were necessary. To ensure ongoing quality of education programs, some institutionalization of continuous faculty and staff development and stakeholder input into curriculum was important. Exchange programs were created to supplement the curriculum for students and help accelerate training of faculty and staff in teaching, research, and other duties. Similar pedagogical approaches were translated to professional training programs co-created and co-delivered with MUET faculty for the water sector and higher education.

Actions

Several core actions were taken to develop and strengthen education and training programs at USPCASW. Fundamentally, all of the education and training activities have cross-over with applied research, partnerships, equity, governance, and sustainability given the capacity development nature of the project. Indeed, as the project progressed it became increasingly apparent that coaching was needed across all components (see Case Study 4). Occasionally additional special events, workshops, or training programs were implemented to improve governance, sustainability, equity, and partnerships (such activities are discussed in those chapters as appropriate). In this chapter, the focus is on curriculum reform and the education and training approaches, techniques, assessment, and associated learning, especially as they relate to the mission training programs, graduate degree programs, U.S. exchange programs for students, faculty and staff, and other professional training and "train the trainer" programs.

Curriculum reform: One of the first things that the U-led team did was to focus on supporting the Center to establish graduate degree programs and benchmark them against international standards. In order to provide some context for this task, it is helpful to have a sense of where things started. The Center at MUET was built on the foundation of two Institutes. First, the Institute of Water Resources Engineering and Management (IWREM) which was established in 1987 with support from the Government of Sindh to address critical issues related to irrigation and drainage, especially in the Sindh province. The second institute was the Institute of Environmental Engineering and Management (IEEM). The programs encompassed important areas of need – wastewater and waste management (IEEM) and irrigation and drainage (IWREM), but did not cover the comprehensive scope of USPCASW. The degrees offered by these institutes were not widely recognized outside of the Sindh Province and Pakistan. Some MS graduates would go abroad for PhD programs (e.g.,

Experiential learning was incorporated into many courses to help students use the campus as a laboratory. Here Dr. Altaf Siyal and Dr. Munir Babar demonstrate field techniques for soil measurement.

to Chinese universities), but none went to the U.S. universities.

In 2015, the two existing degree programs (EE and HID) were reviewed and adapted in collaboration between senior MUET faculty and international experts. This process included benchmarking against international program standards and identifying desired core capacities for practice and research based on stakeholders' feedback. Courses were developed for the MS and PhD programs. Completion of a thesis and dissertation for MS and PhD programs, respectively, was required. Following a similar process of collaboration and benchmarking – and also with thesis/dissertation requirements – new MS and PhD programs were launched in Integrated Water Resources Management (IWRM) in 2015, and a new MS program in Water, Sanitation and Health Sciences (WASH) was launched in 2016.

Table 4 lists the degree programs and their relevance to the corresponding water SDG targets. To support these programs, a total of 32 courses (Annex 19) were developed, refined, modified, and adopted over the project life through the Course Mentoring Program (see Highlight Box 8 and Annex 20 for full program description), once these were reviewed and endorsed by international experts. Training on teaching, learning, and mentoring supported the effective delivery of the curriculum programs, and SOPs were established to provide structure to thesis topic selection, thesis evaluation, and curriculum reform.

Mission training: One of the most significant activities – and certainly the "hallmark activity" – of the U-led team's approach to capacity building was the mission trips to deliver intensive training at MUET. Over 23 missions from 2014-2019 (Annex 13), innovative approaches of using boot camps and coaching as complements to traditional classroom style workshops were developed, implemented, and assessed. More than 750 person-days of faculty, staff, and student time and effort were contributed to training faculty, students, staff, and water sector professionals in the form of 68 workshops, 15 engagement events, 12 micro-trainings, 5 boot camps, and innumerable meetings that related to the project components (see Annex 14). This collection of various types of capacity building activities carried out

HIGHLIGHT 8: Course Mentoring Program

The Course Mentoring Program (CMP) was designed to support curriculum reform and improve teaching effectiveness through a virtual mentoring program that "twinned" international experts with USPCASW faculty members.

The international expert provided in-depth, critical review of – and feedback and mentorship for – an entire semester-length course's worth of lesson plans, learning objectives, lecture slides, reading assignments, homework problems, etc. The mentor also provided an assessment of teaching effectiveness and guided the creation of a course improvement plan.

As the CMP evolved, it shifted from using email and shared folders to using the online Canvas Learning Management System (LMS) to facilitate communication between mentor and mentee. The Canvas system helped keep things transparent which supported trust-building and accountability across the U and MUET teams. (Incidentally, this also introduced faculty to the instructional capabilities of an LMS, which USPCASW eventually adopted in the form of Moodle.)

The resulting internationally-benchmarked curricula represents a major project success.

CASE STUDY 4:
The Coaching Approach to Capacity Strengthening

The U-led team used both coaching and mentoring for different kinds of capacity strengthening. The use of coaching was especially valuable for the kind of high-level technical and professional training needed by faculty and senior management at the Center.

"Coaching" differs from "mentoring" – although both can be aspects of any particular relationship. Coaching involves more structured interactions focused on improving the coachee's skills and performance in very tangible ways. Coaches ask hard questions of their coachees and push them to achieve the best that they can in specific professional areas. These relationships are often based on the coach's expertise and the coachee's needs – and they have clear outcomes in mind.*

The coaching approach enabled trainers to be engaged with learning activities, before, during, and after missions for long-term interaction across an integrated set of objectives – teaching, research, training, outreach, etc. Such repeated interaction focused on specific outcomes that required guidance beyond the generic information delivered in a "one-size-fits-all" workshop approach. This tailoring to meet each individual's needs was important to elevate the research and teaching capacity to meet international standards.

The one-to-one coaching of how to design a research project, manage a team, and deliver meaningful results to stakeholders was an incredibly responsive and adaptive strategy for capacity strengthening. It does not fit the standard "technical training" model of workshops – but it does reflect the sentiments and philosophy behind the mentor-mentee relationship that characterizes graduate education programs in the U.S.

For example, Dr. Rasool Bux Mahar (MUET) first came to the U to work with Dr. Ramesh Goel in Spring 2016. They had already been working together for curriculum development via the Course Mentoring Program – and now they were going to work together for six months on improving Dr. Mahar's research and teaching skills. After the experience, Dr. Mahar had the preparation to return to Pakistan to establish a lab similar to Dr. Goel's to apply molecular diagnostic techniques to environmental engineering problems. For more details, see https://water.utah.edu/2019/05/20/getting-to-know-bad-bugs-in-pakistans-drinking-water/.

*This discussion is based on Christine Zust's blog article for Kent State University's Center for Corporate and Professional Development: https://www.kent.edu/yourtrainingpartner/know-difference-between-coaching-and-mentoring (retrieved 3-3-2020).

during the missions is indicative of the integrated approach taken by the U-led team.

Rather than focusing exclusively on technical workshops, the team used a suite of activities to better tap into different learning domains (cognitive, psychomotor, and affective) as well as to take advantage of face-to-face interactions to provide nuanced guidance about complex issues related to the governance of higher education programs. Innovative approaches to deliver training in learning-by-doing workshops, boot camps, and coaching

Table 3. Relationship of existing degree programs to SDG 6 (Water) and IWREM/IEEM degree programs.

Degree	Relationship to Previous IWREM or IEEM Degree Program	SDG Water Targets
MS Water, Sanitation, and Hygiene (WASH) Sciences	New program	6.1 - Access to safe drinking water 6.2 - Access to basic sanitation
MS Environmental Engineering	Modified from IEEM degree program	6.3 - Pollution control and water quality management
PhD Environmental Engineering	Modified from IEEM degree program	6.3 - Pollution control and water quality management
MS Hydraulics, Irrigation, and Drainage	Modified from IWREM degree program	6.4 - Improving water system efficiency
PhD Hydraulics, Irrigation, and Drainage	Modified from IWREM degree program	6.4 - Improving water system efficiency
MS Integrated Water Resources Management	New program	6.5 – Integrated water resources management
PhD Integrated Water Resources Management	New program	6.5 – Integrated water resources management

helped to accelerate and strengthen the building of time management and habits of effective professors and graduate students. The coaching approach (see Case Study 4) enabled trainers to be engaged with learning activities, before, during, and after missions for long-term interaction across an integrated set of objectives – teaching, research, training, outreach, etc.

This integrated approach also reflects the team's commitment to the vision of helping the Center's faculty become "complete professors" capable of excelling across research, teaching, and departmental and institutional service activities.

Indeed, one major area of emphasis for capacity building was teaching effectiveness – and each year of the project the U-led team delivered activities to improve teaching and learning (Annex 14). To supplement these intensive workshops, regular coaching for teaching effectiveness was provided by the Technical Advisors and through the Course Mentoring Program (CMP; see Highlight Box 9).

Faculty, student, and staff exchange training programs: The exchange programs were another significant element of the project. A total of 169 participants (148 students, 19 faculty, and 2 staff) [18] benefited from exchange programs at the U, CSU, and UNLV over 8 semesters and 3 summers, as per the distribution shown in Table 5. Although this number falls short of the original combined targets from the U (50) and MUET (200) mentioned in the CAs with USAID, it exceeds the revised target (150) set by the

Table 4. Participants in USPCASW U.S.-based exchange programs.

#	Exchange Program	Faculty	Students	Staff
1	Spring 2016	6	0	0
2	Fall 2016	3	18	0
3	Spring 2017	1	13	0
4	Summer 2017	4	0	0
5	Fall 2017	0	15	0
6	Spring 2018	0	22	0
7	Summer 2018	1	6	2
8	Fall 2018	0	18	0
9	Spring 2019	1	22	0
10	Summer 2019	1	9	0
11	Fall 2019	2	25	0
	Total	**19**	**148**	**2**
			Grand Total	**169**

18 Of these, one faculty participant and one staff participant had their participation in the program terminated. Two students completed the program but did not achieve goals. The rest of participants completed the programs and achieved goals.

HIGHLIGHT 9: Student and Faculty Coaching at the Center

Dr. Jeffrey Ullman (Associate Research Professor, Civil & Environmental Engineering, U) served as the project Technical Advisor from mid-2017 to mid-2019. Stationed in Pakistan full time, he was intrinsically involved in an integrated approach to capacity building. His general duties included: (i) *provide research capacity building to faculty and staff*, (ii) *curriculum, course and teaching improvement*, (iii) *develop and deliver training programs*, (iv) *national networking*, and (v) *support mission training visits*.

He worked with all four USPASW program areas (Integrated Water Resources Management; Hydraulics, Irrigation & Drainage; Environmental Engineering; Water, Sanitation & Health Sciences) in assisting the faculty with formulating their research focus, improving their teaching, developing strong student mentoring skills, and various other areas. Dr. Ullman also worked extensively with the students, helping them to refine their research projects and facilitating the Exchange Program selection process to match them with their U.S. mentors.

Dr. Ullman engaged all of the faculty and made recommendations on a wide variety of re-search project topics, but focused primarily on novel water and wastewater treatment technologies, such as biochar filter development and anaerobic digester systems.

Significant time was spent assisting faculty and students on journal article and grant proposal writing. He contributed to the development of standard operating procedures and developing best laboratory practice standards. Additional time was spent enhancing experimental design and data analysis.

teams in their cooperative agreement modification request (Annex 10).

Five types of exchange training programs were delivered:

- Student semester exchange. This program included research mentoring, technical course, writing course, seminar course, field trips, skill-building workshops in technical and professional areas, and social/cultural activities. The emphasis of this program was comprehensive capacity building in research methods, thesis writing, global competencies, and comprehension of U.S.-based research programs and water management systems (see Case Study 5).

Table 5. Graduates across USPCASW's seven degree programs during life of project.

Discipline	MS	Ph.D.	Total
EE	31	4	35
HID	20	1	21
IWRM	13	0	13
WASH	6	0	6
Total	**70**	**5**	**75**

Note: 76 more graduates are expected in Spring 2020

The deliverables were completed thesis chapters and other tangible outputs and outcomes identified by the students in consultation with their mentors and others through an iterative process of goal-setting (see Annex 22).

- Student summer exchange. This program

CASE STUDY 5: The Cultural Diplomat Award

Early on, many participants in the exchange program envisioned it being exclusively focused on their personal research. However, the program aimed also to improve their global competence, which is an especially valuable capacity in today's multicultural, globalized world.

In order to encourage students' enthusiasm for pushing themselves outside of their comfort zones (i.e., the classrooms and labs), the U-led team improved the student orientation materials, exposed students to past exchange participants to better understand the full experience, and devised different interventions to raise the interest and excitement about intercultural experiences.

A particular successful intervention in this regard was the "Cultural Diplomat Award" program, which encouraged students to participate in cultural activities across 7 categories outside of official program activities:

- Outdoor Activities (camping, hiking, etc.)
- Arts Activities (music, theater, art exhibits, etc.)
- Campus Events (socials, sporting events, etc.)
- Fairs and Festivals (Greek Festival, MLK events, etc.)
- Service Opportunities (with local civil society organizations)
- Historical Sites & Museums (Beehive house, This is the Place, etc.)
- Wildcard (anything you create that does not fit in above categories)

Students who participated engaged with people outside of their cohort and found new learning opportunities and unexpected experiences.

In order to support student learning through these activities, students were also expected to write about the experience afterward, outlining who they interacted with from another culture, what they learned, what they shared about their own culture, and what surprised them about the experience. This reflection exercise helped the students focus on what they should be getting out of each of these activities, but also helped them think about the experience in the context of their overall exchange program. The Cultural Diplomat Program thus acclimated visiting students to U.S. and other cultures, gave them more opportunities to interact with locals in a non-academic setting, built self-efficacy, improved English communication skills, and more. After introducing this program in 2017, the vast majority of students participating in the exchange program fulfilled the requirements to receive the Cultural Diplomat Award.



differed from the semester exchange by emphasizing technology and business development with business mentoring and training, entrepreneurship course, prototyping course, writing course, field trips, skill-building workshops in technical and professional areas, and social/cultural activities (for a full description, see Annex 21). The emphasis of this program was developing a technology or venture that could address a water problem or opportunity in Pakistan. The deliverable included a business plan including the concept, market analysis (or patent search analysis), and financial modeling.

- Comprehensive faculty development. This program was conducted over a semester and aims at exposing the faculty member to research methods, innovative teaching techniques, student mentoring, academic governance, leadership, networking, and other aspects of being a complete professor. The deliverables included enhanced capacities in new research methods, analysis of preliminary results, writing of manuscripts and proposals, and development of teaching materials, along the lines defined by the faculty member in the expression of interest and detailed exchange plan.
- Specialized faculty training. This program was shorter-term either in summer or during a period less than one semester. It was focused on different areas including training on research instrumentation and software, academic leadership, and student mentoring. The deliverables included preliminary research results or products/outputs from the training and plans/policies for enhancing leadership and mentoring.
- Specialized staff training. This specialized program was delivered over durations of 3 to 10 weeks. Laboratory technicians were trained on research instruments and software. Also, a program was created on academic governance and students' affairs to enable the M&E Specialist to deliver on SOPs for faculty evaluation and student career opportunities. [19]

Professional training: The U and its partners also supported USPCASW to plan, develop, and deliver training to the professionals in the water sector. The first Technical Advisor worked closely with the USPCASW Project Director to establish a 3-year agreement with the Sindh Irrigation Department for

HIGHLIGHT 10: Writing Program

The overarching contribution of the various writing programs (coursework and boot camps during student exchange program, directed thesis editing, and mission workshops) was to improve student and faculty written and oral communication.

Instruction focused on four observed writing deficits: 1) *mechanics of the English language*; 2) *proper citation usage*; 3) *organization of thought*; and 4) *strategic focus*.

One of the biggest impacts of the student exchange writing program was a reduction in mechanical errors in students' written work. For example, during one semester, the grammatical error rate reduced by 70% from first to final draft submitted.

Several writing instructors were involved over the years (3 of them even visited MUET) – and each had their own unique impact on students – but it was the first writing instructor, Dr. Rick Bereit, who set the tone for the entire writing program (see https://water.utah.edu/2018/06/11/writing-instructor-rick-bereit-trains-students-to-write-the-future/).

training of its engineers. This generated significant external funding for the Center and strengthened the relationship with a key stakeholder. To seek elicitations of other relevant stakeholders, consultative meetings were hosted every year to identify training needs in irrigation and drainage, water resources planning and management, municipal water supply and wastewater management, industrial wastewater management, and public health. These meetings contributed to lists of potential workshops that were planned and some that were executed (Annex 7).

Training the trainers: In the spirit of "training the trainers," the U-led team worked with the USPCASW team to organize two New Faculty Boot Camps in the last year of the project for faculty from outside of the Center. These boot camps were refinements of the various workshops delivered by the U-led team in the previous years. Over the course of 2-3 days, the U.S.-based and USPCASW faculty delivered interactive seminars to improve the teaching and research of new faculty from across the MUET campus and other universities of the Sindh province.

Table 7. Distribution of exchange participants across host universities.

	Female	Male	Grand Total
CSU	7	15	22
UNLV	0	2	2
U	55	87	142
U & CSU	0	2	2
U & UNLV	0	1	1
Grand Total	**62**	**107**	**169**

(Note: These numbers include all visitors under the exchange program, including 2 participants who had their exchanges terminated and 2 who completed but did not achieve goals.)

Similarly, several faculty members from the U, UNLV, and USPCASW contributed their expertise in effective teaching and research as resource persons for the Six-Week Skills-Based Faculty Development Workshop organized by the HEC's National Academy of Higher Education (NAHE) in summer 2019.

Major Results and Outcomes

Table 6. Employment status of USPCASW graduates as of December 2019.

Batch	Not Employed	In PhD Program	Employed	Total
2015	5	12	23	41
2016	19	8	7	34
Total	24	20	30	75

* Tragically, one graduate is deceased

There were several significant outputs and outcomes from these education and training activities. The outputs and outcomes in terms of improved research capacity are described in detail in the Research chapter. Here the focus is on improved curriculum, teaching, and student learning.

Curriculum Reform

Three entirely new degree programs and four reformed programs were established. These programs were needed regionally and the IWRM and WASH programs are unique to Pakistan.

- From 2015-2019, 295 students have been active in the 7 degree programs.
- 75 students graduated by project closeout (Table 6)[20] and 76 are anticipated to graduate in Spring 2020, with more in subsequent semesters.
- The 75 alumni are entering the workforce and pursuing PhD degrees (Table 7).
  - o 20 graduates pursuing PhD: 4 in Pakistan, 11 in U.S., & 5 in other international programs
  - o 30 graduates employed (24 of them in the water sector)
  - o In total, 50 students are either employed or pursuing a PhD, and of these, 86% are in

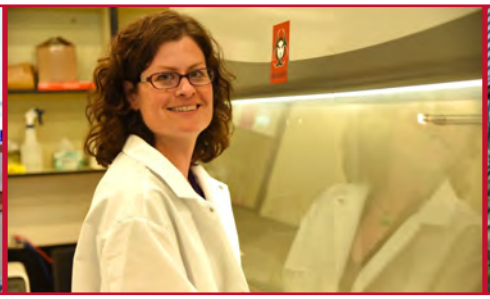
20 With eighteen full-time faculty members affiliated with the Center (and two on leave abroad to pursue PhD degrees), this equates to, on average, two MS graduates per year per faculty member.

HIGHLIGHT 11: "Super-Mentors"

All exchange scholar research mentors were impactful – but some stand apart from the rest for the sheer number of students they mentored throughout the life of the project.

Below are some of these superstar mentors. Collectively this group leveraged the exchanges into tangible research products (joint authored journal articles and conference papers), re-search proposals, and in Dr. Carlson's case the recruitment of two of her mentees to do a PhD program under her supervision.

Dr. Ramesh Goel
Professor, Civil & Environmental Engineering (U)
Research mentor for **21** exchange scholars



Dr. Jennifer Weidhaas
Associate Professor, Civil & Environmental Engineering (U)
Research mentor for **14** exchange scholars

Dr. Krista Carlson
Assistant Professor, Metallurgical Engineering (U)
Research mentor for **12** exchange scholars

HIGHLIGHT 12: The Integrated Learning Approach

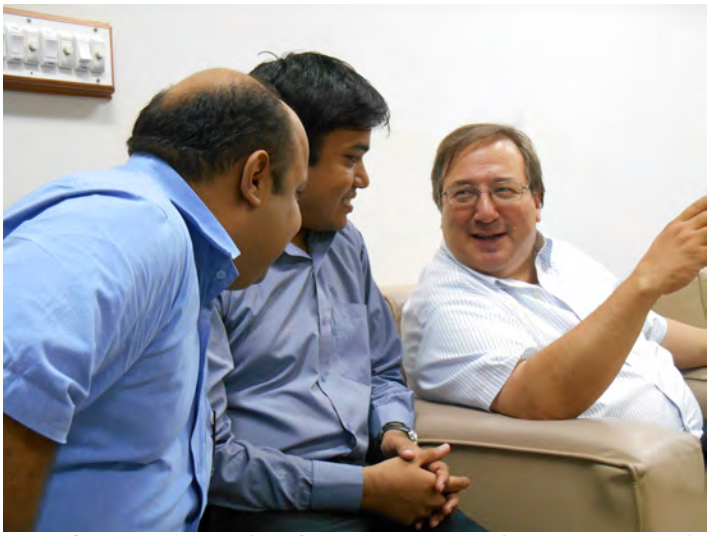
Dr. Jennifer Weidhaas (Associate Professor, Civil & Environmental Engineering, U) exemplified the U-led team's integrated approach to capacity building: classroom training, coaching, and mentoring over a long period of time.

Dr. Weidhaas taught lessons in traditional workshops, hosted visiting faculty, mentored visiting students, mentored faculty on course development and teaching, developed and executed a joint project, and supported faculty continuously on research idea development, proposal writing, journal manuscript development, and interface with stakeholders.

This effort started in 2016. Her central research focus was on waterborne pathogens in drinking water and environmental systems, but she also supported the Center's development of strength in water quality monitoring and management, industrial wastewater management, and risk assessment.

Moreover, she aided in selection of analytical equipment for the environmental engineering laboratory and development of standard operating procedures for laboratory management and training of faculty and students on analytical equipment.

By the end of the project, Dr. Weidhaas had visited Pakistan 4 times, hosted 3 faculty, and mentored 14 students. This produced 3 conference presentations, 1 journal article publication (plus 2 publications forthcoming in early 2020), 2 journal article manuscripts under review, 3 additional manuscripts under preparation, and 6 proposal submissions to date (with more in the works).



Professor Mike Barber discussing research grant proposal writing during workshop break

the water sector (57% of all 75 graduates are working in the water sector).
  - o This attests to the quality of the USPCASW and exchange programs: several MS graduates have the credentials and capacity to enter U.S. PhD programs and receive research assistantships at Top 100 World Universities.
- 32 new or revised courses were developed with international expert mentors and benchmarked against international standards. In all courses, the USPCASW faculty have incorporated project-based learning with linkages to real-world problems and stakeholders.
- The establishment of a USPCASW Curriculum Committee for ongoing curriculum review and revision based on feedback from stakeholders (including employers and alumni) supports ongoing curriculum improvement and alignment with market needs post-project.

Exchanges

The exchange program was a major success of the USPCASW project with high direct impact on the participants [21] and indirectly with reputation building and attracting top students and faculty to the Center at MUET. In total, 167 participants (faculty, students, and staff) completed exchange programs (Table 5). These were primarily hosted by the U, but CSU and UNLV also hosted visitors (Table 8). [22]

Professor Pat Shea and graduate student Jewell Lund guided the visiting students through the exploration of how municipal water systems work in the U.S. as part of the integrated seminar and field trip experiential learning element of the exchange program. They also exposed students to amazing sites and signature activities in Utah and connected it all back to water sustainability.

- The Exchange Program raised technical capacity. The trainings provided under the exchange program contributed to results and impact in the form of improved writing (see Highlight Box 10), better thesis research quality, increased number of publications involving students, higher number of client-driven research projects, increased number of students being accepted to PhD programs in the U.S., and other results (see Highlight Box 11 and Highlight Box 12).
  - o Also, importantly and generally applicable was the improvement in cultural awareness

21 For examples, see https://water.utah.edu/2018/07/31/entrepreneurial-engineers/ and https://water.utah.edu/2018/05/01/waiting-for-water/.

22 An important reason for CSU to serve as a host was to offer participants better alignment with their research interests in HID.

Exchange Coordinator Davey Stevenson worked with faculty and students visiting the U to make the most of their time. His careful coordination and day-to-day oversight helped visitors engage with U resources, participate in professional development activities, and enjoy field visits that even extended to Southern Utah. Additionally, he also provided expertise for a prototyping class to summer Entrepreneurship students, including 3d printing skills.

and intercultural skills. The creation and implementation of the Cultural Diplomat Award led to independent pursuit of inter-cultural experiences from students and faculty visitors (see Case Study 5).

o Evidence of impact also comes from individual testimonials and final reports as well as anonymous survey feedback. In addition to improved technical knowledge and skills, students in particular have commented about their increased self-confidence and feeling of empowerment as a result of their exchange experience. [23]

Table 8. Summary of outcomes of exchange participation.

TraiNet Status	Faculty	Staff	Students	Total
Achieved: Completed Program & Achieved Goals	18	1	145	164
Not Achieved: Completed Program but did NOT Achieve Goals	0	0	3	3
Terminated: USAID Terminated Participant	1	1	0	2
Total	**19**	**2**	**148**	**169**

Professional Training

The establishment of professional training programs for various stakeholders was an important outcome of the project.

- USPCASW developed some trainings independently and some with direct assistance from the U-led team (Annex 7).
- In total, 18 trainings reached 420 professionals, including 46 engineers from the Sindh Irrigation Department

An additional cross-cutting result was the production of legacy teaching and learning materials developed for exchanges workshops, and professional programs – including an entire New Faculty Boot Camp 3-day program to orient new faculty entering at MUET to improve teaching and research (for examples of legacy products, see Annexes 20, 21, and 22). Also, an online writing course was also developed for the Center to use in perpetuity.

Implementation Challenges and Constraints

23 For examples, see https://water.utah.edu/2018/09/10/empowering-women-through-WASH/, and https://water.utah.edu/2018/07/25/focus-trust-determination-what-climbing-offers-entrepreneurs/

Many challenges and constraints were encountered. As mentioned elsewhere, the two largest constraints at project launch were faculty capacity (in terms of human resources available as well as individuals' capacities for teaching, mentoring, and leading research programs) and physical infrastructure (in terms of not only laboratories but even decent classrooms and other facilities). The challenges and constraints are organized below around issues related to facilities, curriculum, exchanges, and training.

Facilities

The building and labs were not completed until 2017, so the 2015 and 2016 batches of students did not have the necessary laboratory facilities, classrooms, etc. to use for learning and research. For learning, there were makeshift or borrowed classrooms. For research, they had to rely on labs of either other MUET departments or other institutions, the exchange visit, or curtail their projects.

After the building construction was complete, significant constraints were experienced related to the building. Disappointingly, the classroom designs and equipment specified were not to international standards. Examples included small white boards, small chairs, lack of modular classroom for project work, and cubicle style desks in computer classrooms preventing team work. Laboratory space was insufficient for the number of students expected to complete research degrees, and small meeting rooms were missing. In addition, the faculty offices were substandard, which took away time from advancing knowledge and skills of faculty and students and caused a drop in morale.

Curriculum

In 2015 the number of faculty was not sufficient to offer all desired programs and were not sufficient to offer electives in the programs that could be delivered. Over time the faculty body grew (see Annex 23) but the Center still struggled to have the breadth of faculty capacity needed for interdisciplinary graduate programs.

Due to recruitment constraints, five of the 27 faculty hired did not have PhD degrees. Generally, there were 18-20 faculty members at any one time, so the non-PhD faculty comprised roughly 27-30% of the entire faculty. These faculty had to be trained from a very basic level of research and teaching, and additionally they had to pursue PhD programs, which either meant time away from their job duties or leaves of absence for multiple years.

HEC and institutional constraints limited curriculum reform. A challenge experienced was the limitation on interdisciplinary degree programs in engineering fields. This led to additional time and effort to create a degree program that could engage non-engineers in the IWRM and WASH degrees. Another major challenge was the approach to grading, which was generally based on examinations, and inhibited project-based learning.

The PhD programs at USPCASW are vulnerable to closure due to lack of sufficient faculty with PhD degrees to contribute to them. The desire by the USPCASW management and faculty to create PhD programs, despite being insufficiently prepared to manage them, was a sentiment that the U-led team had no real power to counter.

The novel degree programs in IWRM and WASH were to some extent externally "suggested" – and due to the novelty of the degree programs they may ultimately not be as beneficial to students as the other two degrees. Whether there is a merging of IWRM and HID, and WASH and EnvEng, remains to be seen over the next few years.

As one of the many parts of the project that helped the team learn about our approach, Cheri Daily from the U Office for Global Engagement assessed the change in cultural competency of Exchange Visitors.

Exchanges
The exchange program struggled to align graduate students with research mentors based on shared research interest. Initially the exchange program's "research experience" was conceptualized as not necessarily contributing directly to graduate students' thesis research – but students were disappointed with this model and requested more direct training on their research topics. The U-led team attempted to solve this problem in various ways – including having the potential mentors interview student applicants prior to acceptance – but it was never fully resolved. One aspect of this challenge was the need to get the Center's faculty more directly connected to research thrusts aligning with U.S.-based faculty, and to select students to bridge the faculty research collaborations.

A major challenge was the degree to which students entering the program had limited capacities in writing and research skills (e.g., statistics, laboratory, and computational) causing the curriculum to be modified to include more basic content. This challenge was not anticipated and impacted the entire program. The U-led team eventually created writing and statistics online programs and data science skill building workshops to train students earlier in their program, but this was only after discovering the challenge.

Some challenges of another nature were encountered with managing the exchange program: two exchange visitors had their programs terminated by USAID (in one case, the participant failed to exit the country in violation of their visa). Two others completed the program but did not achieve their goals. For this reason, it is most accurate to say 169 visitors were hosted, but only 167 completed the program – and only 165 completed the program and achieved their goals (Table 9).

Training
The U-led team sometimes struggled to shift from a supply-side approach (i.e., identifying which faculty at the U and CSU were available to deliver workshops, mentor students, etc.) to a demand-driven one in which the capacity development needs of USPCASW faculty and students determined all programming.

The U-led team provided technical guidance and encouragement to the USPCASW team to develop a "flagship" training program that could build the reputation of the Center and generate revenue through fees. Unfortunately, despite the various trainings, the Center never established a flagship training program due to lack of leadership in this regard. The challenge moving forward is to establish a Training Center with regular offerings that meet market demands rather than ad-hoc trainings.

Missed Opportunities

Developing interventions to support the development of the baseline capacity of students: To start the project, the capacity of entering students was vastly overestimated. Remedial programs and acceleration of skill building was not planned into the curriculum or program, and was sorely needed at the outset. It was developed for core skills of writing and statistics, which was provided online and in mission training. But, an opportunity to impact higher education in Pakistan was missed by not anticipating skill building programs that could be delivered to incoming students and translated to other higher education institutions.

Strengthening alignment between curriculum and market needs: Although stakeholder consultations for curriculum design were held early and throughout the project, a more systematic study of

market needs was delayed for several years. The market survey (conducted in 2018 by IPSOS) concluded: "there is a general view that the Education Program of USPCASW, while essentially aligned with the market needs, requires to be further refined and fine-tuned to meet national and regional requirements." The courses in general match with what would be provided in internationally comparable programs, except for two areas. First, the courses have breadth, but lack depth – and this depth is lacking in areas of local need. Second, and following from the first point, is the lack of advanced courses. Regardless of the delays caused by faculty recruitment, this was a missed opportunity. By the time the market survey was available (mid-2018), there was very little time left in the project to undertake significant curricular adaptation in response.

Certificate programs to build student capacities: Specialized diploma/certificate programs should be defined, developed, and promoted. This has been a missed opportunity so far, and the transition period could be used to make progress on this activity. Promising areas include public health engineering (i.e., application of WASH) and industrial environmental management (i.e., application of EE). In particular, offering a WASH diploma/certificate to EE graduates and professionals may be a way to develop professionals that are employable in the NGO sector. This will be helpful in building the demand for the degree.

Connecting curriculum to professional training: The U-led team repeatedly stressed the need for developing a training unit to connect USPCASW curriculum to the water sector. The challenge was having someone able to dedicate the time and have the experience to develop and manage the unit. An external search was conducted multiple times, but a suitable applicant was not received. This inhibited connecting courses that faculty members teach with opportunities for professional development of the water sector. There is a missed opportunity in the area of using existing courses in the offering of diploma courses – to date only three diploma programs have been designed and delivered for a specific client (Sindh Irrigation Department) and there has not been a strong linkage between courses in the degree programs and the training modules of the diploma courses. This is central in the *Sustainability and Transition Plan*, and an area where sustained international assistance should focus.

Lessons Learned

This chapter dealt with the fundamental methods of capacity development, and several key lessons were learned about how to do it more effectively. Some lessons are cross-cutting, and some pertain to specific areas of curriculum, exchanges, and training.

Baseline capacity matters for program design: There were several instances in which interventions were designed according to certain assumptions about faculty and student capacities that proved incorrect. Had a thorough baseline capacity assessment been possible by the partners at the outset, these missteps might have been avoided. However, with the need to recruit faculty and students, the timeline for discovering this capacity gap took well over a year. It is also the case that USAID could have openly acknowledged the different baseline capacities between MUET and the other CAS universities such that the U-led team could have better met faculty and students "where they were." Overall, this lesson led to support for the co-creation of capacity building programs to not only anticipate baseline capacity gaps, but also comprehending institutional and contextual constraints to capacity building that were not anticipated and not presented in the feasibility study.

<u>Curriculum</u>

Degree flexibility matters: A challenge related to the pipeline is that not all students entering at the MS level have the capacity to do research and ultimately to write it up in a publishable form. Specific areas of challenge noted were information literacy, research methods, English comprehension and writing. This realization after the first year of exchanges led to the creation of online content to help students acceler-

ate their learning of writing and statistics. However, the challenge persisted indicating more definitively that the student writing was near to a U.S. high school level while research capacity was near to a freshmen level in college. An MS non-thesis degree program should have been provided as an option; however, this degree track is contrary to the heavy emphasis in research capacity building. Flexibility in degree options could have enabled an MS non-thesis to have been implemented side-by-side with the thesis degree options. A different fee schedule could have been provided such that only thesis students are on scholarship or are getting a larger stipend or had become eligible for exchange.

Exchanges

Duration and personalization of graduate student exchange experience matters: This project created a conflict between achieving targets for student exchanges and delivering quality. This was expected. The student exchange program was trialed at both half semester and one semester duration, and with direct research mentors and group research mentoring. Based on the experience of these trials, graduate student research exchange visits should be one semester plus one summer and have an individual research mentor to provide a personalized learning experience.

Training

Style of training matters: Workshops delivered in year 1 were traditional classroom style, which is a proven way to efficiently and effectively learn in many contexts. However, after several iterations it was realized that for several reasons (e.g., lack of capacity and incentive for independent learning) classroom workshops were not leading to sustained learning outcomes. Training style therefore evolved toward the end of year 1 and into year 2 to introduce first the boot camp style approach to the training missions – offering smaller 2-hour blocks of instruction and activity to build capacity. Following the boot camp approach, a coaching style was developed to deliver training in workshops and informally that had a shared objective to accomplish a task and trainer and trainee worked side-by-side to accomplish the objective and achieve learning outcomes in the process. The boot camp style led to building of fundamental proven practices for being a successful professor and coaching style led to production of teaching materials, research results, and training materials all being developed as outputs from training activities.

Continuity of training matters: Capacity strengthening of faculty for research and teaching excellence is most effectively done via a delivery through multiple styles (classroom, coaching, boot camp) with continuous mentoring (see Highlight Box 12). This integrated and continuous approach evolved over time and helped to sustain independent learning by not only maintaining oversight but also providing a valuable lifeline to guide and support independent learning. Moreover, this "twinning" approach to training faculty helped build rapport and long-term lasting relationships leading to sustained project impact.

Concluding Thoughts

The Center has been established with locally relevant and internationally recognized graduate degree programs addressing problems of need in Pakistan. The degrees cover the range of SDG 6 targets, cater to local and regional stakeholders in government, industry, and communities. These programs will all be sustained, at least for a period of time.

The use of project-based learning was embraced by the USPCASW faculty. They found workarounds to overcome the grading rigidity at the institutional level, they shared contagious enthusiasm with the students, and they found ways to incorporate practical skills training into the project experience. Since all of these and other adaptations of the introduced concept of project-based learning were developed internally, this intervention is expected to sustain and flourish.

The integrated and continuous training approach

presents a proven model for capacity building that will guide future efforts of USPCASW and with the U-led team. The critical aspect of building strong tier 3 partnerships was not anticipated and provides a strong foundation for long-term interaction among the partners.

There is great potential for continued interaction between the U-led team and USPCASW in areas of curriculum, exchange, and professional training. The professional training is continuing with sustained contributions from the U-led team to training of the Sindh Irrigation Department. Expansion of professional training will hopefully be possible through this interaction. In terms of curriculum, there are tier 3 partnerships that continue to teach the same or similar courses and the sharing of ideas and materials continues. Sustaining the exchange program is more challenging because of the substantial resources it required. MUET is committed to continuing to provide an exchange experience for a much smaller set of students and a modified program focused on supporting the students engaged in research bridging tier 3 partnerships and existing funded projects to those partnerships.

"Partnerships for sustainable development are strongest when they are authentically oriented around shared aspirations for a better world – but connected to tangible and feasible outcomes in real places."

- Dr. Mercedes Ward, Institutional Development Advisor and Researcher, U

Partnerships

Key Accomplishments

- 11 collaborative MOUs signed with governmental and non-governmental organizations
- 80 internships hosted by 29 different organizations
- 29 research and capacity building projects funded by government, industry, and civil society organizations
- Active research partnerships with several industries, including textile, fishery, and irrigation
- Active training partnerships with several government departments (Irrigation, HEC)

Actions

Several core actions were taken to develop and strengthen partnerships with the public and private sector.

Events and workshops: Throughout the five years of the project, many different events were organized to connect with stakeholders, stimulate public and private partnerships, and align the Center with market needs (Annex 6). The Center took the initiative to organize three Young Researchers' Conferences that brought participants from across the country, and the U-led team developed an industry-academia co-creation research forum and workshop in the summer of 2017 that brought potential industry partners to the Center to meet with faculty to brainstorm collaborative projects.

Awarding seed grants for industry-academia partnerships: Seed grants were used strategically to address the industry-academia gap. Specifically, to further support the co-creation process described above, the third and final round of seed grants (awarded in early 2018) included a special RFP for industry-academia collaborations that resulted in four awards (see sidebar).

Establishing networks and committees: In 2016 the Standing Committee on Business-Academia Collaboration on Water and the National Water Research Network (NWRN) were formed with guidance from the U-led team, especially the Deputy Director. The purpose of the Committee was to bridge the divide between academia and business to work together towards a shared national development agenda for water by promoting entrepreneurship, innovation, workshops, and partnerships. The vision of the NWRN was that it would encourage bringing together researchers and policy-makers interested in evidence-based research for improving the quality of policy-making.

Fostering a community of practice: The Center pursued collaborative MOUs with public and private sector organizations as well as NGOs and international agencies. These MOUs varied in scope of engagement and types of activities, but all had the intent of strengthening cooperation across multiple domains (e.g., research, data sharing, outreach, internships, etc.), multiple sectors (e.g., government, research institute, academia), and SDG 6 targets. The Center also developed an internship program for students to gain experience working with water sector organizations, and the U-led team guided the Center to develop training courses that could directly meet the needs of local stakeholders (see Education & Training chapter). These efforts all aimed to foster stronger linkages with other organizations working in the water sector to create a community of practice (see discussion of TOC in Introduction chapter).

Strengthening internal connections: The Center aimed not only to strengthen relationships with external stakeholders but also with others on the MUET campus as well as within the Center itself through the establishment of the campus Women's Resource Center (WRC) and USPCASW's gender equity committee (see Equity chapter), graduate seminar series

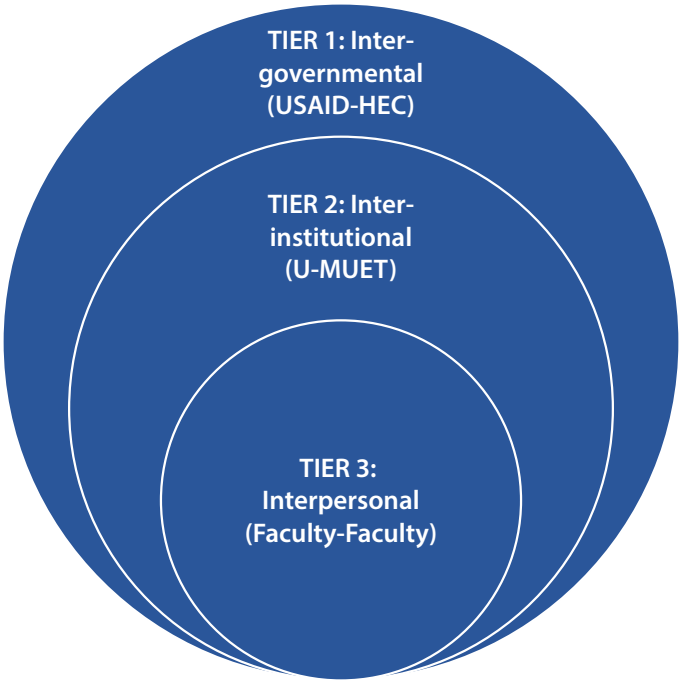


Figure 8. The nested partnership model.

[24], alumni association, and thematic research groups (see Research chapter).

Building "tier 3" partnerships: The MOUs and other inter-institutional agreements represent "tier 2" partnerships (with intergovernmental partnerships representing "tier 1" partnerships; see Figure 8). The project invested considerable energy – through the Course Mentoring Program, the Exchange Program, the Seed Grant Program, and the mission trips to Pakistan (described elsewhere in this report) – to nurture strong "tier 3" partnerships among specific individuals from MUET and the U.S. partner universities (see Case Study 6).

Coaching for partnerships: The U-led team – es-

24 The graduate seminar series – which was managed by MUET with advice from the Deputy Director – was frequently held on Fridays and served a two-fold purpose of student learning and stakeholder engagement. It provided a flexible arena for hosting speakers from diverse sectors and disciplines, and it helped to raise awareness about the Center. Over the course of the five years, 60 graduate seminars were held (for a listing of speakers, see http://water.muet.edu.pk/capacity-building/graduate-seminar-series/).

CASE STUDY 6: How to Generate a Tier 3 Partnership

Not all faculty-to-faculty partnerships thrive. Those that do seem to be a result of sustained interaction generated through several activities of mutual interest.

For example, Professors Tim Gates (CSU) and Munir Babar (MUET) share an interest in solving problems related to hydraulics, irrigation, and drainage (HID). They have been working together for four years in several capacities.

First, Dr. Gates supported Dr. Babar through the Course Mentoring Program to improve courses in the HID curriculum. Second, Dr. Babar spent six months at CSU for a post-doctoral exchange. Third, Dr. Gates mentored Dr. Babar's students during their exchanges at CSU. Fourth, Dr. Gates and other CSU colleagues regularly visited MUET to deliver technical training in HID and develop research proposals and projects with Dr. Babar and others.

Drs. Gates and Babar aim to continue their collaboration: they are preparing proposals to submit to the USDA NIFA AFRI program and the USAID PEER program, respectively.

As Dr. Gates explained, the parallel investigations in Colorado and Pakistan were key to sustaining the collaboration because the research was mutually beneficial for both students and faculty – and both the U.S. and Pakistan.

As a result of this kind of close, peer-to-peer learning, the HID program at USPCASW has been greatly strengthened. For more information, see, "Researchers Aim to Control Canal Seepage."



pecially its Chief of Party, Dr. Aslam Chaudhry – provided extensive mentorship and coaching to the Center's senior management team regarding how to establish and strengthen partnerships. This coaching included how to reach out to partners, what kinds of programs would be of interest to stakeholders, how to structure and organize events, and the importance of follow-up after executive seminars and other major stakeholder dialogue events.

Major Results and Outcomes

Implementation of these activities resulted in the following notable outputs and outcomes.

MUET signed eleven collaborative MOUs with provincial, national, and international partners (Table 10). Several of these MOUs generated activity in terms of training, research, data sharing, and student internships.

Twenty-nine organizations/departments hosted 80 interns (Annex 9). Most of these internships were with the government sector, but 15 were with NGOs, 3 with for-profit businesses, and 2 with a private not-for-profit hospital (Figure 9). These experiences were especially valuable for students who did not participate in the exchange program to the U.S.

The Center succeeded in winning 29 externally-funded grants for research and capacity building activities. This included 15 grants from the public sector,

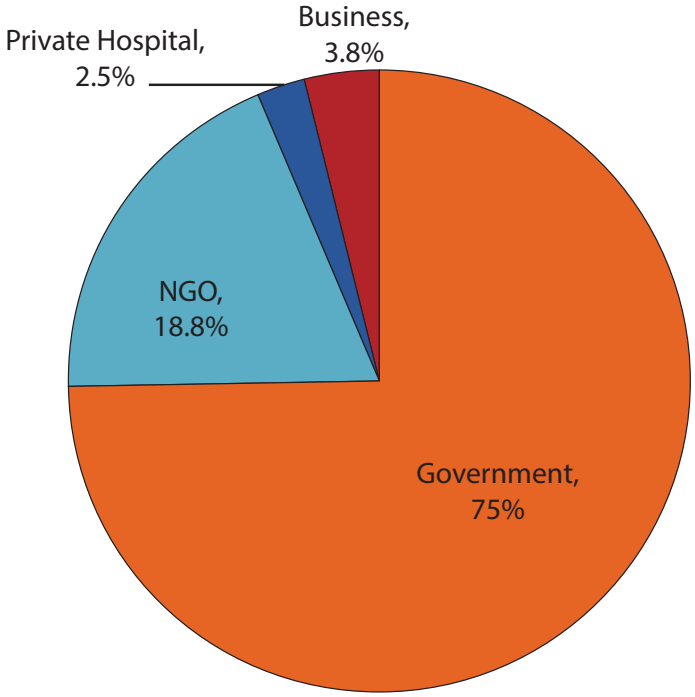


Figure 9. Percent of student internships (n = 80) across different sectors.

HIGHLIGHT 13: Multi-Project Partnership with Government of Sindh through the Water Sector Improvement Project

The Sindh Water Sector Improvement Project (WSIP) is a World Bank-funded project managed by the Planning and Development Department, Government of Sindh, to improve irrigation water distribution in Sindh.

Given the alignment between the goals of WSIP and USPCASW, the Center was able to partner with WSIP to implement four research projects (totaling 13 million PKR / 84,000 USD).

These four WSIP-funded projects included:
1. The Impact of Informal Institutions on Participatory Irrigation Management Outcomes
2. Calibration of Gauges and Development of Rating Curves of 115 distributaries/minors of Nara Canal AWB for Flow Measurement
3. Study on Water Balance of Sindh Water Resources Management
4. Situation Analysis of the Wetlands of Sindh

The first of these is unique because it was the only externally funded research project won by a US-based researcher on behalf of the Center at MUET, and it is the only project for which the US researcher relocated to MUET for several months to lead the project team with her MUET colleague.

Table 9. Typology of USPCASW partnerships and community engagement.

Scope of Engagement	Type of Partnership or Community Engagement						
		Collaborative MOUs	Project Agreements	Groups & Committees	Centers	Networks	Public Engagement*
	USPCASW			Gender Equity Committee -Thematic Research Groups		USPCASW Alumni Association	Graduate Seminar Series
	MUET				Women's Resource Center		Graduate Seminar Series
	Sindh	SIDA** Sindh Irrigation Department Sindh Agric. Univ., Tando Jam	Sindh Irrigation Department [2]*** Sindh Water Sector Improvement Project (WSIP) [4] Matol (Pvt.) Limited [2] Safcco [1]				Graduate Seminar Series Stakeholder & Policy Dialogues Outreach Events
	Pakistan	PCRWR WAPDA IST SDPI Indus Earth Trust	Higher Education Commission (HEC) [5] National Rural Support Programme (NRSP) [1] United Energy Pakistan Limited (UEPL) [2] Global Change Impact Studies Center (GCISC) [1] Oxfam-Pakistan [1]	Standing Committee on Business-Academia Collaboration on Water		National Water Research Network	Graduate Seminar Series Stakeholder & Policy Dialogues Outreach Events Young Researchers' National Conference
	International	WWF-Pakistan Oxfam-Pakistan Tearfund University of Utah	Australian Center for International Agricultural Research (ACIAR) [2] US-Pak (HEC) [1] Heinrich Boll Stiftung [1] International Center for Agricultural Research in Dry Areas (ICARDA) [1] Tearfund [1] -MetaMeta [1]				International Science-Policy Conference on Climate Change PCRWR Conference

* The scope of the audience and speakers for the Graduate Seminar Series and Policy Dialogues varies greatly across each event. Similarly, outreach events are organized at different levels. Some public engagement activities are institutionalized meaning that they are recurring; others, like the international conferences, are one-time-only.

**Green text indicates public sector; blue text indicates NGO/civil society; and purple text indicates private sector (for-profit industry).

***Numbers in brackets indicate the number of specific project agreements.

Table 10. Number of partnerships for research, training, and consultancies from different sectors.

	Business/Industry	Government	NGO/Civil Society	Grand Total
International	0	2	6	8
Joint (National & International	0	1	0	1
National	4	6	3	13
Provincial	0	6	1	7
Grand Total	4	15	10	29

HIGHLIGHT 14: Industry-Academia Seed Grants

- Treatment and reuse of wastewater of fish processing industry. Partner: M.S. Mohammedi & Co. (fishery industry; private sector).
- Wastewater Treatment and Reuse to approach zero water discharge in Al-Rahim Textile industries: substantial increase water use efficiency in Textile processing. Partner: Al-Rahim Textile Industry (private sector).
- Closed-loop secondary-level canal monitoring for equitable and reliable distribution of water. Partner: Sindh Irrigation and Drainage Authority (public sector).
- Eco-innovation in textile processing industry of KITE for sustainable product processing. Partners: Artistic Millinners and Artistic Fabric and Garments Pvt Ltd. (private sector).

4 from the private sector, and 10 from the NGO/civil society sector (Table 11; see also Annex 8).

The high level of investment from the Government of Sindh (GoS) – as demonstrated through funding for research (via WSIP), capacity building (via the Irrigation Department), and gender equity (in terms of construction of a women's hostel) – is important because it shows significant local commitment to the substantive work of the Center (see for example Highlight Box 13).

HIGHLIGHT 15: Industry-academia research partnership with Al-Rahim Textile Industries Ltd.

USPCASW partnered with Al-Rahim Textile Industries Ltd. (ATI) for a project led by Dr. Tanveer Ahmed (USPCASW, MUET) to improve wastewater treatment and reuse in textile processing. The team developed a system that reduced water consumption at ATI by 18%. As a result of the optimized operation of the effluent treatment plant, ATI was able to achieve 60-65% permeate recovery for reuse in textile processing.
Sustainability of Partnership:

- A 3-year MOU was signed for further collaborative work.
- A joint research grant proposal was submitted to the Pakistan Science Foundation to build on the results of this study.

Four seed grants were awarded for collaborations with industries (Highlight Box 14). Three of these "client-driven" projects included co-funding by the industry partner (with total industry funding of 7 million PKR, which is not included in table of externally funded projects). These industry-academia seed grants were supposed to give academics the opportunity to demonstrate to industry the value working together on a shared research agenda – and the ongoing collaborations that are emerging from these seed grants indicate that this strategy has been successful (e.g., Highlight Box 15).

Training Sindh Irrigation Department

The Sindh Irrigation Department funded a major 3-year capacity building program for its engineers to receive advanced technical training through diploma courses designed and delivered by the Center. Faculty from the U, CSU, and UNLV have provided technical assistance with these courses – and the Technical Advisor, Dr. Sajjad Ahmad, was instrumental along with USPCASW Project Director Dr. Bakhshal Lashari in establishing the collaboration between the SID and the Center. This is the kind of partnership between the government and the Center that can amplify impact on the water sector and also finance institutional sustainability – and it is one that will sustain beyond the life of the project.

The value of the U-led team's technical assistance and the nature of the research collaborations and exchange programs caught the attention of the National University of Technology (NUTECH) in Islamabad. In 2019 the U and NUTECH signed an MOU for a partnership, extending the impact of the original partnership with MUET to another university in Pakistan.

The U and MUET signed a second MOU in 2019 for another five years of collaboration.

Implementation Challenges and Constraints

There were several challenges and constraints to building and strengthening partnerships with public and private sector stakeholders that the teams had to deal with during project implementation.

The most significant challenge was the Center's lack of capacity not only to structure and organize the partnership program but also to appreciate how partnerships could be used to advance the Center's work. In particular, in the early years of the project, there were some MOUs signed that really were "paper MOUs" that served mostly for show rather than to strengthen substantive partnerships. This lack of capacity also limited the extent to which the Center's leadership followed the recommendations put forward by the U-led team.

The level of isolation between academia and the public and private sectors is significant in Pakistan. Breaking this barrier was a major challenge that took very targeted activities to even begin to make headway, especially towards the target of five public-private partnerships (PPPs). [25] Although the four industry-academia collaborations were partnerships between the private sector and the public sector, they were discreet research projects rather than long-term arrangements for private sector investment in public infrastructure and service delivery, which is generally what is meant by "PPPs" in both the literature and policy practice. [26]

25 The cooperative agreement included a target of five public-private partnerships or Global Development Alliances (GDAs).

26 For example, see "'Public Private Partnership' – A Hope for Healthier Pakistan" by Kashif Siddiqui, The Nation, 3 November 2019 (retrieved 8 March 2020 from https://nation.com.pk/23-Nov-2019/-public-private-partnership-a-hope-for-healthier-pakistan).

Although some MOUs reflected healthy, productive partnerships, an MOU outcome assessment conducted in preparation of the S&T Plan found that five of the eleven collaborative MOUs had very low implementation. This had been generally understood prior to the formal assessment, but the lack of transparency on MUET's side about the specific points of cooperation agreed upon in each MOU obscured the exact nature of the gaps until it was too late to do course corrections.

The Center lacked a clear "brand" [27] and never developed a strong communication and marketing strategy that could generate widespread brand-recognition and enthusiasm from potential partners.

The Standing Committee on Business-Academia Collaboration on Water and the National Water Research Network did not generate the kinds of action that had been envisioned. The former at least had some recurring activities and although it never advanced a strong agenda, its Chairman has been an effective bridge between the Center and industry. On the other hand, although the NWRN convened once more after its inaugural event, a quorum at the meeting was not obtained – and no subsequent meetings were held.

USPCASW had a target of 50 student internships with private sector organization; this was not achieved: three-quarters of the 80 internships were with government organizations (Annex 9). While it is true that students in HID and IWRM may have been logically placed with public sector organizations (e.g., WAPDA, SIDA), the EE and WASH students could have been aligned with industry if the Center had stronger capacities for networking and convincing industry to take students as interns. Strengthening relationships with private sector businesses remains an ongoing challenge for the internship program.

The project collaborations with external partners were sometimes "consultancies" rather than research projects that were driven by – or at least co-designed with – a faculty member. Consultancies can be helpful for the Center to establish a new relationship and build trust (not to mention raise funds), but they can also weaken the academic caliber (or simply lessen the quantity) of publications coming out of the Center if the project is not well-conceived. Striking an appropriate balance of priorities requires partnerships where each respective side gives due weight to the perspectives and priorities of the other – and this requires time and trust.

Missed Opportunities

Several missed opportunities are evident in hindsight.

Activating MOUs: The major missed opportunity was that the Center failed to take full advantage of all of the MOUs signed with different partners and stakeholders. If all of these MOUs had been implemented fully, the impact would have been significant.

Operationalizing the NWRN: The NWRN was supposed to bring together researchers from different disciplines, institutions, and sectors. Instead of developing these interdisciplinary linkages for large-scale, multi-institutional collaborations, the Center's research teams tended to be discipline-based and projects tended to be small-scale.

Increasing partnerships: The U-led team recognized the weak capacity for partnerships on the Center's side but relied primarily on coaching to build this capacity. There was a missed opportunity to focus more attention on building capacity for partnerships through workshops, boot camps, or

27 The fact that USAID funded the USPCASW and controlled branding (e.g., requiring it be called USPCASW) meant that inevitably the Center conveyed the notion that it was a project. Projects have specific deliverables and timelines – and specific end points. The transition from thinking of the USPCASW as a project to thinking of it as a research center took a long time – yet, this transition is fundamental to long-term institutional sustainability.

HIGHLIGHT 16: Coaching to Leverage Existing Networks for Project Success

The success of outreach, engagement, research, and other activities required developing professional networks to cultivate partners, supporters, and stakeholders. From the decades of experience of working in Pakistan, Project Director Dr. Bakhshal Lashari and Deputy Project Director Dr. Rasool Bux Mahar had cultivated strong connections with networks in the irrigation and drainage community of practice and wastewater management community of practice, respectively.

The value of these existing networks was amplified through the coaching and support of the U Deputy Project Director Dr. Aslam Chaudhry who helped Drs. Lashari and Mahar becoming more mindful of making the stakeholder consultative processes more "participatory" and "outcome oriented". This led not only to successful implementation of project activities but also to the growth of capacity of Drs. Lashari and Mahar for following-up and maintaining momentum after events. This was a significant undertaking, and one that Dr. Chaudhry never tired of doing.

In this way, existing "social capital" was put to use in support of research and education in academia. It is perhaps no surprise that the two themes of USPCASW that flourished (HID and Environmental Engineering) capitalized on these two networks, while the areas that did not achieve as much (IWRM and WASH) did not have the same luxury of strong existing networks.

micro-trainings (as was done for other capacities; see Annex 14). These could have been tailored to meet both management and faculty needs. For example, when the teams were attaining full research capacity and they realized that there was very limited engagement with the private sector, a targeted intervention was carried out in 2017. A similar kind of intervention could have been utilized to strengthen the collaborations with public sector and civil society organizations – especially given the apparent interest NGOs showed in providing small grants and consultancies to the Center. This could also have helped increase the number of interdisciplinary and national level partnerships established using targeted research proposal development workshops with faculty from other disciplines. Setting interdisciplinarity aside, the Center could have emphasized bringing scholars from other provinces to participate in co-creation workshops for research proposals.

Recruiting qualified management and adjunct faculty affiliates: The USPCASW team missed the opportunity to implement several of the recommendations made by the U-led team, including the recommendations to recruit a senior level industry liaison who could help develop relationships with the private sector on behalf of the Center. This gap in human resources was a major missed opportunity. The proposed organizational structure in the S&T Plan includes a department head for partnerships, networking and training. The USCPASW team also failed to implement the recommendations to hire (i) a high-level communication and policy impact person who could have facilitated the broader impact of the research being conducted at the Center – which in turn would have built the Center's reputation and garnered greater interest from stakeholders who might invest funds in the Center's activities, and (ii) honorary professors of practice from industry and policy-making circles. This would not have cost much and could have had a significant impact on strengthening relationships.

CASE STUDY 7:
Leveraging Networks to Build a National Reputation

The relative remoteness of the MUET campus in relation to the major intellectual and economic "exchange-hubs" of Pakistan (e.g., Islamabad, Karachi, Lahore) made it all the more imperative to have a strategy to strengthen the Center's relationship with institutions and stakeholders across the country.

Fortunately, an effective strategy was feasible in large part due to the efforts made by the project's Associate Director, Dr. Tariq Banuri, in the form of leveraging high-profile and extensive personal and professional networks to support the Center's operational activities, and create opportunities for the Center to connect with the research and policy-making circles.

When his affiliation changed from the project's Associate Director to, first, the Executive Director of the Global Change Impact Studies Centre (GCISC) in Islamabad, and then in May 2018, to Chairman of the HEC, he continued to support the Center's involvement with national opportunities when appropriate.

For example, under his leadership at the GCISC, the International Science-Policy Conference on Climate Change in Pakistan (SP3C) was held 18-20 December, 2017, in Islamabad. The SP3C was a great initiative to introduce the Center at the national and international level, since it convened more than 850 national and international delegates from academia, government, and civil society. The conference resulted in the publication of selected conference papers in a special issue of the journal, Earth Systems and Environment.

Once in office at the HEC, Dr. Banuri facilitated the HEC's interactions with the U-led team and the Center, most notably in the form of connecting the strengths of the teams to the HEC's National Academy of Higher Education (NAHE) in support of its Six-Week Faculty Skills Development Course in summer 2019. This effort is now continuing.

These and many similar opportunities gave immense exposure to the Center beyond its usual horizons and would have been difficult to accomplish without Dr. Banuri's capacity for visioning, networking, and leveraging relationships to advance sustainable development.

Lessons Learned

Partnership management matters: The capacities at the Center to manage its partnerships effectively was weak and ultimately affected the implementation of the MOUs. Had the MOUs been implemented in their true letter and spirit, many more things could have been accomplished. The lesson is that building management capacity – not just technical skills capacity for teaching and research – is important, especially for institutional sustainability (see also Governance and Sustainability chapter). Furthermore, although coaching is an effective approach (as emphasized in this report), a truly integrated learning approach may have been more effective. Management training in partnership building should have been implemented in the early years of the project.

Reciprocity matters: Notwithstanding the previous point that ownership matters, reciprocity also matters. From the successes and failures of the various MOUs, one key lesson to emerge is that partnerships based on reciprocal obligations for synergistic growth (i.e., cooperation) are the most likely to flourish and produce meaningful outcomes. The collaborative MOUs that fared the best, for example the U-MUET MoU, may have been those where financial resources were available to support some kind of concrete activity that benefited both parties.

Co-creation approach matters: The industry partnerships were successful in large part due to a specific intervention designed in 2017 following the U-led team's receipt of MSI's "baseline report" for the project. The baseline report clearly emphasized the importance of partnerships with the private sector – and the U-led team's Executive Committee (see Governance and Sustainability chapter) had a strategic meeting during which they brainstormed how to strengthen the Center's connection to private sector stakeholders. From this [28], the concepts of the industry-academia research co-creation workshop and special industry-academia call for seed grant proposals were developed. In this way, the team addressed the challenge of linking academia and industry by adapting the work plan to achieve this goal. Future projects similar to CAS should consider applying this industry-academia co-creation research partnership model to their own contexts as well.

Personal relationships matter: It might be easy to conclude that the Center has relied more on personal relationships than institutional ones. For example, most internships were facilitated as a result of personal relationships, and most research collaborations involving faculty from outside the department are based on personal relationships too. Ultimately, even partnerships that appear to be institutional – as in the case of the Sindh Irrigation Department and the Center – are largely based on the trust and rapport among key individuals. This is social capital, and it requires time and effort to build and use effectively (see Highlight Box 16). The considerable effort that the Utah team invested in interpersonal relationship-building and leveraging for research collaboration should be viewed as social capital generating (and activating) activities that were successful: many tier 3 partnerships show signs of being sustained post-project.

Concluding Thoughts

Building and strengthening partnerships requires considerable strategic effort (see Case Study 7). Although several partnerships were established and some flourished, more could have been done

28 The project director and associate director had recently shared with the Executive Committee their experiences with a USAID co-creation workshop held in Washington, DC. This was a unique approach that the Utah team essentially decided to adapt and apply to the USPCASW context.

had the Center devoted sufficient commitment and human resources for this purpose.

Even so, the industry partnerships have proven not only successful in terms of building a strong linkage between research and private sector needs but also in terms of giving faculty and students – as well as industry people – a new way of viewing the research process and their roles: rather than academics working in silos, they could be doing more impactful research by co-designing and partnering with clients.

Indeed, the co-creation model for designing research projects was successful at generating industry-academia partnerships. This model should be replicated not only with industry but also with NGOs and government departments – and it could be leveraged by the Center to generate a national and even international reputation as an incubator and capacity builder for creative collaborations with real-world impact. In essence, the Center needs to fully embrace the concept of the "Community of Practice" as described in the revised theory of change (Figure 2).

"My exchange visit to the University of Utah was an incredible experience. It shaped my character and changed my view about life. I had the best time and was able to do and see many things that I never dreamed of before."
- Muhammad Touseef, USPCASW Exchange Scholar

"Initially, I was nervous about gender preferences, but quickly realized that there is equal opportunity for both genders in this center. They really encouraged female students and provide an environment where women benefit from a range of opportunities. This built in me and other female candidates the confidence to stand shoulder to shoulder with the men, moving beyond the idea that females are inferior."

Marvi Sharma - USPCASW Exchange scholar

Gender Equity & Inclusion

Key Accomplishments

- Raised awareness and introduced policies and practices to support an inclusive and enabling environment for women and other marginalized groups
- Development and adoption of campus-wide Gender Equity Policy at MUET
- Establishment and operationalization of Women's Resource Center at MUET
- 36% female participation in graduate degree programs
- 26% female participation in faculty

Objective

The project objective to "*increase access for talented, economically and/or culturally disadvantaged students, as defined by HEC, to high quality educational opportunities in the discipline of [water]"* was met through the equity and social inclusion component. The Center aimed to create a supportive environment for female students in particular in order to increase enrollment of female students by at least 15% over the typical level of participation at the host university – with the goal of reaching 50% female participation in CAS activities. The Center also aimed to encourage enrollment of students from economically disadvantaged backgrounds as well as from provinces other than Sindh.[29]

Actions

Outreach: The Center actively sought to mainstream social inclusion including gender participation into all programs and policies. To this end, the Center organized entry test centers in major cities to attract enrollment from all parts of the country. Similarly, in order to attract larger number of female students to the Center, several outreach activities were organized by MUET. This included organizing events with the support of the U-led team at other universities to spread the word about the Center's programs and gender equity policy. This was especially important at the outset of the programs before any reputation had been built – and the U's Deputy Director (Dr. Aslam Chaudhry) and Gender Specialist (Ms. Shabnam Baloch) who were both based at USPCASW in its early years – contributed to raising awareness about gender equity and empowerment in ways that were appropriate to the local cultural context. Free housing accommodations and campus transportation were provided to female students to further incentivize them to join the Center.

In terms of recruiting female faculty, all job advertisements clearly stated that women were encouraged to apply – but the U-led team went further to proactively guide the Center's PMU to "head hunt" female professors. The U Deputy Director in particular was instrumental in all faculty recruitment but especially strategic female and other diversity hires.

The project team worked with MUET faculty to encourage women to engage in field research.

Scholarships: The Center was able to offer scholarships to all students who were accepted into the programs of study. USPCASW used merit-based criteria as the primary one for admission, and gave scholarships to all who were admitted. [30] In addition to a monthly stipend, students received a generous funding allocation for research.

29 Although recruiting and enrolling students from different provinces advanced the goal of building a "national" center, it also represented a commitment by the Center against discrimination on the basis of a person's geographical origin.

30 The Center did not attempt to identify which students came from "underserved" or "disadvantaged" backgrounds – even though one of the required reporting indicators to USAID's PakInfo was "the number of individuals from underserved and/or disadvantaged groups accessing workforce development programs or tertiary education", where "categories of underserved or disadvantaged groups include women, individuals with disabilities or special learning needs, and those facing financial hardship" (PIRS, indicator 4.1.2-a). Ultimately, the Center reported all students as being from underserved/disadvantaged backgrounds on the grounds that all students in Pakistan were at a disadvantage when it came to pursuing postgraduate education. This seems to have been done with the approval of USAID, suggesting this rationale is acceptable.

HIGHLIGHT 17: First Campus-Wide Gender Equity Policy in Pakistan

With the support of the U team, MUET became the first public sector university in Pakistan to adopt a campus-wide Gender Equity Policy.

Gender Policy Objectives
Promote diversity and inclusiveness amongst its faculty, students and staff;
Support women and girls in the realization of their full human rights; and
Reduce gender inequalities in access to research and education related resources and benefits

The full policy is available online.

HIGHLIGHT 18: Operationalization of the Women's Resource Center

After persistent efforts by a few particularly passionate players (e.g., the Gender Equity Committee at USPCASW and the U Deputy Director), the campus-wide WRC was not only inaugurated in 2016, but meaningfully operationalized in 2018-2019.

In the process, the WRC brought together different stakeholders from across campus (and beyond) to engage in activities to promote gender equity. The WRC has a physical space (shown in photo below) located in the Student-Teacher Building on central campus, and the Vice Chancellor has expressed commitment for ongoing staff and activity support.

One especially successful event was a student painting contest for expressions of women's empowerment. Both male and female students participated and the event was a great demonstration of solidarity for gender equity.

Strengthening institutions: A Gender Policy Statement was prepared with significant guidance and input from the U-led team – and it was adopted by not only the Center but the entire university in 2015 (see Highlight Box 17). For the next four years, the overarching goal of implementing the GEP in its letter and spirit was pursued through the establishment of a Gender Equity Committee at the Center, a Women's Resource Center on main campus (see Highlight Box 18), and clear anti-sexual harassment policy statements and awareness-raising sessions.

Creating an inclusive and enabling environment: Although the physical building for the Center was not ready for use until the summer of 2017, its completion marked a new era for the Center because it now had its own physical space to nurture its own kind of learning environment that was inclusive of everyone (see Case Study 8). The new building has a women's-only study room with tables, chairs, and lockers. Most importantly, the management team created an environment where men and women could sit together at the cafeteria. This was the only dining facility on campus where there was no gender segregation and people from across campus would come to the Center for lunch or tea. Similarly, the Center aimed to be welcoming to people of all religions and ethnicities. The U-led team was quick to point out and correct instances at the Center where principles of gender equity and general inclusivity were not being followed – and the U staff embedded at the Center contributed to technical backstopping for gender equity.

Coaching: The U-led team approach for much of this capacity building was through continuous coaching. Early on in the project, two workshops were delivered, and one of the Senior Advisory

CASE STUDY 8: Supporting Gender Equity by Creating New Formal and Informal Institutions

The baseline situation for women on MUET's campus was one of inequity in terms of access to campus resources. For example, there were early evening curfews for women but not for men, who were able to stay late at the library or gym. There were also strict restrictions on shared spaces (e.g., see photo below), such as cafeterias where there was gender segregated seating.

The U Team took a two-pronged approach to supporting a shift towards greater gender equity.

First, the team supported the establishment of formal institutions on campus. The Gender Equity policy and Women's Resource Center each represent significant milestones in the institutionalization of policies and support structures for gender equity. '

Second, the team encouraged an inclusive organizational culture within the Center such that at the Center's cafeteria, men and women ate together and interacted as colleagues of equal status. Sexual harassment awareness-raising sessions were given to new students, and a Gender Equity Committee was empowered to raise issues with management. The inclusive and enabling environment for women (and other marginalized groups) became a hallmark of USPCASW.

Although at the end of the project, there were still differences in men's and women's access to campus resources, the fact that there are new formal – and informal – institutions to support gender equity suggests that a new way of thinking and doing has not only been cultivated but also has the governance structures to sustain it.

Table 11. Batch-wise student enrollment (MS and PhD).

	Female Students	Male Students	Total Students	Percent Female	Scholarship Funding
Fall 2015	12	36	48	25%	USAID
Fall 2016	13	26	39	33%	USAID
Fall 2017	20	28*	48*	42%	USAID
Spring 2018	21	32	53	40%	USAID
Fall 2018	21	42	63	33%	USAID
Subtotal	**87**	**164**	**251**	**35%**	**USAID**
Fall 2019	19	22	41	46%	MUET
Total at project closeout	**106**	**186**	**292**	**36%**	**USAID + MUET**

*Note: One student in Fall 2017 batch was on an externally funded scholarship. With that exception, all students of batches Fall 2015, Fall 2016, Fall 2017, Spring 2018, and Fall 2018 received 100% scholarship (tuition and full stipend), funded by USAID. For the Fall 2019 batch, all MS students received scholarship but with half-stipend, and PhD students received scholarship with full stipend, funded by MUET.

Board members, Ms. Khawar Mumtaz, [31] interacted with faculty and staff through video conferences, site visits to MUET and the U, and interaction with the MUET leadership. This coaching approach was spearheaded by the U Deputy Director and reinforced by the entire U-led team to raise awareness and change practices across the system – from staff, faculty, students, leadership, and stakeholders – and across the range of contexts and activities. In some cases, this was accomplished as learning-by-doing as the Center worked through issues or problems in a transparent way in faculty meetings (when appropriate), and other times this was accomplished through guidance to the USPCASW Project Director regarding how best to respond.

Modeling equity: The U-led team not only expressed the principle of gender equity; it modeled it by including women across many types of team roles (i.e., administrative staff, research mentors, course and workshop instructors, Executive Committee members, and Senior Advisory Board members). Several of the most engaged professors, staff, and graduate students for the faculty and student exchanges and mission programs were women – and their success in terms of teaching, research publications, and leadership highlights the value of having all people contribute to the academic endeavor.

Major Results and Outcomes

The actions for equity had several successes in terms of both participation and institutionalization.

- MUET was the first public sector university in Pakistan to adopt a campus-wide gender equity policy. As a result of this policy, many awareness-raising activities were carried out to disseminate information about the policy as well as the role of the Gender Equity Committee at the Center. The policy – and people's awareness of it – seem to have succeeded in

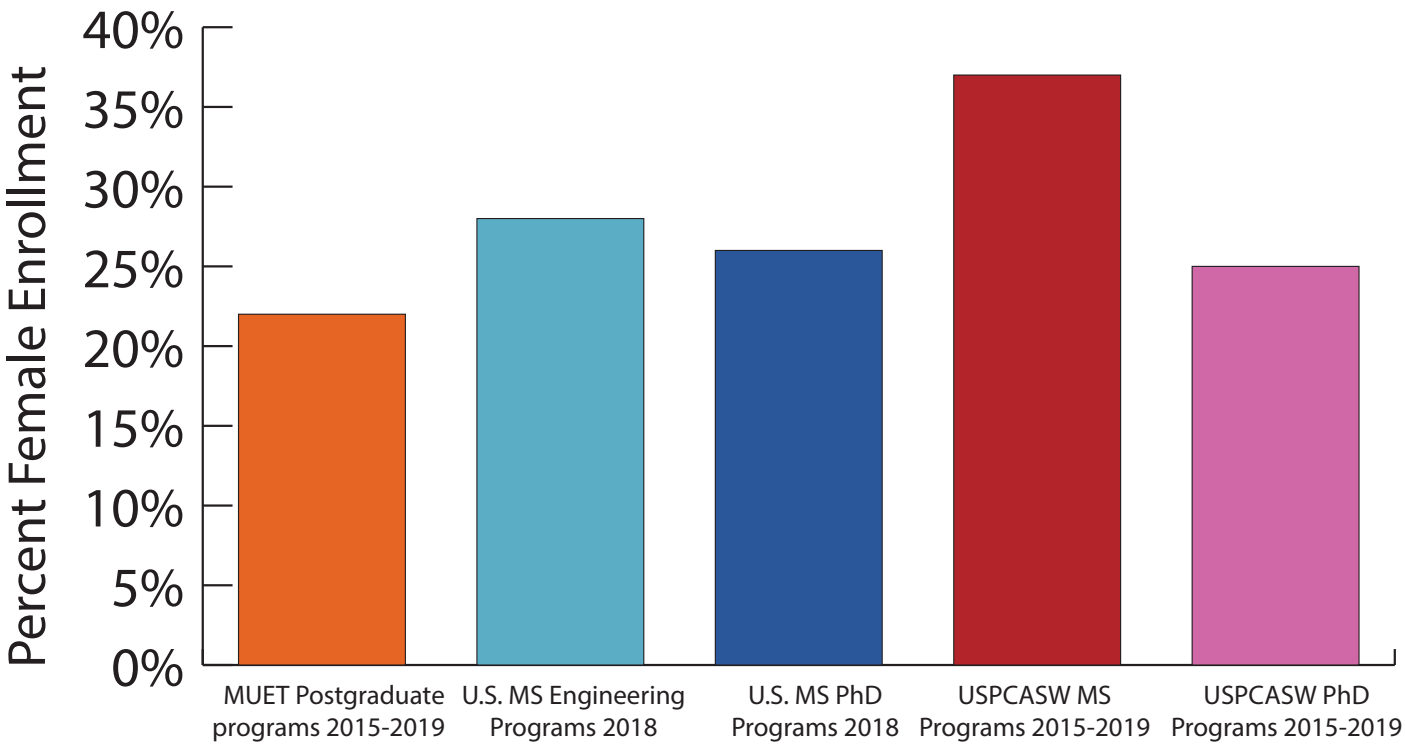


Figure 10.Comparison of enrollment of women in postgraduate degree programs at USPCASW, MUET, and the U.S. Note: Data on U.S. programs comes from Roy, J. (n.d.), "Engineering by the Numbers", American Society for Engineering Education, retrieved 3-11-2020 .

31 Ms. Khawar Mumtaz, a prominent women's rights activist and scholar, has been Chairperson of Pakistan's National Commission on the Status of Women since 2017.

Table 12.The percent of female graduates across each discipline.

Discipline	Graduates (Batch 2015)		Graduates (Batch 2016)		Overall Percent Female Graduates
	Female	Male	Female	Male	
EE	6	17	5	7	31%
HID	4	9	3	5	33%
IWRM	1	4	2	6	23%
WASH	NA	NA	3	3	50%
Total	11	30	13	21	32%

improving the overall environment for women at the Center; indeed, not a single case of sexual harassment was reported at USPCASW during the five years.

- The scholarships offered by the Center made it possible for the talented students, including those representing economically disadvantaged groups, to pursue graduate studies in water and acquire the relevant skills to meet the needs of government and the business community. All students received scholarships, including in Fall 2019 when scholarship funding shifted from USAID to MUET (Table 11).
- USPCASW gave admission to 119 women and 272 men, which means 30% of admitted students were women.
- In terms of enrollment before accounting for dropouts, 102 out of 333 (31%) were women.
- Eighty-three students dropped out of their degree programs; 15 of these were women (18%). This indicates that women dropped out at a lower rate than men did.
- Looking at all batches of students, 36% were women (Table 12), which is 14 percentage points higher than the MUET rate of 22% female enrollment for all postgraduate programs, thereby meeting the target that the percentage of female student participation should

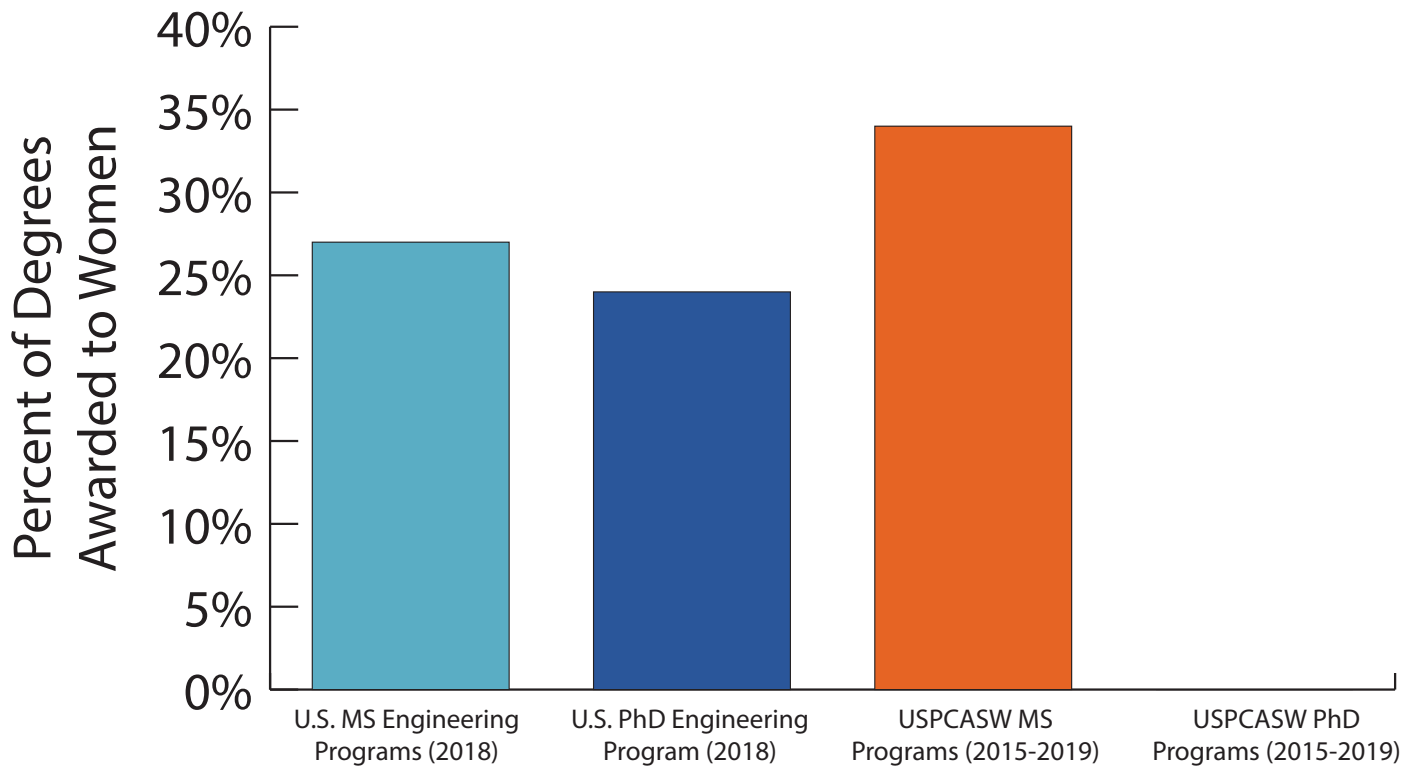


Figure 11.Comparison of number of MS and PhD degrees awarded to women at USPCASW and U.S. engineering programs. Note: Data on U.S. programs comes from Roy, J. (n.d.), "Engineering by the Numbers", American Society for Engineering Education, retrieved 3-11-2020.

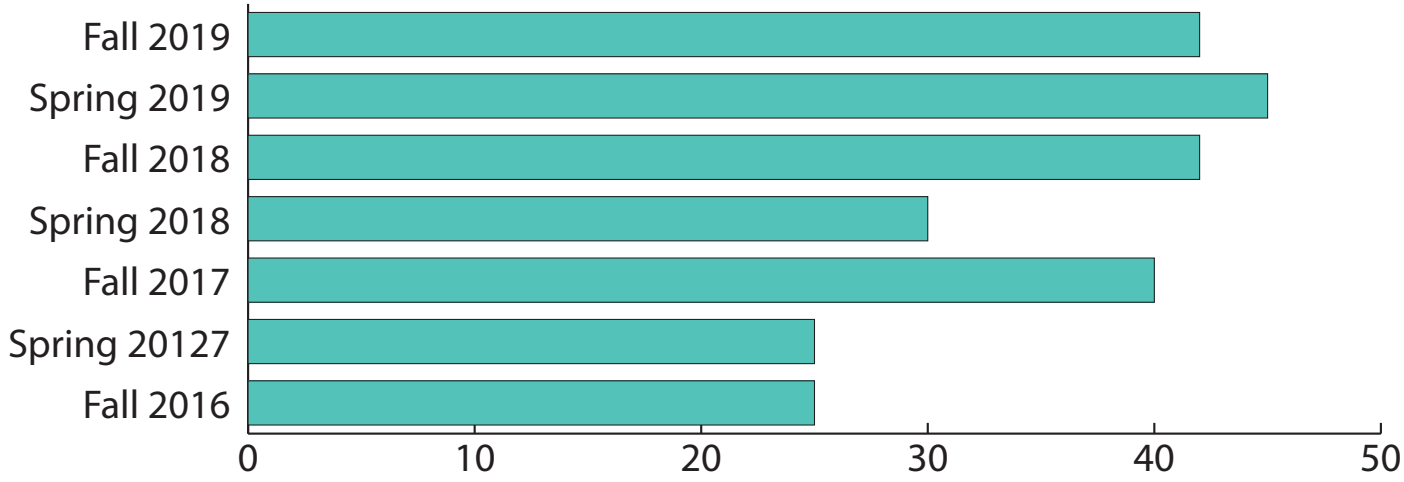


Figure 12. Percent of females in each student exchange cohort.

Table 13. Student enrollment, disaggregated by degree program and gender.

A. With USAID-funded scholarships

Discipline	MS Students			PhD Students			Total Students		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
HID	59	47	12	4	4	0	63	51	12 (19%)
ENV.ENG	84	57	27	9	7	2	93	64	29 (31%)
IWRM	40	29	11	6	5	1	46	34	12 (26%)
WASH	48	14	34	0	0	0	48	14	34 (71%)
Total	**231**	**147**	**84**	**19**	**16**	**3**	**250**	**163**	**87 (35%)**

B. With MUET-funded scholarships (half stipend for MS students, full stipend for PhD students)

Discipline	MS Students			PhD Students			Total Students		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
HID	10	8	2	3	1	2	13	9	4
ENV.ENG	13	8	5	2	1	1	15	9	6
IWRM	4	2	2	0	0	0	4	2	2
WASH	9	2	7	0	0	0	9	2	7
Total	**36**	**20**	**16 (44%)**	**5**	**2**	**3 (60%)**	**41**	**22**	**19 (46%)**

exceed by 15% the baseline rate of participation at MUET (with the objective of reaching 50% participation in CAS activities). This overall percentage is also higher than U.S. engineering programs, although the percent enrollment by women in the Center's MS programs is higher than for its PhD programs (Figure 9).

- Overall, 24 out of 75 (32%) degrees awarded went to women (Table 13), which is higher than for U.S. engineering programs (Figure 10), although again this pattern is being driven by the MS programs since no women had graduated with a PhD by December 2019.
- It is anticipated that in Spring 2020 there will be 32 female graduates (including 1 PhD) out of 76, representing 42% percent.
- The percent of faculty that was female fluctuated from year to year as both male and female faculty joined and left the Center. In the course of five years, eight female faculty members were employed by the Center. By comparison, over the same period, there were 21 male faculty members. This reflects 30% female faculty. At the project's end, the faculty included 5 females and 14 males – or 26% female participation – compared to 17% female facul-

ty (tenured/tenure-track) across engineering disciplines in the U.S. [32]
- Women were well-represented in each exchange cohort (Figure 11), especially considering the differences in enrollment between men and women at the Center at MUET (Table 14). Some exchange cohorts had 50% female representation.
- The GoS also was supportive of the broader mission of gender equity by giving approximately 1.45 million USD to build a women's hostel on campus that could accommodate the Center's female students and faculty.

Implementation Challenges and Constraints

There were several implementation challenges and major constraints. The most notable are described here.

The most significant challenge was the local context itself: MUET is a typical public sector university located in the interior of Sindh. Much of its faculty and administration also comes from rural Sindh where social norms and values are very different than those one might find in institutions located in Karachi, Lahore, or Islamabad. In other words, the way that people at MUET perceive gender equity and empowerment issues may be perceived (and addressed) differently than at urban universities in Pakistan, not to mention at U.S. universities.

The pipeline of female applicants for the four graduate programs presented a challenge for reaching the target goal of 50% female participation (i.e., fewer women than men took the admission test). This project did not –nor could it – address the pipeline problem even though it was a major constraint on achieving the target. The U-led team did support outreach efforts to increase applications from women.

The U-led team was never able to identify an effective U.S.-based "lead" to advance the gender equity component from the technical assistance side, although as mentioned before, the U PMU played an important role. Over the years different individuals played different roles, but in general the equity component did not receive the depth, breadth, and consistency of technical/advisory support for programming and activities that the other components did.

Gender Empowerment Workshop

On the MUET side, similarly there was never a strong leader for gender equity, although the Gender Equity Committee and the Gender Focal Person – did initiate and organize activities in an ad-hoc manner to raise awareness (e.g., co-ed sporting events; art competition; see Highlight Box 18).

Despite taking clear steps to recruit female faculty, the Center struggled to find and retain qualified female faculty.

The stipends for the Fall 2019 batch of students were reduced to 50% for MS students due to insufficient funds to provide full stipends. The impact of this on enrollment by economically disadvantaged students is not known since no data on this was collected (see footnote 32). However, it does not appear to have negatively affected female participation since the

32 Data on U.S. programs mentioned in this section come from Roy, J. (n.d.), "Engineering by the Numbers", American Society for Engineering Education, retrieved 3-11-2020 from https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf.

Fall 2019 batch is 43% female – a record so far.

The WRC was officially established, but it seems that the university administration never had a vision for the Center to have a standout leader who could drive a strong agenda forward (e.g., writing major grant proposals to fund activities and gender-related research). An attempt was made to recruit a lower level "coordinator" to help manage activities, but even that position was never filled. Female interns and the USPCASW Gender Equity Committee (with both female and male members and led by a Gender Focal Person) played key role in keeping the WRC alive and incrementally building it in a grassroots way.

A major challenge across the entire project was overcoming institutional and social norms, many of which were beyond reach and certainly out of control of the U-led team's interventions. The U-led team strived to strike an appropriate balance between supporting initiatives for gender equity and respecting local social norms. Perhaps this balance was not struck at the right place since at the end of the project, there were still differences in men's and women's access to learning resources on campus (see Case Study 8) – and female students and faculty still expressed frustration with elements of the Center's work and learning environment.

Missed Opportunities

Engaging students and their families: The backdrop to the gender equity activities was that the university administration seemed fearful that some parents would object to certain "progressive" policies. Therefore, one missed opportunity was to arrange a meeting with parents to respond to any concerns they might have and to give them a tour of the campus and Center facilities. USAID mentioned this as something that could be a valuable opportunity to build bridges and create a more supportive community – but the teams were never able to organize such an event. However, a more significant missed opportunity was to initiate (or better yet, institutionalize) a committee consisting of students, parents, and university administrators. This committee could have met once in each quarter to find and implement a reasonable balance between the university's policies, students' freedom, and parents' reservations.

Career outreach for women: The WRC never developed proper professional development support or outreach programs for women at MUET. The fact that unemployment rates for female alumni of the Center are higher than for male alumni of the Center suggests such a program would be of great value in bridging the gap. Such a program could have been initiated but was not – and this is in spite of the recommendation by MSI's midterm evaluation that all the CAS invest in establishing Career Centers to facilitate job placement.

Delivery of more gender equity training: The U-led team regularly invited female faculty to MUET to deliver technical training, but, outside of coaching, the missions ceased to include a strong gender equity capacity building component after 2016. Clearly this was a missed opportunity for ongoing sexual harassment awareness sessions and dialogues on topics such as women researchers "in the field."

Greater focus on broader social inclusion: Although the U Deputy Director provided coaching on inclusiveness in terms of religion, geographical origin, etc., the project team focused more institutional development effort on addressing the gender equity challenge. With that said, even though the percent of students from provinces other than Sindh was not very high (approximately: Sindh 90%, Punjab 4%, Khyber Pakhtunkhwa 2%, Gilgit Baltistan 3%, Balochistan 1%), in the local context this 10% carried symbolic significance of inclusiveness.

Lessons Learned

Diversity in support of diversity matters: One of the most straightforward ways for an organization to demonstrate its commitment to diversity is for it to be diverse. For example, it seems that having a diverse faculty helped recruit diverse students (e.g., a faculty member from Gilgit-Baltistan encouraged students from this province to come to the Center). Moreover, female faculty and students were some of the most outspoken members of the Center, and they contributed greatly to generating the social norms that supported equity. The Center could aim to increase the diversity of its faculty, especially to include senior female faculty as well as more faculty from different provinces and ethnic groups. Although there is a challenge in terms of finding qualified female candidates due to the aforementioned pipeline issue, a stronger outreach to "head hunt" top candidates might improve outcomes.

Female representation on all mission teams and across all disciplines and ranks matters: Many excellent researchers are women – and they should be intentionally included on technical mission teams. Not only does their inclusion mean that young women have role models to look up to, but also that senior male faculty have female counterparts who they interact with as intellectual and social equals.

Having strong male "allies" matters: Just as it is important that young women have strong female role models, it is also important that men have male role models who advocate for gender equity. Having high-ranking, senior Pakistani men (i.e., Dr. Tariq Banuri and Dr. Aslam Chaudhry) as the strongest and most vocal advocates for women's rights was significant. It "normalized" the principles of gender equity and social inclusion. Their advocacy contributed greatly to creating a safe space for everyone at the Center, as did the efforts of those male faculty and students who were also strong allies.

Cultural competence matters: Every culture has its own beliefs, customs, and social norms about how people should interact with each other. It is very important to have international team members who are sensitive to the local cultural context and can be allies for women's empowerment in ways that are respectful of general community values.

Student Success Story: Vengus Panhwar

Photo: Panhwar (right) with fellow students on the U.S. Exchange Program.

Vengus Panhwar (Batch 2016) completed her master's degree in Integrated Water Resources Management and was awarded the Certificate of Excellence for her extraordinary performance during her master's study. Similarly, she was recognized as a top student during the semester exchange program to Utah, where she received three awards: Cultural Diplomat, Best Writer, and a Certificate of Distinction.

As a researcher she has excelled in presenting, publishing, and collaborating. Panhwar published one journal paper and three conference papers during her two years of study with the Center. After graduation she has continued to be engaged with several research projects at the Center as a Research Associate and is planning to pursue an international PhD.

Outside of research, Panhwar has been involved in various activities in the Center, including active membership in the Society of Water Managers and work as a trainer in Training on Application of Geospatial Techniques in Hazard and Disaster Management at COMSATS Abbottabad, which was organized by USPCASW.

(For full story, see USPCASW Website).

Holistic, merit-based selection processes matter: Selection for the U.S. exchange program was based on merit and alignment with research mentors. However, the selection process evolved over time and shifted away from a purely quantitative approach based on grades and attendance rates to a more qualitative and holistic approach that weighted research more heavily. This shift in selection criteria and process occurred because many students were coming on the exchange with insufficient technical preparation or research alignment to take full advantage of the opportunities available. An important observation is that this shift towards research alignment and thesis progress seemed to, if anything, improve women's acceptance rates into the exchange program (Figure 11). This suggests that introducing more holistic assessments for student evaluation may reduce gender disparities.

Job placement support matters: Women face many barriers to entering the workforce, especially in engineering fields involving field-based work (e.g., irrigation). Although the Center's dropout rate for women is lower than for men, the employment rate of female graduates is also lower. The WRC should emphasize creating a network of professional women who can mentor others and help connect graduates to employment opportunities. This kind of social capital tends to be unevenly distributed among students and having a Career Center to facilitate job placement would help less advantaged students succeed.

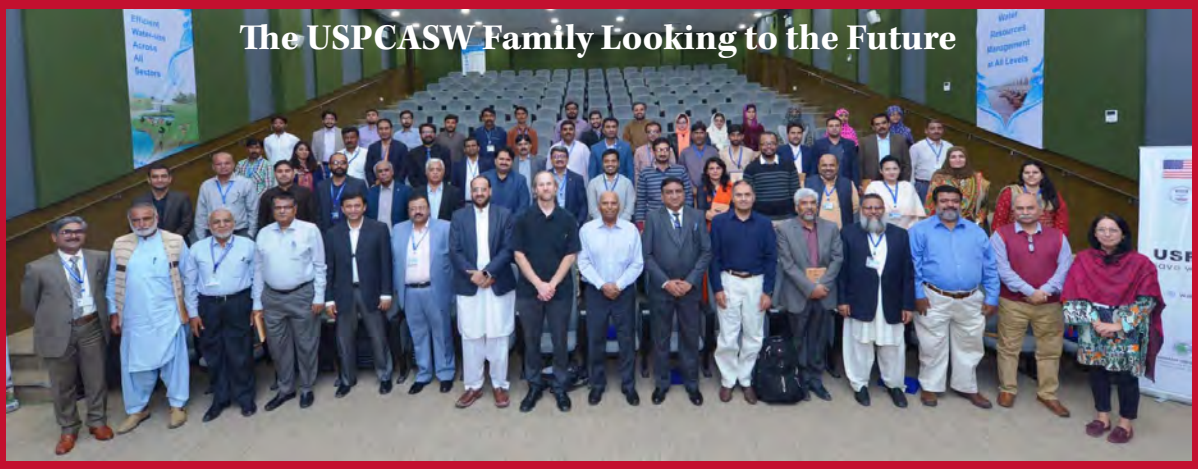
Concluding Thoughts

By all accounts, the Center had created a much more inclusive and equitable environment than characterized the rest of MUET. Indeed, it was generally seen as having a different kind of environment – one that was supportive of women's success and tried to hold men accountable for their bad behavior towards women. However, a great deal of work remains, especially in continuing to reinforce the social norms – and enforce formal policies – to protect women from harassment and foster an enabling working and learning environment for everyone.

The role that the WRC will play in promoting gender equity in the years to come will be partially determined by the attitude of the MUET VC. If the attitude is that the WRC is critically important, then it will receive the budget support it needs for staff and activities. The GEP was adopted campus-wide, and the WRC is the institution tasked with seeing that it is fully implemented. After much persistence, the WRC was taking root institutionally by the end of the project. It will likely be sustained in 2020, but whether it will thrive or wither as the years proceed is hard to say.

"On my Exchange, I worked in Dr. Jennifer Weidhaas' Environmental Microbiology Lab Microbiology Lab. I learned many new things related to media preparation, culturing of bacteria, DNA extraction, and tests using PCR, QPCR Gel electrophoresis. I also learned basic lab skills like usage of Autoclave and DNA Kit. An important part of my learning was 2 lab safety trainings that helped me to be more careful in the lab."

- Sadaf, USPCASW Exchange Scholar



Conclusion

The USPCASW project was a grand experiment. Armed with a structured approach from USAID, a fully-invested MUET (see Highlight Box 19), guidance from HEC, an energized water sector in Sindh, and an international team of committed experts, the U-led team implemented an ambitious program to help build and sustain USPCASW. The project team's intellectual curiosity and adaptive learning mindset combined with the flexibility inherent in the USAID project delivery mechanism propelled USPCASW to achieve its objectives and targets. The project activities translated to impact, the team's reflection translated to insight, and the human approach to the project led to long-term relationships. **USPCASW was a successful project in terms of meeting its targets agreed in the CA, fostering impact, seeding systemic change, delivering models for a research center and its activities, and laying the foundation for a long-term Center for Advanced Studies in Water.**

The success of the USPCASW project will ultimately be measured by the cascading impact of the students, faculty, and staff engaged in its creation and growth – in Pakistan and in the U.S. At this point, USPCASW has delivered a sizeable number of highly trained water sector professionals entering the workforce or pursuing a PhD degree internationally. These professionals have the necessary technical background and a unique combination of mindset, motivation, and inspiration to tackle the water sector challenges. The career impact of these, and subsequent graduates and trainees, will be tremendous in terms of planning, designing, constructing, operating, and maintaining sociotechnical water systems for a wide array of purposes. The current, and past, USPCASW professors, administrators, and staff have grown enormously in ways that cannot be measured. Their outlook and approach have shifted through their involvement with the creation of USPCASW. They are equipped with the foundational skills and more importantly the resilience to overcome roadblocks as they advance research in higher education to help Pakistan achieve water sustainability. The U.S. participants and institutions involved in creating and supporting USPCASW also will carry forward the impacts from the project. Sustained interaction with USPCASW, new ventures, and sharing of knowledge and experiences from USPCASW with others will extend and multiply the U.S. partner impact at MUET, in Pakistan, and around the world. Finally, stakeholders in business, government, and civil society that have interacted with USPCASW have built partnerships, initiated collaborations, and generated ideas that will carry forward the impact (see Annex 24 for institutional partnerships; see Annex 25 for contacts). By personal accounts, the USPCASW team and stakeholders in Pakistan and in the U.S. were inspired in ways that cannot be easily measured and cannot be observed except over the long term.

The project was highly successful in many ways. However, it had numerous missed opportunities and many important lessons were learned, the most important of which were highlighted in this final report. Reflecting more globally about the project, local solutions to water problems require diverse perspectives, coordinated cross-sector engagement in public works projects, and time. Similarly, three critical overarching constraints on the project - the lack of interdisciplinary perspectives, lack of coordination as part of a cross-sector public works project team, and insufficient time - ultimately reduced the impact and potential of USPCASW.

First, USPCASW did not engage sufficient expertise from the range of disciplines needed to solve water problems holistically. At the outset, the setup of USPCASW had inherited design problems in terms of underestimating the extent of the interdisciplinary dimension of the water grand challenge. From the start and throughout the project, the U-led team tried to broaden participation to the necessary levels. Solving Pakistan's water problems requires engineers, planners, policy makers, physical and social scientists, community organizers, humanists, public health professionals, and others to work together. This massively-broad disciplinary participation was the way the technical assistance from the U-led team was designed: to cover engineering, health sciences, law and policy, economics, social sciences, and more. Although the U proposal articulated this sociotechnical vision and team structure, it was not conceived in the project design and the involvement of the comprehensive set of disciplines throughout the project was in the end limited on the Pakistan side. The second overarching shortcoming of USPCASW

was the limited ability to get involved in large-scale water projects that could have served as learning opportunities, research testbeds, and long-term partners across the life-cycle of the project. USPCASW pursued these opportunities in Jacobabad, the barani areas in Punjab, the KPK, Sindh, and Balochistan. Success was found in Sindh in several projects, but not in other areas. Even in Sindh the success was limited in terms of USPCASW being fully engaged in the public works project. Part of the reason for this failure lies with the USPCASW and U-led team not finding and cultivating the right partnerships with the right projects. However, part of the failure also lies with USAID and the inability to connect USPCASW in logical ways with USAID infrastructure projects. Opportunities were explored with the drinking water projects and health clinic in Jacobabad, schools in Sindh, and water management in KPK. But in each case the entities and people responsible for implementing these projects were surprisingly not open to USPCASW becoming involved and USAID could not capitalize on this opportunity. With foresight and pre-planned coordination, USAID could have created opportunities for USPCASW to get engaged in large-scale public works projects setting an example and further nurturing (and taking advantage of) their investment. Moreover, USAID could have streamlined the effort and extended the impact by engaging HEC to seek synergistic opportunities to involve the three CAS programs in these projects.

The third critical element that limited the success of the project was time. The time allocated for this project was half of what should have been provided for the establishment of a major university research center. Consider the standard for the National Science Foundation and the National Institutes of Health, in the U.S.: major research centers receive five years of initial funding and five years of follow-on funding—and the baseline for those efforts is much higher than what was encountered in Pakistan. Even without an increase in funding allocation, USAID should

HIGHLIGHT 19: Institutional Commitment Drives Success



From the first interaction to the final mission visit to Pakistan, the commitment of MUET leadership to the project was critical. Project Director Dr. Bakhshal Lashari set the tone for the USPCASW faculty, staff, and students leading to enthusiastic participation in activities, receptivity to new ideas, and warm hospitality for each and every visitor to Pakistan. All visitors to Pakistan from the U-led team were energized by the kindness of Dr. Lashari and his team, which contributed to their interest to continue to engage in the project and return to Pakistan.

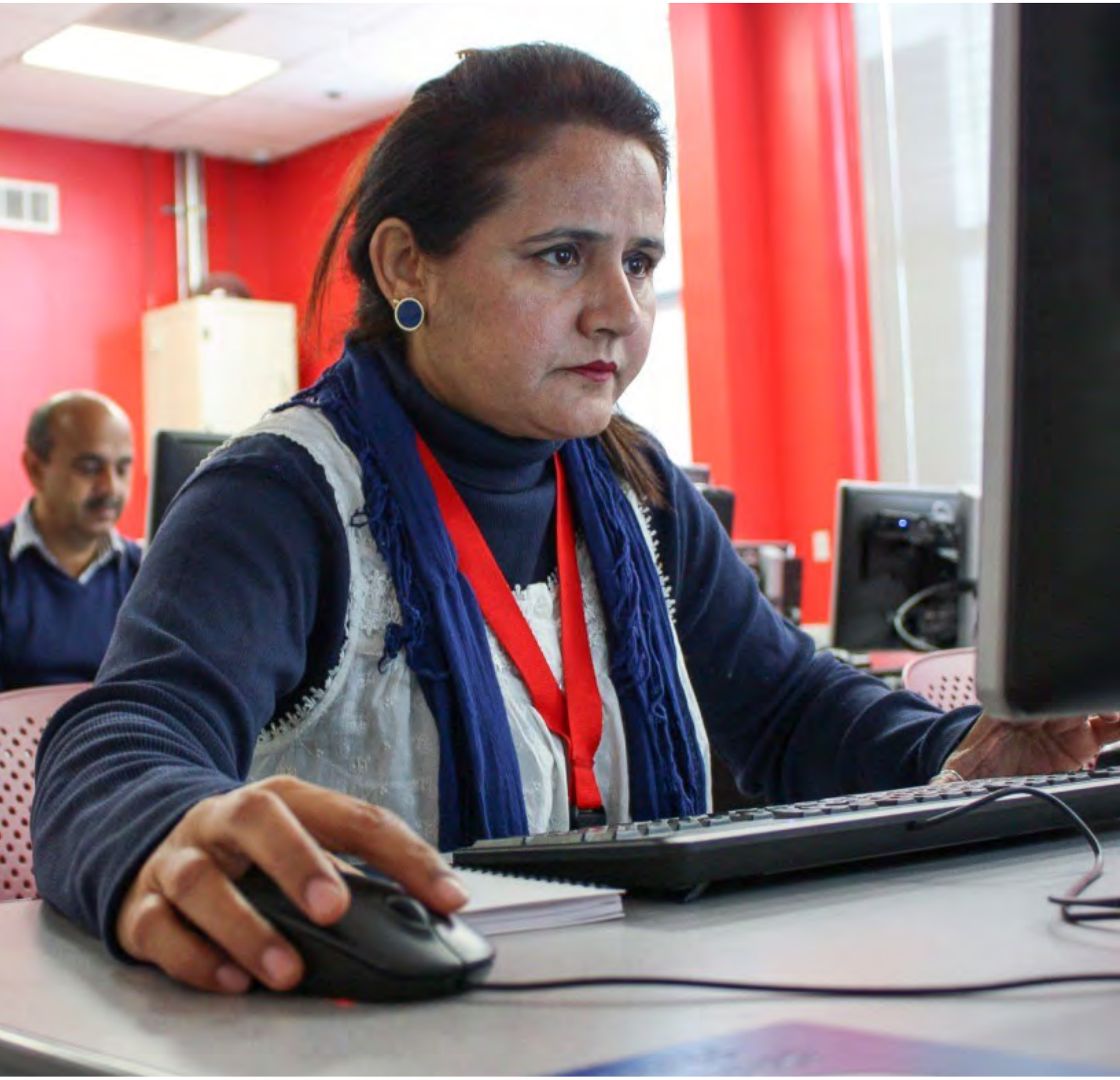
Dr. Lashari's dedication to the project was equaled by MUET Vice Chancellor Dr. Muhammad Aslam Uqali who helped in translating USPCASW ideas into institutional policies and practices. His notable contributions towards transforming the USPCASW from a project to an institution included providing a building to the Center in its first three years when its own building was being constructed, construction of a women hostel, advancing gender equity agenda, and regularization of the faculty, among others.

This multi-level commitment was critical for USPCASW to gain traction as a start-up, grow with few constraints, and establish a firm foundation for sustainability. This institutional commitment was not lost on senior administrators at the U, CSU, and UNLV who responded in kind with commitments and support for faculty and staff involvement in activities.

have set the time duration of the project longer. At the end of five years, a no cost extension with mutually agreed benchmarks could have been a plausible option.

In the end, USPCASW is a huge success on many levels. But most importantly, it changed the culture of the faculty, staff, and students engaged at one of the leading universities in the country. It changed the mindset of the leadership at MUET in the present and likely influenced those that will lead the institution in the future. It influenced the outlook, policies, and practices at industry, government, and civil society partners, and the HEC. And it sprouted dedicated relationships with international institutional and individual partners. Indeed, **the entire community of practice advancing water sustainability has shifted from resigning to live with the water problems in Pakistan to rising up together to meet the challenges and develop solutions**.

In summary, the shortcomings can all be addressed and the successes can all be extended in the continued growth of USPCASW and future USAID higher education projects of this nature. USPCASW scratched the surface of what is needed by creating one research center at one engineering and technology higher education institute. Looking to the next steps, the U-led team remains committed alongside MUET to perpetuating USPCASW into the future and expanding the reach to other institutions in Pakistan and around the world. Working with the HEC, USAID, the broader international donor community, government and industry partners, and others, the success of USPCASW will sustain.



"I am thankful to USAID for providing me a wonderful exchange opportunity to visit the University of Utah. When I arrived at Utah, I struggled to understand the American accent. With the help of my Utah teachers and mentors, I gradually improved my understanding as well as improved my ability to speak with them. I learned many things in my class, research training, seminar, and other activities. And I experienced many new things on field trips, culture events, hiking in mountains, ice skating, and much more that made my trip unforgettable."

- Anila Memon USPCASW Exchange Scholar

Annexes

Annex 1. Project team (2014-2019)

The table lists all faculty, staff, and students that contributed time and effort to the USPCASW project. (Titles and departments reflect roles on this project and are not necessarily current.)

NAME	TITLE	DEPARTMENT	INSTITUTION
Abushan Achhami	Graduate Research Assistant	Civil and Environmental Engineering	UNLV
Sajjad Ahmad	Professor	Civil and Environmental Engineering	UNLV
Allan Andales	Professor	Irrigation and Water Science	CSU
Connor Arrington	Graduate Research Assistant	College of Law	UU
Ryan Bailey	Associate Professor	Civil and Environmental Engineering	CSU
Tariq Banuri	USPCASW Associate Director, Professor	Economics	UU
Mike Barber	Department Chair, Professor	Civil and Environmental Engineering	UU
Jeff Bates	Assistant Professor	Materials Science and Engineering	UU
Scott Benson	Associate Professor	Family and Preventive Medicine	UU
Rick Bereit	Writing Instructor	Civil and Environmental Engineering	UU
Haimanti Bhattacharya	Associate Professor	Economics	UU
Stacey Board	Administrative Program Coordinator	U Water Center	UU
Gabe Bowen	Associate Professor	Geology and Geophysics	UU
Zak Breckenridge	Writing Instructor	Civil and Environmental Engineering	UU
Simon Brewer	Associate Professor	Geography	UU
Paul Brooks	Professor	Geology and Geophysics	UU
AJ Brown	Graduate Research Assistant	Civil and Environmental Engineering	CSU
Saria Bukhary	Graduate Research Assistant	Civil and Environmental Engineering	UNLV

Steve Burian	U Water Center Dir, USPCASW Project Director, Professor	Civil and Environmental Engineering	UU
Krista Carlson	Assistant Professor	Metallurgical Engineering	UU
Aslam Chaudhry	USPCASW Chief of Party, Deputy Project Director, Professor	Economics	UU
Imran Chaudhry	Graduate Research Assistant	Civil and Environmental Engineering	UU
Jose Chavez	Associate Professor	Civil and Environmental Engineering	CSU
Brian Craig	Graduate Research Assistant	Civil and Environmental Engineering	CSU
Robin Craig	Professor	College of Law	UU
Cheri Daily	Director, External Relations and Global Programs	Office for Global Engagement	UU
Susan De Long	Associate Professor	Civil and Environmental Engineering	CSU
Jonathan Duncan	Communication Specialist	U Water Center	UU
Tim Edgar	Associate Instructor	Geography	UU
Rick Forster	Professor	Geography	UU
Josh Garn	Assistant Professor	School of Community Health Sciences	UNR
Tim Gates	Professor	Civil and Environmental Engineering	CSU
Ramesh Goel	Professor	Civil and Environmental Engineering	UU
Caleb Griffin	Writing Instructor	Civil and Environmental Engineering	UU
Neil Grigg	Professor	Civil and Environmental Engineering	CSU
Rod Handy	Professor	Family and Preventive Medicine	UU
Linda Hinshaw	Coordinator	Civil and Environmental Engineering	CSU
Jim Ippolito	Associate Professor	Soil and Crop Sciences	CSU
Trevor Irons	Research Assistant Professor	Civil and Environmental Engineering	UU
Yusuf Jameel	Graduate Research Assistant	Geology & Geophysics	UU

Rubayat Jamal	Graduate Research Assistant	Civil and Environmental Engineering	UU
Bill Johnson	Professor	Geology & Geophysics	UU
Matt Kosko	Graduate Research Assistant	Economics	UU
Nir Krakauer	Associate Professor	Civil Engineering	CUNY
Tarendra Lakhankar	Assistant Professor	Civil Engineering	CUNY
Mallory Leatham	Assistant Professor	Family and Preventive Medicine	UU
Joshua Lenart	Associate Instructor	Engineering	UU
Jiada Li	Graduate Research Assistant	Civil and Environmental Engineering	UU
Ming Li	Finance & Grants Manager	U Water Center	UU
Jewell Lund	Graduate Research Assistant	Geography	UU
Rehman Lund	Graduate Research Assistant	Civil and Environmental Engineering	CSU
Hammad Malik	Graduate Research Assistant	Metallurgical Engineering	UU
Dan McCool	Professor	Political Science	UU
Luther McDonald	Assistant Professor	Civil and Environmental Engineering	UU
BJ McPherson	Professor	Civil and Environmental Engineering	UU
Shelley Minteer	Professor	Chemistry	UU
Gaurang Mistry	Graduate Research Assistant	Civil and Environmental Engineering	UNLV
Peter Nelson	Associate Professor	Civil and Environmental Engineering	CSU
Carlos Oroza	Assistant Professor	Civil and Environmental Engineering	UU
Christine Pomeroy	Associate Professor	Civil and Environmental Engineering	UU
Kristina Quynn	Assistant Professor	Graduate School	CSU
Ahmed Rafique	Graduate Research Assistant	Civil and Environmental Engineering	UU
Khawar Riaz	Graduate Research Assistant	Civil and Environmental Engineering	UU

Pratt Rogers	Assistant Professor	Metallurgical Engineering	UU
Shad Roundy	Professor	Mechanical Engineering	UU
John Ruple	Research Professor	College of Law	UU
Summer Rupper	Associate Professor	Geography	UU
Rubab Saher	Graduate Research Assistant	Civil and Environmental Engineering	UNLV
Sierra Quinn Sahulka	Graduate Research Assistant	Civil and Environmental Engineering	UU
Cecily Sakrison	Communication Specialist	U Water Center	UU
Joe Scalia	Associate Professor	Civil and Environmental Engineering	CSU
Karlene Schindler	Coordinator	Civil and Environmental Engineering	CSU
Sailuj Shakya	Graduate Research Assistant	Civil and Environmental Engineering	UNLV
Pat Shea	Associate Instructor	Biology	UU
Sangmin Shin	Postdoctoral Researcher	Civil and Environmental Engineering	UU
Geoff Silcox	Professor	Chemical Engineering	UU
Maya Silver	Writing Instructor	Civil and Environmental Engineering	UU
Kip Solomon	Professor	Geology and Geophysics	UU
Amanda Smith	Assistant Professor	Mechanical Engineering	UU
Haroon Stephen	Associate Professor	Civil and Environmental Engineering	UNLV
Davey Stevenson	Communication Specialist, Engagement Specialist	U Water Center	UU
Court Strong	Associate Professor	Atmospheric Science	UU
Windy Tanner	Assistant Professor	Family and Preventive Medicine	UU
Kazi Tamaddun	Graduate Research Assistant	Civil and Environmental Engineering	UNLV
Saman Tavakoli	Postdoctoral Researcher	Civil and Environmental Engineering	CSU

Jeff Ullman	Technical Advisor	U Water Center	UU
Jim VanDerslice	Interim Chief, Associate Professor	Family and Preventive Medicine, Division of Public Health	UU
Karan Venayagamoorthy	Professor	Civil and Environmental Engineering	CSU
Mercedes Ward	Institutional Dev Advisor, Research Assoc, M&E Specialist	U Water Center	UU
Reagan Waskom	Director	Colorado Water Institute and Water Center	CSU
Dennis Wei	Professor	Geography	UU
Jennifer Weidhaas	Associate Professor	Civil and Environmental Engineering	UU
Yangyi Wu	Graduate Research Assistant	Geography	UU
Darrin Young	Professor	Civil and Environmental Engineering	UU
Shundana Yusaf	Associate Professor	School of Architecture	UU
Azhar Zaheer	Entrepreneurship Specialist	U Water Center	UU

Annex 2. Reports and outreach products

Progress and Planning Reports

Title	Submission/ Publication Date	Publication Type
Quarterly Progress Reports		
QPR2 FY15 (Jan-Mar 15)	April 15, 2015	Quarterly Progress Report
QPR3 FY15 (Apr-Jun 15)	July 30, 2015	Quarterly Progress Report
QPR4 FY15 (Jul-Sep 15)	October 29, 2015	Quarterly Progress Report
QPR1 FY16 (Oct-Dec 15)	January 15, 2016	Quarterly Progress Report
QPR2 FY16 (Jan-Mar 16)	April 29, 2016	Quarterly Progress Report
QPR3 FY16 (Apr-Jun 16)	July 29, 2016	Quarterly Progress Report
QPR4 FY16 (Jul-Sep 16)	October 30, 2016	Quarterly Progress Report
QPR1 FY17 (Oct-Dec 16)	January 31, 2017	Quarterly Progress Report
QPR2 FY17 (Jan-Mar 17)	April 30, 2017	Quarterly Progress Report
QPR3 FY17 (Apr-Jun 17)	July 31, 2017	Quarterly Progress Report
QPR4 FY17 (Jul-Sep 17)	October 31, 2017	Quarterly Progress Report
QPR1 FY18 (Oct-Dec 17)	January 31, 2018	Quarterly Progress Report
QPR2 FY18 (Jan-Mar 18)	April 30, 2018	Quarterly Progress Report
QPR3 FY18 (Apr-Jun 18)	July 31, 2018	Quarterly Progress Report
QPR4 FY18 (Jul-Sep 18)	October 25, 2018	Quarterly Progress Report
QPR1 FY19 (Oct-Dec 18)	January 31, 2019	Quarterly Progress Report
QPR2 FY19 (Jan-Mar 19)	April 30, 2019	Quarterly Progress Report
QPR3 FY19 (Apr-Jun 19)	July 31, 2019	Quarterly Progress Report
QPR4 FY19 (Jul-Sep 19)	October 31, 2019	Quarterly Progress Report
QPR1 FY20 (Oct-Dec 19)	January 31, 2020	Quarterly Progress Report
Annual Progress Reports		
USPCAS-W UU Annual Report 2015	March 16, 2016	Annual Progress Report
USPCAS-W UU Annual Report 2016	March 15, 2017	Annual Progress Report
USPCAS-W UU Annual Report 2017	March 17, 2018	Annual Progress Report
USPCAS-W UU Annual Report 2018	March 17, 2019	Annual Progress Report
USPCAS-W UU Annual Report 2019	March 16, 2020	Annual Progress Report
After Action Reports		
November 2015 Outreach Activity Report	November 25, 2015	After Action Report
October 2016 Mission Report	November 10, 2016	After Action Report
August 2017 Mission Report	August 24, 2017	After Action Report
Fall 2017 Research Visit Report	January 8, 2018	After Action Report
December 2017 Mission Report	December 22, 2017	After Action Report
December 2018 Mission Report	December 22, 2018	After Action Report
Dec 2018 CSU Mission Report	January 11 2019	After Action Report
March 2019 Mission Report	March 14, 2019	After Action Report
March 2019 Mission 2 Report	March 30, 2019	After Action Report
August 2019 Mission Report	August 29, 2019	After Action Report
November 2019 Mission Report	November 20, 2019	After Action Report

Market Studies		
Assessing Relevance of CAS-W Program Outputs to Sector/ Industry Needs	November 2, 2018	Market Study
Sustainability and Transition Reports		
Sustainability Plan	September 30, 2018	Strategic Planning Report
Project Closeout Plan	July 30, 2019	Planning Report
Sustainability & Transition Plan	September 30, 2019	Strategic Planning Report
USPCASW Competency Statement	November 29, 2019	Marketing
Final Report		
USPCASW Final Report	March 16, 2020	Final Report

Communication & Outreach Reports

Title	Publication Date	Type
USPCAS-W: Pat Shea on Pakistan - Spring 2016	June 16, 2016	Video
U.S.-Pakistan Center for Advanced Studies in Water | Water Security for the 21st Century	Oct 8, 2018	Video
Spring 2019 Exchange | Southeast Utah Field Trip	May 30, 2019	Video
Fiza Mansoor, Spring 2019 Exchange #TestimonialTuesday	November 8, 2019	Video
Nayyab Agha, Summer 2019 Exchange #TestimonialTuesday	December 17, 2019	Video
USPCASW Eblast, Monthly/Quarterly Updates (9 issues)	June 2015 – June 2016	Newsletters
Visiting Faculty Update, Weekly Updates (14 Issues)	January 2016 – April 2016	Newsletters
Fall 2016 Exchange, Weekly Updates (13 Issues)	August 2016 – January 2017	Newsletters
Spring 2017 Exchange, Weekly Updates (9 issues)	January 2017 – April 2017	Newsletters
Fall 2017 Exchange, Weekly Updates (12 issues)	September 2017 – November 2017	Newsletters
Spring 2018 Exchange, Weekly Updates (14 issues)	January 2018 – April 2018	Newsletters
Summer 2018 Exchange, Weekly Updates (6 issues)	June 2018 – August 2018	Newsletters
Fall 2018 Exchange, Weekly Updates (11 issues)	August 2018 – December 2018	Newsletters
Spring 2019 Exchange, Weekly Updates (13 issues)	January 2019 – April 2019	Newsletters
Summer 2019 Exchange, Weekly Updates (10 issues)	May 2019 – August 2019	Newsletters
Fall 2019 Exchange, Weekly Updates (14 Issues)	August 2019 – November 2019	Newsletters

USPCASW Water in the World (3 Issues)	October 2018, February 2019, May 2019	Newsletter
USPCASW Making Waves	December 2018	Newsletter
What is PCASW	May 2015	Trifold Brochure
What is USPCASW Flyer | Research, Education, Innovation, Equity	May 2017	One Sheet Flyers
Pakistan Water History	December 12, 2019	Web Portal
USPCASW Reflections	March 16, 2019	Picture Book
USPCASW Through the Years	March 16, 2019	Picture Book

Self-Assessment (Internal) Reports

Title	Availability	Type
Ad-Hoc Assessments		
Evaluation of Pre-Admission Communication and Orientation Experience	August 31, 2015	Survey Report
USPCASW Student Feedback on the Experience of First Week	September 7, 2015	Survey Report
Summary of Annual Feedback Survey	July 1, 2016	M&E Memo
Internal Assessment of Course Mentoring Program	November 27, 2017	M&E Report (using primary and secondary longitudinal data)
Summary of Focus Group with New USPCASW Faculty Hires	April 23, 2018	M&E Memo
Exchange Program Feedback		
Fall 2016 Exchange Program Feedback	After Program	Survey Report
Spring 2017 Exchange Program Feedback	After Program	Survey Report
Fall 2017 Exchange Program Feedback	After Program	Survey Report
Spring 2018 Exchange Program Feedback	After Program	Survey Report
Fall 2018 Exchange Program Feedback	After Program	Survey Report
Spring 2019 Exchange Program Feedback	After Program	Survey Report
Summer 2019 Exchange Program Feedback	After Program	Survey Report
Fall 2019 Exchange Program Feedback	After Program	Survey Report
Mission and Workshop Feedback		
July-August 2015 Mission		
End of Mission Survey Results	August 18, 2015	Survey Report
December 2015 Mission		
Seminar Evaluation (Graduate Students)	December 30, 2015	Survey Report
Research Workshop	January 7, 2016	Survey Report
Effective Teaching Boot Camp	December 2015	Survey Report
Entrepreneurship and TVC Workshop	December 2015	Survey Report
May 2016 Mission		
Summary of May 2016 Mission Evaluations	May 31, 2016	M&E Memo

July-August 2016 Mission		
Summary of Effective Teaching Workshop and Research Coordination Workshop Evaluations	October 23, 2016	M&E Memo
December 2016 Mission		
Summary of December 2016 Mission Evaluations	January 12, 2017	M&E Memo
May 2017 Mission		
Climate Vulnerability Training Evaluation Summary	June 7, 2017	Survey Report
Flipped Classroom Training Evaluation Summary	June 7, 2017	Survey Report
August 2017 Mission		
Workshop Feedback Summary	August 16, 2017	Survey Report
December 2017 Mission		
Mission and Workshop Feedback Summary	January 10, 2018	M&E Memo
May 2018 Mission		
Workshop Feedback Summary	May 29, 2018	Survey Report
July 2018 Mission		
Mission and Workshop Feedback Summary	August 5, 2018	Survey Report
December 2018 Mission		
Mission Feedback Summary (Faculty)	January 16, 2019	M&E Memo
Mission Feedback Summary (Students)	January 16, 2019	M&E Memo
July-August 2019 Mission		
Communication Workshop Feedback (Faculty)	August 17, 2019	Survey Report
Statistics Workshop Feedback (Faculty)	August 17, 2019	Survey Report
Writing Workshop Feedback (Faculty)	August 17, 2019	Survey Report
Statistics Workshop Feedback (Students)	September 19, 2019	Survey Report
Writing Workshop Feedback (Students)	September 19, 2019	Survey Report

Annex 3. Executive Committee members (2014-2019)

NAME	TITLE	DEPARTMENT	DATES
Tariq Banuri	USPCASW Associate Director, Professor	Economics	Dec 2014 - July 2018
Mike Barber	Department Chair, Professor	Civil and Environmental Engineering	Nov 2015 - Dec 2019
Haimanti Bhattacharya	Associate Professor	Economics	Nov 2016 - Aug 2018
Stacey Board	Administrative Program Coordinator	U Water Center	April 2015 - Nov 2018
Steve Burian	U Water Center Director, USPCASW Project Director, Professor CVEEN	Civil and Environmental Engineering	Dec 2014 - Dec 2019
Aslam Chaudhry	USPCASW Chief of Party, Deputy Project Director, Professor	Economics	Dec 2014 - Dec 2019
Cheri Daily	Director, External Relations and Global Programs	Office for Global Engagement	May 2017 - Dec 2019
Jonathan Duncan	Communication Specialist	U Water Center	Jan 2017 - Feb 2018
Bill Johnson	Professor	Geology & Geophysics	Jul 2015 - Oct 2016
Ming Li	Finance & Grants Manager	U Water Center	April 2015 - Dec 2019
Jewell Lund	Graduate Research Assistant	Geography	Aug 2018 - Dec 2019
Christine Pomeroy	Associate Professor	Civil and Environmental Engineering	Oct 2015 - Feb 2018
Cecily Sakrison	Communication Specialist	U Water Center	March 2018 - Dec 2019
Davey Stevenson	Communication Specialist, Engagement Specialist	U Water Center	April 2015 - Dec 2019
Court Strong	Associate Professor	Atmospheric Science	May 2017 - Dec 2019
Jeff Ullman	Technical Advisor	U Water Center	May 2017 - July 2019
Jim VanDerslice	Interim Chief, Associate Professor	Division of Public Health	Feb 2016 - Dec 2019
Mercedes Ward	Institutional Development Advisor, Research Associate, M&E Specialist	U Water Center	April 2015 - Dec 2019
Jennifer Weidhaas	Associate Professor	Civil and Environmental Engineering	Feb 2018 - Dec 2019
Azhar Zaheer	Entrepreneurship Specialist	U Water Center	Jun 2018 - Sep 2019
Pat Shea	Associate Instructor	Biology	Oct 2015 - Dec 2019

Annex 4. Senior Advisory Board members (2015-2019)

NAME	TITLE	DEPARTMENT, INSTITUTION
Mike Hardman (Chair)	Chief Global Officer	Office for Global Engagement, University of Utah
Robert Adler	Dean	College of Law, University of Utah
Cynthia Berg	Dean	College of Social and Behavioral Sciences, University of Utah
Mary Anne Berzins	Assistant Vice President	Human Resources, University of Utah
Richard Brown	Dean	College of Engineering, University of Utah
Cynthia Furse	Associate Vice President	Vice President for Research, University of Utah
Laura Hunter	Director	Utah Education Network
Ishrat Husain	Dean and Director	IBA Karachi, Pakistan
Khalid Mohtadullah	Senior Advisor	Global Water Partnership, Pakistan
Khawar Mumtaz	Chairwoman	National Commission on the Status of Women, Pakistan
Juan Carlos Negrette	Director	Global Health, University of Utah
Amy Wildermuth	Associate Vice President for Faculty	Academic Affairs, University of Utah

Annex 5. Standard operating procedures, committees, and IT systems established at USPCASW

SOPs and Committees

1) Board of Governors
2) HR Selection Board
3) Curriculum Review Committee
4) Admission Committee
5) Procurement Committee
6) Research Grants Management Committee
7) Faculty Activity Report
8) Student Handbook: A manual describing the rights and responsibilities of students.
9) Students Research Grant Committee
10) Disciplinary Committee
11) Gender Equity Committee
12) Endowment Fund Committee
13) Standing Committee on Business-Academia Collaboration under FPCCI
14) Building Management Committee
15) Store/Inventory Management
16) SOPs--Store/Inventory Management
17) SOPs—Terms and Conditions of the Exchange Program
18) SOPs—Laboratories
    a. Advanced Water and Wastewater Quality Control Lab
    b. Pilot Scale Water and Wastewater Treatment Lab
    c. Geographic Information System and Remote Sensing Lab (GIS & RS)
    d. Soil and Water Analysis Lab

IT Systems

In addition to the above SOPs, the following web-based systems for information management have been established and instituted to further improve efficiency and accountability of governance actions.

1) Financial Information System: For managing finances received from different sources
2) SOP Portal: A web-based portal which includes management of monthly time-sheet of staff, office item requisitions, leaves, travel applications, and activity plans
3) Admission Portal: To manage the application process for admissions into degree programs
4) Inventory Management System: For record keeping of all equipment, furniture, consumables, and other material
5) Students Information System: Reporting on data of admissions, enrollment, drop-outs, and alumni
6) Learning Management System (Moodle): An open source interactive system largely used by students and faculty for management of courses

Annex 6. Stakeholder engagement events

Count	Date (Location, # Attended)	Event	Outputs and Outcomes
1	June 9, 2015 (Jamshoro, 60)	Water Sector Stakeholder Consultation	Presented USPCASW to stakeholders, built reputation and network, and generated initial ideas for research projects
2	Aug 3, 2015 (Karachi, 100)	Executive Seminar on Water Governance	Oriented engineering faculty members in USPCASW to policy research, gathered ideas for applied research to improve water governance, signed research MOUs
3	Dec 18, 2015 (Karachi, 100)	Executive Seminar on Technology, Innovation, and Entrepreneurship	Introduced USPCASW as a developer of technologies and ventures, created concept of industry-academia committee, increased network, identified specific areas for technology development at USPCASW
4	April 1, 2016 (Jamshoro, 23)	Water experts meeting on "water resources challenges of Pakistan"	Meeting notes circulated
5	May 23-24, 2016 (Islamabad, 50)	Workshop to Develop National Water Research Agenda	Contributed to National Water Research Agenda
6	May-June, 2016 (Jamshoro)	Lecture and dialogue on "Integrated Land & Water Management".	Meeting notes circulated
7	December 15, 2016 (Jamshoro, 20)	Sindh Irrigation Department Workshop to Co-Create and Design Training Programs	Compiled list of ideas for training programs that led to Diploma Courses launched in 2017
8	December 18, 2016 (Quetta, 200)	Strengthening Research-Policy Interface for Improving Water Management in Baluchistan.	Network expansion, collaborations with higher education institutions and NGOs in Baluchistan partners.
9	May 9, 2017 (Jamshoro, 09)	Stakeholder Consultation on Water Management Issues.	Dialogue transcript circulated
10	May 15-16, 2017 (Jamshoro, 20)	Industry-Academia Water Technologies Research Co-Creation Workshop	Stakeholder awareness of technology and venture development at UPCASW, research partnerships and project ideas to pursue seed grants

11	July 31-Aug 2, 2017 (Jamshoro, 20)	Client-Driven Research Development Workshop	Research seed grant concept note outlines
12	December 18-20, 2017 (Islamabad, 400)	Science-Policy Conference on Climate Change in Pakistan	Research dissemination to national audience, research partnership with Global Change Impact Studies Centre
13	December 15, 2018 (Karachi, 100)	Executive Seminar on Industrial Wastewater Management	Increased research network, identified additional research projects for industry
14	August 5, 2019 (Karachi, 100)	Executive Seminar on Industrial Wastewater Management	Increased research network, identified additional research projects for industry
15	December 13, 2019 (Jamshoro, 50)	Community of Practice Dialog: Strengthening Service Delivery in the Water Sector	Ideas for water sector training programs to implement during transition year

Annex 7. USPCASW's professional training and diploma courses for various stakeholders

Count	Title	Dates	No. of Participants
1*	Training Workshop on Flood forecasting for various stakeholders	28 – 30 May, 2015	31
2*	Training Workshop on GIS & Remote Sensing for engineers of Sindh Irrigation Department	26 Feb – 02 Mar, 2016	21
3	Training Workshop on "Geo-informatics" for various stakeholders	10 – 12 April, 2016	25
4	Training Workshop on Spate Irrigation for various stakeholders	10 – 12 April, 2016	20
5*	Training Workshop on Advanced Hydraulic Modelling Using HEC-RAS for engineers of Sindh Irrigation Department	5 – 10 Dec, 2016	21
6*	Training Workshop on Climate Change Projections for various stakeholders	17 – 18 Aug, 2017	36
7*	Diploma Course on Flood Forecasting for engineers of Sindh Irrigation Department	Nov 2017 – Jul 2018	12
8	Training Workshop on Data Analysis using SPSS for various stakeholders	20 – 23 Nov, 2017	22
9	Workshop on Groundwater Data Analysis and Modelling for various stakeholders	9 – 11 Nov, 2017	10
10	Introduction to Geographic Information System (GIS) and remote sensing using ArcGIS 10.3 for various stakeholders	26 – 30 Mar, 2018	28
11	Training Workshop on Improving Groundwater Management and Modeling for various stakeholders	25 – 29 June, 2018	20
12	Training Course on Satellite Altimetry and its Hydrological Application	27 – 30 Nov, 2018	31
13*	Diploma Course in Sediment Transport for Engineers of Sindh Irrigation Department	Dec 2018 – Jun 2019	18
14	Training on "Commercialization of Research Projects, and Academia, Industry, Government & Society Linkages"	31 Jan – 02 Feb, 2019	34
15	Training on Rehabilitation and Management of Salt-Affected Soils in the Indus Basin of Pakistan	18-22 Mar, 2019	28
16*	Training Course on "Designing of Drinking Water Distribution System" for various stakeholders	18-22 Nov, 2019	21
17	Training on Monitoring and Mapping of Forests Using Satellite data for Clean and Green Pakistan	27-29 Nov, 2019	22
18*	Diploma Course on Reservoir Modeling and Management Engineers of Sindh Irrigation Department	Nov 2019 – May 2020	20

*Training with significant involvement of U-led team.

Annex 8. Externally funded research, consultancy, and capacity building projects.

Count	Project Title	Lead PI	Funding Agency	Provincial/National/ International	Category	Amount (M PKR)
1	Identifying the likely impacts of coal combustion residues from Thar coal-fired power plant on the Region's ecosystem	Dr. R.B Mahar	Heinrich Böll Stiftung	International	NGO/Civil Society	2
2	Sustainable fresh groundwater management for irrigated agriculture in Lower Indus Basin (LIB) using PMWIN model	Dr. Abdul Latif Qureshi	HEC	National	Government	4.7
3	Improving groundwater management to enhance agriculture and farming livelihood in Pakistan	Dr. Bakhshal Lashari	ACIAR	International	Government	2.88
4	Diffusion and adoption through partnerships and action of the best watershed rehabilitation and irrigation practices and technologies to help rural farmers -Phase-II.	Dr. Bakhshal Lashari	ICARDA	International	NGO/Civil Society	1.3
5*	Capacity building at MUET, Jamshoro to address drinking water issues in Pakistan	Dr. R.B Mahar	US-Pak (HEC)	Joint (National & International)	Government	50
6	Optimization of anaerobic digestion process using co-digestion of crop residues and buffalo dung	Dr. R.B Mahar	HEC	National	Government	4.4
7	Efficient participatory irrigation institutions to support productive and sustainable agriculture in South Asia.	Dr. Bakhshal Lashari	ACIAR	International	Government	7.161
8**	Capacity building of the officers / officials of Sindh Irrigation Department	Dr. Bakhshal Lashari	Sindh Irrigation Department	Provincial	Government	42
9	Role and loss of biodiversity: implications for local community of Hangu District, KPK	Dr. Asmatullah	HEC	National	Government	1.044
10	Baseline survey of existing WaSH conditions in Thatta City (Ward No. 3)	Dr. Bakhshal Lashari	NRSP	National	NGO/Civil Society	0.5
11	Rehabilitation of sewage treatment plant (STP) installed at Niamat gas field, United Energy Pakistan Limited	Dr. R.B Mahar	UEPL	National	Business/Industry	1.016

12	Smart groundwater monitoring for sustainable groundwater extraction in Sindh	Waqas Ahmed	NRPU-HEC	National	Government	2.988
13	Situation analysis of waste management at processing facilities of United Energy Pakistan (UEP)	Dr. Zubair Ahmed, Dr. R.B Mahar	UEPL	National	Business/Industry	1.1
14	Impact of climate change in the Indus River Delta and coastal region of Pakistan	Dr. Altaf A. Siyal	Global Change Impact Studies Centre (GCISC)	National	Government	1.5
15	The Impact of informal institutions on participatory irrigation management outcomes	Dr. Mercedes Ward, UU	Water Sector Improvement Project (WSIP) (plus MUET & UU)	Provincial	Government	1.9
16	Water scarcity is a myth or reality? (exploratory study)	Dr. Bakhshal Lashari	Oxfam Pakistan	International	NGO/Civil Society	1.2
17	Assessment of methane gas production potential of the primary effluent treatment plant	Dr. R.B. Mahar	MATOL (PVT) Ltd.	National	Business/Industry	0.3
18	Technical support to the program on turning Solid waste into compost, biogas and other products.	Dr. R.B. Mahar	Tearfund (UK based NGO)	International	NGO/Civil Society	0.5
19	Calibration of gauges and development of rating curves of 115 distributaries/minors of Nara Canal AWB for flow measurement	Dr. Bakhshal Lashari	WSIP, P&D Dept. GoS	Provincial	Government	8.376
20	Study on water balance of Sindh water resources management	Dr. Bakhshal Lashari	WSIP, P&D Dept. GoS	Provincial	Government	1.38
21	Situation analysis of the wetlands of Sindh	Dr. Bakhshal Lashari	WSIP, P&D Dept. GoS	Provincial	Government	1.38
22	Numerical modelling of T-Head Spur along Moria Loop Bund, Larkana	Dr. Bakhshal Lashari	Sindh Irrigation Deptartment	Provincial	Government	1.596
23	Development and upscaling of indigenized anaerobic digester for the Biotransformation of textile sludge into the production of biogas and biocompost	Dr. R.B. Mahar, Dr. Tanveer Ahmed	TDF-HEC	National	Government	13.717

24	Development of a prototype for treatment of spent wash produced by distilleries of sugar industry	Dr. Naveed Qambrani	MATOL (Pvt) Ltd.	National	Business/Industry	3
25	Undertaking a water quality assessment of the water points in UC31 to identify the contaminated water points	Dr. Bakhshal Lashari	MDC/UNICEF	National	NGO/Civil Society	7
26	Endline survey	Mr. Muhammad Ali	Oxfam Pakistan	International	NGO/Civil Society	0.97
27**	Community training project	Mr. Muhammad Ali	Safcco	Provincial	NGO/Civil Society	0.25
28	Baseline survey for spate irrigation project	Dr. Bakhshal Lashari	MetaMeta	International	NGO/Civil Society	1.19
29	Closed-loop canal monitoring [continued funding]	Dr. Latif Qureshi	RDF	National	NGO/Civil Society	1.303
					Total (million PKR)	***166.651***

*Although titled “capacity building”, it includes a significant research component.

**These are “capacity building” projects and are excluded from the total amount of externally generated funding for research and consultancies.

Annex 9. Internships

Name of Organization	Type	No. of Interns
Pakistan Council of Research in Water Resources (PCRWR)	Government	9
Water and Sanitation Agency (WASA) Hyderabad	Government	5
Pakistan Council of Scientific and Industrial Research (PCSIR)	Government	4
DRIP, Tando Jam	Government	3
DRIP, PCRWR	Government	2
National Centre of Excellence in Analytical Chemistry (NCEAC)	Government	2
NESPAK	Government	2
Pakistan Meteorological Department (PMD)	Government	2
Water and Power Development Authority (WAPDA)	Government	2
Sindh Irrigation and Drainage Authority (SIDA)	Government	15
Institute of Space Technology	Government	1
Irrigation Department Balochistan	Government	1
Pakistan Oil Field Limited	Government	1
Sindh Irrigation Department	Government	5
Space and Upper Atmosphere Research Commission (SUPARCO)	Government	1
Textile Department	Government	1
Associated Consulting Engineers	Business	2
UNiCol	Business	1
National Rural Support Program (NRSP)	NGO	4
Research and Development Foundation (RDF)	NGO	4
AWARE	NGO	2
International Union for Conservation of Nature (IUCN)	NGO	2
World Wide Fund for Nature (WWF)	NGO	2
Orangi Pilot Project	NGO	1
Isra Hospital	Private Hospital	2
Punjab Irrigation Department, Jhang	Government	1
Water Management Research Center, Faislabad	Government	1
Irrigation Department, Small Dams, Jamshoro	Government	1
Irrigation Department, Nara Canal Subdivission, Sukkar	Government	1

Annex 10. Mandatory minimum results and targets

Mandatory minimum results and targets (as listed in the U Cooperative Agreement)	Progress by Project Closeout	Summary Remarks
Governance		
Establish PMU	Achieved	The PMU was successfully established for both the U-led team and the USPCASW team. The PMUs were integral to the success of the project. However, the Center's PMU was not fully integrated with the proposed management structure of the Center post-project – and in that sense it functioned much like a "project management unit" rather than a management team that would run the Center post-project. Indeed, the first challenge in the transition period is identifying the Center's post-project Executive Director (ED). This was something the U-led team strongly recommended, but at the time of closeout, no ED had been hired (although there had been two rounds of advertisement for the position).
Support MUET CASW visioning and strategic planning process	Achieved	This support is best illustrated by the teams' collaborative preparation of a detailed *Sustainability and Transition Plan* with clear strategic planning recommendations to support a thriving Center post-project. The plan was approved by the Center's BoG in 2019.
Establish a required advisory structure	Achieved	During the project, the advisory structure for the Center included the BoG, and for the U-led team it included the SAB as well as the Executive Committee. These different groups provided valuable insights and suggestions to steer the teams towards delivering significant outcomes of an enduring nature. With that said, the *Sustainability and Transition Plan* makes the recommendation that the BoG be expanded to include greater representation from the private sector or policy-making circles. This would expand the BoG's ability to leverage their connections to attract support and investment in the Center's activities and sustainability.
Establish a required management structure	Achieved	Achieved through the establishment of the PMU at the Center – the issue is whether there is an effective management structure for a post-project context. Again, the *Sustainability and Transition Plan* presents a clear organizational structure for post-project management of the Center.

Advance M&E capacity	Achieved	The shift in the Center's reporting style for formal reports to USAID was especially noticeable in its Final Report. The draft share with the U-led team showed considerable improvement in terms of self-assessment. For example, rather than reporting things as "established" when in fact they were not meaningfully operationalized/functional demonstrated a transformation from development *signaling* to development *thinking*.
Support the development of financial management at USPCASW	Achieved	The U-led team did not oversee financial management of the Center. However, over the years the faculty capacity to write winning grant proposals, as well as the management team capacity to organize and support the faculty in this endeavor, was improved through various workshops and coaching. Moreover, the *Sustainability and Transition Plan* devotes considerable attention to the Center's financial sustainability (fundraising, budgeting, etc.).
Curriculum		
At least 3 professional certification degrees or programs established and operating	Achievement exceeded the target	Four Master's degree programs and 3 PhD programs were established across four disciplines: HID, EnvEng, IWRM, and WASH. In the case of HID and EnvEng, these were significantly revamped and strengthened programs; the other 3 degree programs in IWRM and WASH were completely new not only to MUET but to the country.
Each CAS will develop at least 20 courses that feature a modern, relevant Pakistan-centric curriculum that meets international standards	Achievement exceeded the target	32 courses were developed over the course of the project. For the current curriculum, see Annex 16.
Assess infrastructure for teaching and learning	Achieved	This was done throughout the life of the project. In addition to providing lists of recommended equipment for the labs, the U-led team identified that a key missing piece of "infrastructure" was the social infrastructure: the standard operating procedures needed to ensure lab safety as well as data accuracy and reliability. The importance of lab safety has been repeatedly stressed through missions as well as during exchange program training.
Create curriculum reform support structure	Partially achieved	The Curriculum Review Committee was established at the Center to oversee curriculum reform, maintain international standards, and ensure ongoing improvements are made to align curriculum with market needs. However, this committee was never fully activated by the Center's management, although evidence does suggest that both the management and faculty had internalized the importance of ongoing curriculum reform and renewal, especially to support impactful applied research.

Develop plans and policies for continuous advancement of teaching and learning	Partially achieved	In addition to the Curriculum Review Committee (described above), a faculty performance evaluation policy was drafted and circulated among the Center's management and faculty. Part of this policy dealt with how teaching should be evaluated (i.e., using more than one method), as well as how the management might respond by providing support (e.g., mandated training workshops) to faculty who showed areas of weakness in teaching so that they could improve. This policy was never formally adopted, although some of the ideas and sentiments may have been.
Applied Research		
Create Council for Research and Policy (CRP)	Partially achieved	The CRP was not established per se, but many of its functions have been achieved through the establishment of other stakeholders' committees and networks. The value of the CRP as originally conceived by the CA is that it brought very diverse groups together around a shared agenda of applied water research and policy. The policy aspect of the CRP was not achieved through these other groups.
Research visioning	Achieved	This was carried out in many ways throughout the life of the project. Details are in the Research Chapter.
Research infrastructure capacity building	Achieved	During exchange visits to the U.S., students, faculty, and technicians gained experience using laboratory equipment that they then could put to use back at USPCASW's labs. Also, various mission workshops, micro-trainings, and coaching supported the effective and safe use of the new research infrastructure at the Center (Annex 11).
Convene policy and planning dialogues	Achieved	As listed in Annex 4, there were 15 major stakeholder dialogues, with most focusing on some aspect of water policy or management/governance.
Develop CAS-W collaborative research program	Achievement exceeded the target	The target of 10 "joint research projects" was significantly exceeded. With more than 20 joint research projects, the strength of the partnership between the U.S. universities and USPCASW is remarkable and will persist post-project through externally-funded research projects.
Support MUET to conduct at least 50 applied research projects • At least 28 should be research grants awarded to MUET faculty and/or other Pakistani universities or Research and Development organizations	Achieved	30 research grants were awarded by the Center, and 27 externally-funded research and consultancy projects were awarded to the Center (plus 2 capacity building projects were awarded to the Center). In addition, more than 150 student research projects (theses and dissertations) have been completed, with another 100 in progress.

Exchanges and Scholarships		
At least 250 degrees awarded to students who received CAS-funded scholarships	30% achieved by closeout; 60% will be achieved by Spring 2020	75 students have graduated, and another 76 are expected to graduate in Spring 2020, with more in the pipeline. (A formal request to reduce this target to account for the slow time-to-degree – partially due to the semester-length exchange program and partially due to the immense capacity gap in terms of faculty and student preparedness for research – was not granted.)
At least 250 (50 from U's Cooperative Agreement + 200 from MUET's Cooperative Agreement) faculty and students participating in exchanges to the U.S.	67% achieved	169 visitors were hosted, but only 167 completed the program and only 165 completed the program and achieved their goals. (A formal request to reduce this target to 150 in light of the demand-driven semester-length programs, but this was not granted.)
At least one strong American-Pakistani university linkage established that significantly strengthens the quality of teaching and research and improves how universities interact with and receive funds from the business community	Achievement exceeded the target	MUET has developed strong linkages with three U.S. universities: U, CSU, and UNLV. A second 5-year MOU between U and MUET was signed in 2019.
Develop an Exchange Training Program (ETP)	Achieved	The exchange program was not only developed, but it is expected to be sustained, albeit with smaller cohorts.
Create an Effective Teaching Exchange Program (ETEP)	Partially achieved	This has not been created as a stand-alone program. Instead, faculty participants in the research exchange program receive coaching and/or training in effective teaching during their visits.
Creation of an internship program	Achieved	80 students completed internships, mostly with the public sector (Annex 7).
Help administer the Research Grant Program	Achieved	The U-led team helped – among other ways – with rigorous peer review of grant proposals to support a strong merit-based grant program.
Sustainability		
At least 50% of CAS graduates employed in a field related to their CAS sector	Achieved	Although only 75 students have graduated, 50 (67%) are either employed (30) or pursuing a PhD (20). Of the 50 students employed or pursuing a PhD, 86% are in the water sector. Among all the graduates taken together, 57% are working or continuing their studies in the water sector.

A wide regional diversity of students trained of whom at least 50% are economically disadvantaged	NA	The Center has struggled to achieve regional diversity. By far most students come from Sindh province (90%). Regarding economic disadvantage, the Center's approach is to consider all enrolled students as from disadvantaged groups so as to promote higher education in the field of water. This approach does not permit any kind of meaningful analysis or reporting of the number or percent of "economically disadvantaged" students.
Percentage of female student and faculty participation in CAS activities exceeds by 15% the present rate of participation at the hosting university, with the objective of 50% female participation	Partially achieved	The goal of 50% female participant was achieved for some of the exchange program cohorts, but only about 36% of active students at the Center were female. Different degree programs had different female participation percentages, but in general exceeded or were comparable to U.S. rates of female participation in engineering programs. In terms of faculty, like the student batches, the percent fluctuated somewhat from year to year; at closeout it was 26%.
At least 50 students placed in internships with private sector entities	Not achieved	80 internships have been completed. However, 75% of these were with the government sector. Of the remainder, only 2 internships were with for-profit businesses (most of the rest found placement with NGOs).
At least $1 million generated from industry and other sources besides the GoP and the international donor community	Achievement exceeded the target	Total external funding for research and capacity building is 167 million PKR, although about 78 million is from the GoP (or joint GoP and International). This is 89 million PKR / approximately $562,000 USD. Additionally, the GoS gave $1.45 million USD for construction of the women's hostel. This brings the total to about $2 million USD generated from sources other than the GoP and international donor community.
At least 5 Public-Private Partnerships (PPPs) or Global Development Alliances	Partially achieved	The Center has reported all of their MOUs and project agreements under this target. However, these do not fit the common technical definition of PPPs found in the literature and policy circles. Given that USAID did not provide clear guidance about how PPPs were defined within the context of this project, a middle ground can be found by claiming the subset of four MOUs and project agreements that were made with private industries.
Establish coordination network	Partially achieved	The Pakistan Water Research Network was established, but it has failed to realize its potential. The Business-Academia Committee on Water has had more success, although still limited. Recently, the "community of practice" informal network of public sector, private sector, civil society, and academia has been gathering momentum at the Center. Whether this informal network can be leveraged usefully will likely depend on the next Executive Director.

Establish technology commercialization support	Achieved	This was done is several ways, the most notable being the organization of a summer entrepreneurship exchange program to support technology innovation and commercialization.
Implementation of M&E program	Achieved	The hallmark of the M&E approach was critical reflection to identify what could be done better, not only in terms of quantitative targets but in terms of quality of outcomes – especially those that would matter for long-term institutional sustainability. These recommendations were made on at least a quarterly basis.

Annex 11. Methods for monitoring, evaluation, and learning (MEL)

Both quantitative and qualitative methods were used for MEL.

USAID/Pakistan required a specific set of indicators to be reported in the online database, Pakinfo. These indicators were changed by USAID/Pakistan a few times during the project, and the assignment of whether the U-led team or the MUET team was responsible for reporting certain indicators also changed. These changes led to some confusion, and the U-led team relied more on tracking progress towards the targets as stated in the Cooperative Agreement and using self-identified indicators that were consistently reported in quarterly and annual progress reports according to the USAID-approved MEL Plans. These qualitative and quantitative indicators helped provide a sense of the distribution of inputs/activities across components as well as where there were gaps in terms of key outputs and outcomes.

To acquire an understanding of the *quality of the inputs*, feedback from USPCASW management, faculty, and students was sought through anonymous feedback surveys (for training workshops, exchange programs, and as needed for other activities), exchange student final reports, focus group discussions, and one-on-one meetings. This information was used by the management team to make improvements to mission activities and exchanges.

To assess the *quality of the outputs*, information was sought from faculty who were in a position to assess the quality of academic work conducted by the USPCASW students and faculty under their mentorship (or in their classes) during the exchange program. The U-led team also provided technical reviews of the first batch of theses, which gave a clear indication of the quality of technical work being produced and the gaps in capacity that remained. The regular U missions to USPCASW for technical training and governance-related meetings provided ample opportunities for further qualitative assessment of progress in the areas of governance, research, curriculum reform, external funding, and more.

Additional methods were used for other activities. For example, the Course Mentoring Program – which paired a U.S.-based faculty mentor and a USPCASW faculty mentee for a semester-length course – took advantage of the Canvas Learning Management System to track the inputs of the mentors as well as the outputs of the mentees.

The goal of these various methods was not scientific precision but adaptive management. In this sense, equally as important as the production of information was its interpretation and management application. The U's M&E Specialist/Institutional Development Advisor played a role in not only collecting information but also interpreting and critically reflecting on it in discussion with her USPCASW counterpart in order to make recommendations to the management teams at both the U and USPCASW. At the U, the Executive Committee, comprised of the project staff and core faculty members engaged with the project, played an integral role in using this information and providing their own critical assessment and troubleshooting throughout the project life cycle. Perhaps the most significant attribute of the Executive Committee was its genuine interest in developing MUET's capacity for high quality research and graduate education. This "North Star" guided a great deal of decision-making about which activities to prioritize.

In addition to the self-assessments, there was a third-party assessment conducted by Management Systems International (MSI). MSI conducted a baseline assessment and the U-led team received the report in early 2017. MSI conducted a midterm assessment in April 2018 and the teams received the report in early 2019.[1]

The Center also awarded a grant to Ipsos, an Islamabad-based consulting firm, to conduct a market needs assessment (i.e., the "market survey) to assess the alignment of the Center's curriculum and research agenda with the needs of the market. The Center received the final report in November 2018.[2]

Taken together, this information helped shape the themes and scope of capacity development activities (i.e., the Annual Work Plans) during project implementation. It also helped shape the substantive recommendations made in the *Sustainability and Transition Plan* prepared in 2019 to support the Center's sustainability post-USAID funding.

Finally, as part of the MEL approach, each quarterly and annual progress report to USAID included not only reporting on progress towards targets and other metrics but also critical reflection about project successes, challenges, and troubleshooting/adaptation to respond to those challenges.

[1] Both the baseline and midterm assessments were received by the implementing partners much later than they should have if the idea was to put the information to use for project management. There will be no final evaluation by MSI.

[2] The Office of the Inspector General (OIG) also conducted a performance audit in 2018. The audit report was not available to implementing partners during the life of the project (LoP) and thus was not used to improve project implementation.

Annex 12. Monitoring and evaluation tools and materials

#	Title
1	Mission Feedback Survey Template
2	Workshop Feedback Survey Template
3	Exchange End-of-Term Feedback Survey
4	Goal-Setting Worksheet and Review Process
5	Exchange Program Weekly Student Self-Assessment Questionnaire
6	Exchange Program Mid-Term and End-of-Term Progress Assessment Form (filled by Mentor)
7	Student Exchange Final Report Template
8	Student Exchange Social Network Survey
9	USPCASW Annual Feedback Survey for Center PD, DD, and Faculty
10	USPCASW Course Mentoring Program Assessment Form
11	Pre-Admission Communication and Orientation Experience Feedback Form
12	USPCASW Student Feedback Form (Experience of First Week)
13	Focus Group Questions for New USPCASW Faculty
14	Revised Teacher/Course Evaluation/Student Feedback Form (implemented by USPCASW)
15	Faculty Activity Report (implemented by USPCASW)

Annex 13. Missions to MUET (2014-2019)

Mission	Dates	Theme	Personnel Time and Effort*
1	December 16 - 21, 2014	Kickoff	2 professors 10 person-days
2	May 30 – June 13, 2015	Project Launch	4 professors + 1 staff 54 person-days
3	July 26 – August 6, 2015	Catalyzing Research Teams and Ideas	4 professors + 1 staff 50 person-days
4	December 13 – 19, 2015	Inculcating Effective Habits	5 professors + 1 staff 37 person-days
5	May 16 - 24, 2016	Building the Research Program	3 professors + 1 staff 19 person-days
6	July 17 - 27, 2016	Strengthening Research Collaboration	4 professors, 1 staff, 1 graduate student, 6 SAB members 54 person-days
7	October 9-14, 2016	Governance and Sustainability	1 professor 5 person-days
8	October 16-21, 2016	Clean Water Research Project	2 professors 12 person-days
9	December 11-20, 2016	Building a Collaborative Water Centers Network	6 professors 34 person-days
10	May 10 – 20, 2017	Innovation for Impact	5 professors + 1 staff 48 person-days
11	July 30 – August 12, 2017	Building Collaborative Research Partnerships	7 professors + 1 graduate student 60 person-days
12	December 12 – 22, 2017	Taking the Next Step	6 professors + 1 staff 58 person-days
13	May 3-12, 2018	Improving Research with Attention to Detail	6 professors + 2 graduate students + 1 staff 45 person-days
14	July 16 – 23, 2018	Sustaining Processes and Practices of USPCASW	4 professors + 1 staff 40 person-days
15	August 6 – 10, 2018	Salinity Management Research	1 professor + 1 graduate student 10 person-days
16	December 9-22, 2018	Improving Quality of Research	6 professors, 1 student, 1 staff 52 person days
17	March 6 – 10, 2019	Focus on Transition	6 professors + 1 staff 35 person-days
18	June 9 – 13, 2019	WASH Technical Training	2 professors 10 person-days

19	July 28 – August 9, 2019	Accelerating Transition	6 professors, 2 staff, 2 students 72 person-days
20	October 26 – November 1, 2019	Gates Foundation *S. Typhi* Study	3 professors 15 person-days
21	November 18-22, 2019	Drinking Water Distribution Systems	1 professor 5 person-days
22	December 5 – 13, 2019	Expanding the Impact	2 professors, 3 students, 2 staff 56 person-days
23	February 3 – 15, 2020	Finalizing the Transition	2 professors, 1 staff, 42 person-days

**Note: The Deputy Project Director and Technical Advisor were present for all missions and are not included in count of professors and person-hours.*

Annex 14. Capacity development activities during mission to USPCASW, MUET

Legend for Types Training Experiences*:

Type	Description
Workshop**	1-3 days of organized training with learning objectives and structured interaction in the classroom, laboratory, field, or other educational context.
Engagement Event	2 hours or longer engagement of stakeholders with specific objective, theme, invitations, program, feedback, and action items.
Micro-training**	1-4 hours of organized training with learning objectives and structured interaction in the classroom, laboratory, field, or other educational context
Boot camp	One or more 1-2 hour sessions of organized training with learning objectives and unstructured coaching focused on building habits and just-in-time delivery of guidance and instruction

*In addition to the organized training noted, many meetings as well as the engagement events were used as opportunities to coach, mentor, and train USPCASW leadership and faculty on organization, time management, agenda setting, follow-up, and other best practices.

**Workshops and micro-training were delivered in two primary styles – classroom or coaching. Classroom style involved a more formal instruction style with prepared objectives, learning materials, practice exercises, and assessments. Coaching style involved more informal instruction while working together on a particular activity (i.e., collaborative learning-by-doing). The style of workshops and micro-training are noted below. Note that classroom style could have been conducted in a lecture hall, conference room, lab, field, etc. – the label "classroom" simply implies formal structured learning with aligned lessons.

Mission Training Summary

#	Mission	Date	Title	Type	Targeted Participants*	Targeted Component
1	1	December 17, 2014	Project Implementation Planning	Micro-Training (Coaching)	USPCASW Leadership	Governance & Sustainability
2	1	December 17, 2014	Curriculum Design	Micro-Training (Coaching)	USPCASW Leadership	Curriculum
3	1	December 18, 2014	Research Thrusts	Micro-Training (Coaching)	USPCASW Leadership	Research
4	1	December 18, 2014	Faculty Recruitment	Micro-Training (Coaching)	USPCASW Leadership	Governance & Sustainability
5	2	June 1, 2015	Curriculum Design	Workshop (Classroom)	USPCASW Faculty (12)	Curriculum
6	2	June 2, 2015	Governance: Exchanges,	Workshop (Coaching)	USPCASW Faculty (12)	Governance, Sustainability, Exchanges &

			Research Grant Management, M&E			Training, Research
7	2	June 7-8, 2015	Effective Teaching	Workshop (Classroom)	USPCASW Faculty (12)	Curriculum
8	2	June 9, 2015	USPCASW Launch & Stakeholder Consultation at MUET	Engagement Event	USPCASW Faculty, Staff, MUET Administrators, Stakeholders (60)	Governance & Sustainability
9	2	June 10, 2015	Gender Equity in USPCASW	Workshop (Classroom)	USPCASW Faculty (12)	Governance, Gender Equity
10	3	July 25-26, 2015	System Dynamics Modeling with Stella	Workshop (Classroom)	USPCASW Faculty (14)	Research
11	3	July 27, 2015	USPCASW Research Agenda Planning	Workshop (Coaching)	USPCASW Faculty (14)	Research
12	3	July 28, 2015	WEAP Software	Workshop (Classroom)	USPCASW Faculty (14)	Research, Curriculum
13	3	July 29, 2015	Linking Research to Curriculum, Teaching, and Gender Equity	Workshop (Coaching)	USPCASW Faculty (14)	Research, Curriculum, Gender Equity
14	3	July 30, 2015	Research Proposal Writing	Workshop (Classroom)	USPCASW Faculty (14)	Research
15	3	July 31 – August 1, 2015	Climate Change and Water Quality	Workshop (Classroom)	USPCASW Faculty (14)	Research
16	3	August 3, 2015	Improving Water Governance in Pakistan	Engagement Event	USPCASW Faculty (14), Stakeholders (~150)	Governance
17	3	August 5, 2015	Launch of Technology, Venture, and Commercialization Program	Engagement Event	USPCASW Faculty (14), Stakeholders (~10)	Sustainability
18	4	December 14-17, 2015	Technical Writing	Boot Camp	USPCASW Faculty (14)	Research
19	4	December 14-17, 2015	Leading a Research Group	Boot Camp	USPCASW Faculty (14)	Research
20	4	December 14-17, 2015	Teaching: Lesson Planning, Assessment, and	Boot Camp	USPCASW Faculty (14)	Curriculum

			Project-Based Learning			
21	4	December 14, 2015	Faculty Performance Evaluation	Micro-Training (Coaching)	USPCASW Faculty (14)	Governance
22	4	December 16, 2015	Graduate Student Development	Workshop (Classroom)	USPCASW Students (35)	Curriculum
23	4	December 19, 2015	Entrepreneurship, Technology, and Institutional Sustainability in Higher Academia	Engagement Event	USPCASW Faculty (14), Stakeholders (50)	Sustainability
24	5	May 13 – 14, 2016	HEC-RAS Hydraulic Modeling	Workshop (Classroom)	USPCASW Faculty (12)	Research
25	5	May 16, 2016	Status of Water Data in Pakistan	Micro-Training (Coaching)	USPCASW Faculty (12)	Research
26	5	May 16 – 18, 2016	Research Data Management and Analysis	Boot Camp	USPCASW Faculty (12)	Research
27	5	May 16 – 18, 2016	Curriculum Reform and Streamlining	Boot Camp	USPCASW Faculty (12)	Curriculum
28	5	May 19, 2016	Thesis Proposal Writing	Workshop (Classroom)	USPCASW Students (35)	Curriculum, Research
29	5	May 21 – 22, 2016	Developing a National Water Research Agenda	Workshop (Coaching)	PCRWR, USPCASW Faculty (3)	Research
30	6	July 18, 2016	Effective Teaching	Workshop (Classroom)	USPCASW Faculty (16)	Curriculum
31	6	July 19, 2016	Research Coordination	Workshop (Coaching)	USPCASW Faculty (16)	Research
32	6	July 20, 2016	Student Mentoring	Workshop (Classroom)	USPCASW Faculty (16)	Curriculum
33	6	July 21, 2016	Student Exchange	Micro-training (Coaching)	USPCASW Faculty (35)	Exchanges & Training
34	6	July 25 - 29, 2016	U Senior Advisory Board visit	Engagement Events	USPCASW Faculty (16)	Governance & Sustainability
35	7	October 10, 2016	Exchange Program Coordination	Micro-training (Coaching)	USPCASW Faculty (16) and Students	Governance
36	7	October 11, 2016	Academia-Business Linkages	Engagement Event	USPCASW Faculty (16), Stakeholders	Sustainability

37	8	October 16-21, 2016	Water Distribution Network Characterization	Workshop (Coaching)	USPCASW Faculty (16), USPCASW Students	Research
38	9	December 12, 2016	Research Collaboration	Workshop (Coaching)	USPCASW Faculty (16)	Research
39	9	December 13, 2016	Research Proposal Writing	Workshop (Classroom)	USPCASW Faculty (16)	Research
40	9	December 14, 2016	Teaching: Motivating and Supporting Student Success	Micro-training (Classroom)	USPCASW Faculty (16)	Curriculum
41	9	December 15, 2016	Graduate Student Research Review	Workshop (Coaching)	USPCASW Students	Curriculum
42	9	December 16, 2016	Community-Engaged Research and Teaching	Workshop (Classroom)	USPCASW Faculty (16)	Curriculum, Research
43	9	December 19 - 20, 2016	Strengthening Research-Policy Interface for Improving Water Management in Balochistan	Engagement Event	USPCASW Faculty (4)	Research
44	10	May 11 – 12, 2017	Climate Vulnerability Assessment and Adaptation of Water Systems	Workshop (Classroom)	USPCASW Faculty (16)	Research
45	10	May 15, 2017	Industry-Academia Water Technologies Research Forum	Engagement Event	USPCASW Faculty (16), Stakeholders	Research
46	10	May 16, 2017	Industry-Academia Water Technologies Research Co-Creation	Workshop (Coaching)	USPCASW Faculty (16), Stakeholders	Research
47	10	May 18, 2017	Flipped Classroom	Workshop (Classroom)	USPCASW Faculty (16)	Curriculum
48	10	May 19, 2017	Graduate Student Research Review	Workshop (Coaching)	USPCASW Students	Curriculum
49	11	July 31 – August 2, 2017	Client-Driven Research Co-Creation	Workshop (Coaching)	USPCASW Faculty (16), Stakeholders	Research
50	11	August 3 – 4, 2017	Human Subjects Research	Workshop (Classroom)	USPCASW Faculty (16)	Research
51	11	August 10 – 11, 2017	Faculty Development	Workshop (Classroom)	Pakistan Science Foundation	Curriculum, Research

52	12	December 8 – 9, 2017	Flood Forecasting and Management	Workshop (Classroom)	Sindh Irrigation Department	Exchanges & Training
53	12	December 11, 2017	Research Mentoring	Workshop (Coaching)	USPCASW Faculty (16)	Research
54	12	December 12, 2017	Curriculum Modernization	Workshop (Classroom)	USPCASW Faculty (16)	Curriculum
55	12	December 11 – 12, 2017	Thesis Writing	Workshop (Classroom)	USPCASW Students (35)	Curriculum
56	12	December 14, 2017	Thesis Proposal Writing	Workshop (Classroom)	USPCASW Students (35)	Curriculum
57	12	December 14 – 15, 2017	Communicating Research Results	Workshop (Classroom)	USPCASW Faculty (16)	Research
58	12	December 18 - 20, 2017	Science-Policy Conference on Climate Change	Engagement Event	USPCASW Faculty (16)	Research
59	13	May 3 – 4, 2018	Applied Statistics for Research	Workshop (Classroom)	USPCASW Faculty (16)	Research
60	13	May 7 – 8, 2018	Collaborative Research Projects – Multiple Themes	Workshops (Coaching)	USPCASW Faculty (16)	Research
61	13	May 7 – 8, 2018	Thesis Writing	Workshop (Classroom)	USPCASW Students (100)	Curriculum
62	13	May 9, 2018	Applied Statistics	Workshop (Classroom)	USPCASW Students (100)	Curriculum
63	13	May 10 – 11, 2018	Student Thesis Proposal Writing	Workshop (Classroom)	USPCASW Students (100)	Curriculum
64	14	July 16, 2018	Faculty Performance Evaluation	Workshop (Coaching)	USPCASW Faculty (16)	Governance
65	14	July 17, 2018	Proposal Review and Critique	Workshop (Classroom)	USPCASW Faculty (16)	Research
66	14	July 18 – 23, 2018	WASH Focused Lab Techniques	Workshop (Coaching)	USPCASW Faculty (8)	Research
67	14	July 22, 2018	Governance and Sustainability	Micro-training (Coaching)	USPCASW Faculty (16)	Governance & Sustainability
68	15	August 6 – 7, 2018	Salinity Field Measurements	Workshop (Classroom)	USPCASW Faculty (6)	Research
69	15	August 9 – 10, 2018	Remote Sensing of Salinity in Agriculture Settings	Workshop (Classroom)	USPCASW Faculty (6)	Research
70	16	December 10 – 11, 2018	Experimental Design	Workshop (Classroom)	USPCASW Faculty (18)	Research

71	16	December 13 – 14, 2018	Mentoring Graduate Student Writing	Workshop (Classroom)	USPCASW Faculty (18)	Curriculum
72	16	December 15, 2018	Executive Seminar on Industrial Wastewater Management	Engagement Event	USPCASW Faculty (18), USPCASW Students (50), Stakeholders	Research
73	16	December 10 – 11, 2018	Writing	Workshop (Classroom)	USPCASW Students (100)	Curriculum
74	16	December 13 – 14, 2018	Data Science	Workshop (Classroom)	USPCASW Students (100)	Curriculum
75	16	December 17 – 21, 2018	HID Technical Training	Workshops & Micro-training (Coaching)	USPCASW Faculty (6), Students (20)	Research
76	17	March 4 – 7, 2019	Sustainability and Transition Plan	Workshop (Coaching)	USPCASW Faculty (18)	Sustainability
77	17	March 3 – 8, 2019	WASH Field and Lab Methods	Workshop (Coaching)	USPCASW Faculty (6), Students (~20)	Research
78	17	March 8, 2019	Graduation	Engagement Event	USPCASW Faculty (18)	Governance & Sustainability
79	18	June 10 – 13, 2019	Community Transmission of Antibiotic Resistant Organisms	Workshop (Coaching)	USPCASW Faculty (6), Students (~20)	Research
80	19	July 29 – 30, 2019	Developing and Communicating the USPCASW Brand	Workshop (Classroom)	USPCASW Faculty (18)	Governance
81	19	July 29 – 30, 2019	Technical Writing	Workshop (Classroom)	USPCASW Students (40)	Curriculum
82	19	July 31, 2019	Advanced Statistical Analysis	Workshop (Classroom)	USPCASW Faculty (18)	Research
83	19	August 1 – 3, 2019	New Faculty Boot Camp	Workshop (Classroom)	USPCASW Faculty (3), MUET Faculty (20)	Curriculum, Research, Governance
84	19	August 1 – 2, 2019	Statistical Analysis	Workshop (Classroom)	USPCASW Students (40)	Curriculum
85	19	August 5, 2019	Industrial Wastewater Management Executive Seminar	Engagement Event	USPCASW Faculty (18), USPCASW Students (50)	Research

86	19	August 6 – 9, 2019	Water Pollutant Source Tracking	Workshop & Micro-training (Coaching)	USPCASW Faculty (8), USPCASW Students (20)	Research
87	19	August 6 – 9, 2019	Multilevel Soil Moisture and Salinity Monitoring	Workshop & Micro-training (Coaching)	USPCASW Faculty (6), USPCASW Students (15)	Research
88	20	October 26 – November 1, 2019	WASH Research Laboratory Safety and Field Sampling Protocols;	Workshop (Coaching)	USPCASW Faculty (6), USPCASW Students (10)	Research
89	20	October 31, 2019	WASH in Schools and Healthcare Facilities	Workshop (Coaching)	USPCASW Faculty (6), USPCASW Students (30), Stakeholders	Exchanges & Training
90	21	November 18-22, 2019	Drinking Water Distribution Systems	Workshop (Classroom)	USPCASW Faculty (3), Stakeholders	Exchanges & Training
91	22	December 5 – 6, 2019	Advanced Microbial Tools for Exploring the Interface of Environmental Process Engineering and Microbiology – Application to Antibiotic Resistant Bacteria	Workshop (Classroom)	USPCASW Faculty (6), USPCASW Students (10)	Research
92	22	December 5 – 6, 2019	Data Science	Workshop (Classroom)	USPCASW Faculty (6), USPCASW Students (10)	Research
93	22	December 7, 2019	Preparing Policy Briefs	Workshop (Classroom)	USPCASW Faculty (16), USPCASW Students (1)	Research
94	22	December 10, 2019	Faculty Retreat	Engagement Event	USPCASW Faculty (16)	Sustainability
95	22	December 11 – 12, 2019	New Faculty Boot Camp	Workshop (Classroom)	MUET Faculty (24)	Curriculum, Research, Governance
96	22	December 13, 2019	Stakeholder Dialog on Strengthening Service Delivery in the Water Sector	Engagement Event	USPCASW Faculty (16), Stakeholders	Research, Training

97	23	February 4, 2020	Graduation Ceremony	Engagement Event	USPCASW Faculty, Students, Stakeholders	Governance & Sustainability

**Note: the number of participants for each event is in parentheses. These numbers do NOT reflect different individuals across different activities. Indeed, the same 20 or so faculty members were the recipients of the bulk of these capacity development inputs.*

Annex 15. Grants awarded by the Center at MUET

(Client-driven projects denoted with label "Industry-Academia Seed Grants"; Strategic directed grants listed at end of table.)

Projects from 1st Phase Grants (awarded in 2016)			
Project Title	**Principal Investigator**	**PI Affiliation & Partner Institute / University**	**Rs (millions)**
Assessment of Environmental Degradation of Manchar Lake	Mr. Zamir Ahmed Soomro	PCRWR & USPCASW, MUET	2.752
Decision Support System for Water Resources Planning and Management	Mr. Waqas Ahmed	USPCAS-W, MUET & University of Nevada, Las Vegas	1.823
Climate Change: Assessing Impact of Seawater Intrusion on Soil, Water & Environment in Indus delta using GIS & Remote Sensing	Dr. Altaf Ali Siyal	USPCAS-W, MUET	2.484
Managing Uncertainties in Projected Impacts of Climate Change on Precipitation Patterns in the Indus Basin, Pakistan	Mr. Ghulam Hussain Dars	USPCAS-W, MUET & University of Victoria, Canada	1.647
Water Conservation and Mitigation of Arsenic in Rice through Sprinkler Irrigation System	Dr. Abida Farooqi	Quaid-i-Azam University, Islamabad, Pakistan	2.381
Identification of Antibiotic Resistant Bacteria in Different Source Waters in Hyderabad City and its Surroundings	Dr. Rasool Bux Mahar	USPCAS-W, MUET & PCSIR	2.76
Projects from 2nd Phase Grants (awarded in 2017)			
Project Title	**Principal Investigator**	**PI Affiliation & Partner Institute/ University**	**Rs (millions)**
Changing Climate in Pakistan: Food Security and Water Management Implications – Provide High Resolution Climate Simulations for Complex Terrain: An Action to Protect our Asset	Mr. Ghulam Hussain Dars	USPCAS-W, MUET & University of Utah	3.15
Assessing Effectiveness of Linear Anionic Polyacrylamide (LA-PAM) to Reduce Seepage Losses in Unlined Canals	Dr. Munir Babar	USPCAS-W, MUET & Colorado State University	2.949
Crop Water Productivity Assessment of Major Crops in Sindh and Punjab	Mr. Mohammad Ali	USPCAS-W, MUET & NIAB, Faisalabad	2.98

Keenjhar Lake Water Quality Assessment and Valuing Ecosystems Services (KL-WAVES)	Ms. Uzma Imran	USPCAS-W, MUET	2.89
Monitoring Seawater Intrusion in the Indus Delta for Climate Change Adaptation	Dr. Ashfaq Ahmed Sheikh	PCRWR, USPCAS-W, MUET	2.835
Assessment of water, sanitation and hygiene services in primary schools of Sindh, addressing Sustainable Development Goal -6	Dr. Jamil Ahmed	USPCAS-W, MUET & Emory University, USA	3.019
Use of Multi-Level Remote Sensing to Evaluate Salinity on Irrigated Lands	Dr. Altaf Ali Siyal	USPCAS-W, MUET	2.999
Projects from 3rd Phase Grants (awarded in 2018)			
Project Title	**Principal Investigator**	**PI Affiliation & Partner Institute/ University**	**Rs (millions)**
Governance and Civic Capacity for the Provision of Drinking Water in Urban Sindh	Ms. Maha Ahmed	National University of Science and Technology (NUST) & University of Delaware, USA	2.742
Isolation and Characterization of Antimicrobial Resistant Water Contaminant and Bacteriophage Remedy to Improve Water Quality	Dr. Ayaz Ahmed	Panjwani Center for Molecular Medicine & Drug Research (PCMD), Univ. Karachi	2.789
2D Materials Design and Discovery in Water Treatment	Dr. Ghulam Mustafa	ICCBS, University of Karachi	2.939
Simulation Modeling and Analysis of Household Water Consumption in Pakistan using Hybrid Approach	Dr. Imran Mehmood	National University of Science and Technology (NUST)	2.283
Assessment of sediment pollution in a diverse (Goi Nala) catchment of River Jhelum, Azad Jammu and Kashmir	Dr. Mohsin Zafar	The University of Poonch Rawalkot	2.672
Multifunctional nanocomposite membranes for wastewater treatment	Dr. Farha Masood	COMSATS Institute of Information and Technology	2.998
Integrating water sanitation and hygiene indicators into the National Health Information System in healthcare facilities of Pakistan: the use of this novel tool in a cluster randomized trial	Dr. Jamil Ahmed	USPCAS-W, MUET + University of Nevada	2.878

Production of drinking water from Indus River through Canal bank filtration for Mehran University Jamshoro: Estimation of yield, pumping requirements, bioclogging, and characterization of water quality	Dr. Zubair Ahmed	USPCAS-W, MUET & U	2.999
Improved Hydro meteorological forecast under changing climate by using robust modelling techniques	Mr. Ghulam Hussain Dars	USPCAS-W, MUET & U	2.59
Indus River Water Level Monitoring in Sindh using Satellite Radar Altimetry	Dr. Arjumand Zaidi	USPCAS-W, MUET & SID	2.866
Estimating Sustainability Cost of Urban Water Supply for Hyderabad City, Sindh, Pakistan	Dr. Kamran Ansari	USPCAS-W, MUET	2.272
Industry-Academia Seed Grant Eco-innovation in textile processing industry of KITE for sustainable product processing	Dr. Zubair Ahmed	USPCAS-W, MUET	2.999
Industry-Academia Seed Grant Treatment and reuse of wastewater of fish processing industry	Dr. Zubair Ahmed	USPCAS-W, MUET + Fishery Industry & U	3 (plus 1 from industry)
Industry-Academia Seed Grant Wastewater Treatment and Reuse to approach zero water discharge in Al-Rahim Textile industries: substantial increase water use efficiency in Textile processing	Dr. Tanveer Ahmed Gadhi	USPCAS-W, MUET and Al-Rahim Textile Industry	2.838 (plus 3 from industry)
Industry-Academia Seed Grant Closed-loop secondary-level canal monitoring for equitable and reliable distribution of water	Dr. Abdul Latif Qureshi	USPCAS-W, MUET, SIDA and U	3 (plus 3 from SIDA)
MUET Directed Strategic Grants (awarded in 2018)			
Project Title	**Principal Investigator**	**PI Affiliation & Partner Institute/ University**	**Rs (millions)**
Assessing relevance of CAS-W program outputs to Sector/Industry needs (i.e., the "Market Study")	Ipsos [consulting firm]	Ipsos [consulting firm]	4.949 (3 M from Center + 1.949 M from U)
An Integrated Development Plan for the Barani Areas of the Punjab Province (Barani-2 Report)	National Rural Support Program (NRSP)	National Rural Support Program (NRSP)	2.889

Annex 16. Budget support for U.S.-based researchers

Project #	Principal Investigator (PI), Organization, MUET Collaborator	Project Title	Budget (USD)
1	Dr. Steven Burian, UU, Ms. Rakhshinda Bano	Estimating sustainability cost of urban water supply for Hyderabad City, Sindh Pakistan	$78,807
2	Dr. Steven Burian, UU, Dr. Latif Qureshi, Mr. Waqas Ahmed	Closed-loop secondary-level canal monitoring for equitable and reliable distribution of water	$26,624
3	Dr. Gabe Bowen, UU, Mr. Ghulam Hussain Dars	Lower Indus isotope hydrology and integrated water resources management	$30,000
4	Dr. Court Strong, UU, Mr. Ghulam Hussain Dars	Improved hydro meteorological forecasts under changing climate by using robust modeling techniques	$82,177
5	Dr. Josh Garn, UNR, Mr. Jamil Soomro	Integrating water sanitation and hygiene indicators into the National Health Information System in healthcare facilities of Pakistan: the use of this novel tool in a cluster randomized trial	$75,167
6	Dr. Krista Carlson, UU, Dr. Sara Hassan	Characterization of an electrocatalytic point-of-use water disinfection device	$57,364
7	Dr. Summer Rupper, UU, Mr. Ghulam Hussain Dars	Glacier contributions to urban water resources	$45,528
8	Dr. Carlos Oroza, UU, Dr. Latif Qureshi, Mr. Waqas Ahmed	Smart agriculture water management	$29,000
9	Dr. Jim VanDerslice, UU, Mr. Jamil Soomro	A collaborative new-investigator initiative assessing antibiotic resistant bacteria transmission via fecal-oral routes in Sindh Province, Pakistan	$68,997
10	Dr. Sajjad Ahmad, UNLV, Dr. Kamran Ansari, Mr. Waqas Ahmed	Indus River modeling	$75,000
11	Dr. Darrin Young, UU, Dr. Latif Qureshi, Mr. Waqas Ahmed	Wireless sensor networks for canal flow and water quality monitoring	$30,000
12	Dr. Robin Craig, UU, No MUET Collaborator*	What science and social questions should we answer before suggesting improvements to Pakistan's water law and why?	$22,607
13	Dr. Shelley Minteer, UU, No MUET Collaborator*	Salinity & bioelectrochemical systems for wastewater treatment: solving orthogonal problems	$19,612

14	Dr. Ramesh Goel, UU, Dr. Rasool Bux Mahar, Dr. Rizwan	Micro-promoting innovative water research and updating environmental engineering courses at MUET	$20,000
15	Dr. Krista Carlson, UU, Dr. Sara Hassan	Micro-visualization of the electrocatalytic inactivation of viruses	$20,000
		Total (USD)	***$680,883***

*In cases when a MUET collaborator was not present, the PI was either contributing a general research product (the legal/policy assessment by Professor Craig) or hosting students working on projects in the PI's area of expertise (Dr. Minteer), but were being advised by MUET faculty members without the relevant expertise/research program (microbial fuel cells).

Annex 17. USPCASW peer-reviewed journal article publications (2015-2019)

Publication Reference	
2019	
1	Achhami, A., Ahmad, S., & Stephen, H. (2019). Relating Urbanization and Irrigation Water Demand in Gujranwala District of Pakistan. World Environmental and Water Resources Congress, Pittsburg, PA. pp. 1-14.
2	Ahmed, N., Ok, Y. S., Jeon, B. H., Kim, J. R., Chae, K. J., & Oh, S. E. (2019). Assessment of benzene, toluene, ethyl-benzene, and xylene (BTEX) toxicity in soil using sulfur-oxidizing bacterial (SOB) bioassay. *Chemosphere*, 220, 651-657.
3	Ahmed, W., Palmier, C., Atteia, O., & Class, H. (2019). Multiphase Simulation Model for Validating the Estimate of Light Non-Aqueous Phase Liquids (LNAPL) Transmissivity Using Bail-Down Test. *Arabian Journal for Science and Engineering*, 44(6), 6099-6107.
4	Ali, A., Mahar, R. B., & Sheerazi, S. T. H. (2019). Renewable Electricity Generation from Food Waste Through Anaerobic Digestion in Pakistan: A Mini-Review. *Earth Systems and Environment*, 3(1), 95-100.
5	Ali, A., Mahar, R. B., Abdelsalam, E. M., & Sherazi, S. T. H. (2019). Kinetic modeling for bioaugmented anaerobic digestion of the organic fraction of municipal solid waste by using Fe 3 O 4 nanoparticles. *Waste and Biomass Valorization*, 10(11), 3213-3224.
6	Ali, A., Malik, S. A. A. D., Zaidi, A. Z., Ahmad, N., Shafique, S., Aftab, M. N., & Aisha, K. (2019). Standing Stock Of Seaweeds In Submerged Habitats Along The Karachi Coast, Pakistan: An Alternative Source Of Livelihood For Coastal Communities. *Pak. J. Bot*, 51(5).
7	Bhatti, N. B., Siyal, A. A., Qureshi, A. L., & Bhatti, I. A. (2019). Land Covers Change Assessment After Small Dam's Construction Based on the Satellite Data. *Civil Engineering Journal*, 5(4), 810-818.
8	Bhatti, N. B., Siyal, A. A., Qureshi, A. L., & Bhatti, I. A. (2019). Socio-Economic Impact Assessment of Small Dams Based on T-Paired Sample Test Using SPSS Software. *Civil Engineering Journal*, 5(1), 153-164.
9	Bhatti, N. B., Siyal, A. A., Qureshi, A. L., Solangi, G. S., Memon, N. A., & Bhatti, I. A. (2019). Impact of small dam's construction on groundwater quality and level using water quality index (WQI) and GIS: Nagarparkar area of Sindh, Pakistan. *Human and Ecological Risk Assessment: An International Journal*, 1-22.
10	Bhutto, A. H., Zardari, S., Bhurgri, G. S., Zardari, M. A., Bhanbhro, R., Babar, M. M., & Memon, B. A. (2019). Parametric Analysis of an Embankment Dam's Stability. *Engineering, Technology & Applied Science Research*, *9*(6), 5016-5020.
11	Bhutto, A. H., Zardari, S., Zardari, M. A., Bhurgri, G. S., Memon, B. A., Bhanbhro, R., & Babar, M. M. (2019). Mohr-Coulomb and hardening soil model comparison of the settlement of an embankment dam. *Engineering, Technology & Applied Science Research*, *9*(5), 4654-4658.
12	Gadhi, T. A., Hernández, S., Castellino, M., Jagdale, P., Husak, T., Hernández-Gordillo, A., ... & Russo, N. (2019). Insights on the role of β-Bi2O3/Bi5O7NO3 heterostructures synthesized by a scalable solid-state method for the sunlight-driven photocatalytic degradation of dyes. *Catalysis Today*, 321, 135-145.
13	Gionco, C., Hernández, S., Castellino, M., Gadhi, T. A., Muñoz-Tabares, J. A., Cerrato, E., ... & Paganini, M. C. (2019). Synthesis and characterization of Ce and Er doped ZrO2 nanoparticles as solar light driven photocatalysts. *Journal of Alloys and Compounds*, 775, 896-904.

14	Hassan, D, Burian, S.J., Bano, R., Ahmed, W., Arfan, M., Naseer Rais, M., Rafique, A., and Ansari, K. (2019). An assessment of the Pakistan Water Apportionment Accord of 1991. *Resources*, 8(3), 120.
15	Hassan, D., Rais, M. N., Ahmed, W., Bano, R., Burian, S. J., Ijaz, M. W., & Bhatti, F. A. (2019). Future water demand modeling using water evaluation and planning: a case study of the Indus Basin in Pakistan. *Sustainable Water Resources Management*, 5(4), 1903-1915.
16	Hernández-Gordillo, A., Bizarro, M., Gadhi, T. A., Martínez, A., Tagliaferro, A., & Rodil, S. E. (2019). Good practices for reporting the photocatalytic evaluation of a visible-light active semiconductor: Bi 2 O 3, a case study. *Catalysis Science & Technology*, *9*(6), 1476-1496.
17	Ijaz, M. W., Mahar, R. B., Ansari, K., & Siyal, A. A. (2019). Optimization of salinity intrusion control through freshwater and tidal inlet modifications for the Indus River Estuary. *Estuarine, Coastal and Shelf Science*, *224*, 51-61.
18	Imran, U., Ullah, A., Shaikh, K., Mehmood, R., & Saeed, M. (2019). Health risk assessment of the exposure of heavy metal contamination in surface water of lower Sindh, Pakistan. *SN Applied Sciences*, *1*(6), 589.
19	Ivanov, V., Stabnikov, V., Stabnikova, O., Salyuk, A., Shapovalov, E., Ahmed, Z., & Tay, J. H. (2019). Iron-containing clay and hematite iron ore in slurry-phase anaerobic digestion of chicken manure. *AIMS Materials Science*, *6*(5), 821.
20	Jamro, S., Dars, G. H., Ansari, K., & Krakauer, N. Y. (2019). Spatio-Temporal Variability of Drought in Pakistan Using Standardized Precipitation Evapotranspiration Index. *Applied Sciences*, *9*(21), 4588.
21	Korai, M. S., Ali, M., Lei, C., Mahar, R. B., and Yue, D. (2019). Comparison of MSW management practices in Pakistan and China. *Journal of Material Cycles and Waste Management*, 1-11.
22	Kori, J. A., Mahar, R. B., Vistro, M. R., Tariq, H., Khan, I. A., & Goel, R. (2019). Metagenomic analysis of drinking water samples collected from treatment plants of Hyderabad City and Mehran University Employees Cooperative Housing Society. *Environmental Science and Pollution Research*, 1-13.
23	*Krakauer, N. Y. (2019). Year-ahead predictability of South Asian Summer Monsoon precipitation. *Environmental Research Letters*, *14*(4), 044006.
24	Krakauer, N. Y., Lakhankar, T., & Dars, G. H. (2019). Precipitation Trends over the Indus Basin. *Climate*, *7*(10), 116.
25	Mahessar, A. A., Ansari, K., Arain, G. M., Kori, S. M., Qureshi, S., & Qureshi, A. L. (2019). Impact of Right Bank Outfall Drain-I (RBOD-I)/Main Nara Valley Drain (MNVD) on Manchar Lake, Sindh, Pakistan. *Engineering, Technology & Applied Science Research*, *9*(6), 5074-5079.
26	Mahessar, A. A., Laghari, A. N., Qureshi, S., Siming, I. A., Qureshi, A. L., & Shaikh, F. A. (2019). Environmental Impact Assessment of the Tidal Link Failure and Sea Intrusion on Ramsar Site No. 1069. *Engineering, Technology & Applied Science Research*, 9(3), 4148-4153.
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*These papers are excluded from the analysis of publications in main text since there is no USPCASW co-author (either faculty, student, or alumni).

Annex 18. Drafted policy briefs

#	Policy Brief Title	USPCASW Author (PI)
1	Keenjhar Lake Water Quality Assessment and Valuing Ecosystems Services	Ms. Uzma Imran
2	Canal Water Monitoring Using ICT for Equitable and Reliable Water Distribution	Dr. Abdul Latif Qureshi
3	The River Indus Monitor (TRIM): Trim Your Budget with TRIM	Dr. Arjumand Zaidi
4	Hyderabad District: A Hotspot for Flexner's Dysentery	Dr. Ayesha Tajammul
5	Risk of Waterborne Diseases to Primary School Children of Sindh, Pakistan (A Quantitative Microbial Risk Assessment Tool)	Dr. Jamil Soomro
6	Monitoring and Managing MUET's Drinking Water Quality	Dr. Syeda Sara Hassan
7	Smart Monitoring and Adaptive Management of Groundwater is the Solution to Control Water Logging and Over-Exploitation of Groundwater	Mr. Waqas Ahmed
8	More Crop Per Drop: Water and Energy Conservation through Laser Land Grading	Mr. Muhammad Arfan*

*USPCASW PhD student in IWRM.

Annex 19. Curriculum for Master's degree programs.

Semester	Common Courses			
All 4	Graduate Seminar			
1	Research Methods			
1-2	Technical Writing			
2	Statistics			
3 or 4	Water Law, Policy, and Community			
	IWRM	**HID**	**EnvEng**	**WASH**
1	Hydroinformatics: Data Management and Analysis	Hydroinformatics: Data Management and Analysis	Physical, Chemical & Biological Processes	Water and Health
1	GIS and Remote Sensing	GIS and Remote Sensing	Environmental Economics	Biostatistics and Epidemiology
1	IWRM: Principles and Applications	Open Channel Hydraulics	Solid & Hazardous Waste Management	Chemistry and Biology of WASH
2	Sustainable Development	Groundwater Hydraulics	Water Supply Engineering	Small Water System Design
2	Hazard Planning and Risk Management	Watershed Modeling	Water and Wastewater Treatment Design	Sanitation Systems, Water Reuse and Hygiene
2	Climate and Water	Irrigation Water Management	Water Quality Management	WASH and Community
3	Advanced Modeling and Analysis for IWRM	Agricultural Land Drainage	Environmental Impact Assessment	WASH Assessment and Practical Management

Annex 20. Course Mentoring Program Description

COURSE MENTORING PROGRAM
Spring 2018

Goal

The goal of the USPCAS-W Course Mentoring Program (CMP) is to develop and deliver instruction at Mehran University of Engineering and Technology (MUET) that is consistent with expectations at the leading institutions of higher education in the world. To enable MUET to achieve this goal, first-time instructors at USPCAS-W are assigned mentors at the University of Utah and other institutions to review learning materials and delivery of the courses comprising the USPCAS-W curriculum. The CMP is designed to be an efficient system with accountability for verifying course development and delivery quality.

Format and Process

The USPCAS-W CMP will be coordinated using the Canvas online learning management system (LMS) along with Box online file storage for sharing materials. The MUET instructor and mentor will be granted access to the system and guided through the process using assignments, discussions, and other tools in the Canvas LMS. The mentor shall provide review and critique of learning materials. The USPCAS-W Course Mentoring Administration Team will review progress and interaction in Canvas and provide additional feedback to the instructor and mentor as needed.

Deliverables Completion Schedule (details of deliverables provided after table)

	Deliverable	Submission Deadline* (MUET Instructor)	Review Deadline* (Mentor)
1	Schedule Meetings	February 2, 2018	
2	Syllabus	February 2, 2018	February 9, 2018
3	25% of Lessons	February 16, 2018	February 23, 2018
4	Learning Assessments	March 2, 2018	March 9, 2018
5	50% of Lessons	March 16, 2018	March 23, 2018
6	75% of Lessons	April 6, 2018	April 13, 2018
7	100% of Lessons	April 27, 2018	May 2, 2018
9	Course Improvement Plan	May 11, 2018	May 18, 2018

*Note: The instructor and mentor must work incrementally on lesson deliverables, which means as deliverables are completed the instructor uploads and requests review from mentor. For example, the deadlines for 25% of lessons are February 16 (submitted) and February 23 (reviewed), but the instructor should upload Lesson 2 to Box as soon as it is ready and the mentor should review and provide feedback to the instructor before the lesson is delivered to the students.

1. Schedule Progress Meetings

A schedule for online (or in person) meetings shall be established between the instructor and mentor. Expectation is at least two meetings per month. Meetings can be conducted using Skype, Google Hangout, GoToMeeting or other format and should last approximately one hour. More frequent interaction through email, brief online exchanges, and other means should occur as needed (especially toward the beginning of the semester). The MUET instructor will send the schedule of meetings to Davey Stevenson (davey.stevenson@utah.edu) for insertion into a shared GoogleDoc available through the Canvas LMS Collaborations element.

Checklist

MUET Instructor (Due 2/02/18)

- ☐ Send the agreed-upon schedule of meetings to Davey Stevenson for insertion into the GoogleDoc available through the "Collaborations"

2. Review Syllabus

A course syllabus shall be prepared by the MUET instructor that includes course description, learning goals, grading policy, listing of topics/schedule, reading assignments/textbook, and other course administration and delivery items. The course syllabus will be uploaded to Box by the instructor. The Syllabus Review Form will be completed by the instructor and uploaded to Canvas. The mentor will review the syllabus, provide feedback to instructor, complete the Syllabus Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed.

Checklist

MUET Instructor (Due 2/02/18)

- ☐ Upload syllabus to Box
- ☐ Complete a self-assessment using the Syllabus Review Form
- ☐ Upload the Syllabus Review Form to Canvas for the Assignment "Review Syllabus"

Mentor (Due 2/09/18)

- ☐ Review the syllabus in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete the Syllabus Review Form
- ☐ Upload the Syllabus Review Form to Canvas (via SpeedGrader) for the Assignment "Review Syllabus"
- ☐ Mark assignment as "Completed" in Canvas

3. Critique 25% of Lessons

As soon as lessons are prepared and before they are delivered to students, the MUET instructor will upload lesson materials to shared folder in Box and alert the mentor that the materials are ready for review. The mentor will then review and provide feedback. This should happen incrementally, one or two lessons at a time. The deadline of January 20 for upload and January 27 for review indicates when 25% of lessons should be completed (submitted and reviewed). The instructor will complete a Lesson Review Form and upload to Canvas. The mentor will review the materials in Box, provide feedback to instructor, download and complete the Lesson Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed. Use one Lesson Review form for the entire lesson block, but provide lesson specific feedback through other means and Skype discussions.

Checklist

MUET Instructor (Due 2/16/18)

- ☐ Incrementally (one or two lessons at time) upload materials for the first 25% of lessons to the assigned course folder in Box
- ☐ Alert your mentor as you add materials to Box
- ☐ Complete a self-assessment using the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas for the Assignment "Critique 25% of Lessons"

Mentor (Due 2/23/18)

- ☐ Incrementally (one or two lessons at a time) review the materials for the first 25% of lessons in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas (via Speed Grader) for the Assignment "Critique 25% of Lessons"
- ☐ Mark assignment as "Completed" in Canvas

4. Review Learning Assessments

The MUET instructor will upload to Box a list of course learning assessments (use Course Alignment Grid worksheet) that contribute toward achieving the course learning goals. The instructor will also upload to the Box folder all assessment instruments (e.g., homework, rubrics, solutions, exams, project assignments). The instructor will complete assessment based on the Course Alignment Grid Worksheet and upload to Canvas. The mentor will review the materials in Box, provide feedback to instructor, download and complete the Learning Assessment Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed.

Checklist

MUET Instructor (Due 3/02/18)

- ☐ Complete Course Alignment Grid Worksheet
- ☐ Upload Course Alignment Grid Worksheet to Box
- ☐ Upload all assessment instruments to Box
- ☐ Complete a self-assessment using the Learning Assessment Review Form
- ☐ Upload Learning Assessment Review Form to Canvas for the Assignment "Review Learning Assessments"

Mentor (Due 3/09/18)

- ☐ Review assessment materials in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete assessment using the Course Alignment Grid Worksheet
- ☐ Upload assessment to Canvas (via Speed Grader) for the Assignment "Review Learning Assessments"
- ☐ Mark assignment as "Completed" in Canvas

5. Critique 50% of Lessons

The MUET instructor will upload lesson materials for the first 50% of lessons to the shared folder in Box. Similar to the previous lessons, included in the Box folder should be lesson alignment grid, lesson plan, descriptions of learning activities, presentations, handouts, assessment instruments, and other materials used for instruction. The instructor will complete a Lesson Review Form and upload to Canvas. The mentor will review the materials in Box, provide feedback to instructor, download and complete the Lesson Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed.

Checklist

MUET Instructor (Due 3/16/18)

- ☐ Upload materials for the first 50% of lessons to the assigned course folder in Box
- ☐ Complete a self-assessment using the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas for the Assignment "Critique 50% of Lessons"

Mentor (Due 3/23/18)

- ☐ Review the materials for the first 50% of lessons in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas (via Speed Grader) for the Assignment "Critique 50% of Lessons"
- ☐ Mark assignment as "Completed" in Canvas

6. Critique 75% of Lessons

The MUET instructor will upload lesson materials for the first 75% of lessons to the shared folder in Box. The instructor will complete a Lesson Review Form and upload to Canvas. The mentor will review the materials in Box, provide feedback to instructor, download and complete the Lesson Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed.

Checklist

MUET Instructor (Due 4/06/18)

- ☐ Upload materials for the first 75% of lessons to the assigned course folder in Box
- ☐ Complete a self-assessment using the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas for the Assignment "Critique 75% of Lessons"

Mentor (Due 4/13/18)

- ☐ Review the materials for the first 75% of lessons in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas (via Speed Grader) for the Assignment "Critique 75% of Lessons"
- ☐ Mark assignment as "Completed" in Canvas

7. Critique 100% of Lessons

The MUET instructor will upload all remaining lesson materials to the Box shared folder. The instructor will complete a Lesson Review Form and upload to Canvas. The mentor will review the materials in Box, provide feedback to instructor, download and complete the Lesson Review Form, upload form to Canvas via SpeedGrader, and mark assignment as completed.

Checklist

MUET Instructor (Due 4/27/18)

- ☐ Upload materials for 100% of lessons to the assigned course folder in Box
- ☐ Complete a self-assessment using the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas for the Assignment "Critique 100% of Lessons"

Mentor (Due 4/02/18)

- ☐ Review the materials 100% of lessons in Box
- ☐ Provide feedback directly to instructor (e.g., during Skype meeting)
- ☐ Complete the Lesson Review Form
- ☐ Upload the Lesson Review Form to Canvas (via Speed Grader) for the Assignment "Critique 100% of Lessons"
- ☐ Mark assignment as "Completed" in Canvas

8. ***Complete Course Improvement Plan***

The final step of the CMP is the review of materials and teaching and writing of the Course Improvement Plan (CIP). The mentor will review all elements of the CMP and complete a CIP using the template provided on Canvas that identifies the key areas for the instructor to improve course materials and her or his teaching effectiveness. The instructor will review the CIP, modify, and approve. The instructor and mentor will agree on the CIP contents, sign, and the instructor will upload the completed CIP to Canvas to complete the assignment. The CMP Administration Team will review signed CIP submissions and mark the assignment as completed.

Checklist

MUET Instructor (Due 5/11/18)

- ☐ Review all elements of the CMP in Box
- ☐ Complete a Course Improvement Plan Form
- ☐ Share the Course Improvement Plan Form with Mentor

Mentor (Due 5/18/18)

- ☐ Review the Course Improvement Plan
- ☐ Iterate with the instructor to finalize the Course Improvement Plan, sign the form, and upload to Canvas for the Assignment "Complete Course Improvement Plan"

Review by CMP Team (Due 6/01/18)

- ☐ Review all signed Course Improvement Plans submitted through Canvas
- ☐ Mark as "Complete" all those who have completed the Assignment "Complete Course Improvement Plan"

Fall 2019 Semester Exchange Program

THE UNIVERSITY OF UTAH

USPCASW Semester Exchange Program
Fall 2019

Introduction

The USPCASW Semester Exchange Program (SEP) provides the opportunity for *exceptional* students and faculty in the USPCASW program at Mehran University of Engineering and Technology (MUET) to study at the University of Utah (U) and Colorado State University (CSU). The SEP is administered by the USPCASW team at U and CSU. This document describes the goal and objectives of the SEP and the activities.

Goal and Objectives

The goal of the SEP is to provide a learning experience to prepare students and faculty to serve as the next generation of water professionals helping Pakistan achieve Sustainable Development Goal 6, Clean Water and Sanitation for all. With technical, non-technical, and cross-cultural experiences, the SEP provides a well-rounded education to support the development of a *complete engineer*.

Outcomes

Over the course of the SEP, students will develop two key deliverables:

1. An ePortfolio reflecting the student's work over the course of the semester and reflections on that work.
2. A well-developed research poster showcasing the student's thesis work.

In pursuit of these outcomes and in development of a complete engineer, students will participate in courses, workshops, and other activities to build their capacity. The key areas the program will focus on are:

1) *Substantive knowledge* – knowledge gain in a particular subject or topic, including coursework, workshops, trainings, and independent study.
2) *Applied research skills* – ability to carry out new technical analyses contributing to an applied research
3) *Communication skills* – ability to convey ideas effectively in both speaking and writing, with a focus on completing the first three chapters of the student's thesis and presenting research ideas
4) *Global perspectives* – awareness of issues affecting people in different countries, how these intersect with each other, how these solutions relate to the research the students are working on, and why it's important for local solutions
5) *Cross-cultural interaction skills* – ability to engage professionally with those who come from a different cultural background, preparing students for work in a globally connected world
6) *Networking & collaboration skills* – ability to make new contacts, establish meaningful professional relationships, and work in teams, including students, advisors, and other professionals

7) *Leadership skills* **–** ability to set goals and generate collective enthusiasm to work towards innovative solutions to problems
8) *Professional skills* – ability to manage time, organize activities, be inclusive, and produce quality work

In essence, the SEP's emphasis on knowledge and skills (i.e., *human capital*) is because these are non-depletable resources that Exchange Visitors will be able to continue to invest in her or his own future development and career. For example, by improving ability to network effectively, visitors will be able to increase *social capital*, which refers to the goodwill, trust, and shared values embedded in meaningful relationships that can be drawn upon to facilitate cooperation and collaboration (for research, policy-making, etc.).

The means by which these general outcomes will be achieved involves several distinct but integrated components: research training, technical coursework, field trips, interdisciplinary seminar, writing training and lab, social activities, and cultural experiences. An exchange coordinator monitors progress, provides advice, and troubleshoots problems. The core activities are described in the sections below.

Despite this detailed programming—and because capacity development is "the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities *to set and achieve their own development objectives over time*" (UNDP, *Capacity Development: A UNDP Primer*, 2009, p. 5, emphasis added)—visitors are encouraged and expected to take ownership of their own intellectual and professional development by taking advantage of the plethora of learning opportunities on the U and CSU campuses and surrounding communities. This is motivated through the use of incentives rewarding credentials to those students that take initiative to seek out and complete independent learning opportunities.

Program Overview

The calendar below shows a ***sample*** of regularly scheduled items of the program (with the human and/or social capital area listed in parentheses). The technical course audit will be fit into the available time slots. During the time each week outside the common elements, visitors will be working on research activities associated with their thesis, additional training, course assignments, and participating in technical field trips, meetings, and social and cultural activities. Remaining time each week outside of scheduled items is available for the visitors to use as they choose to improve their capacities and enhance their experiences – research, reading, socializing, sight-seeing, and so on. Additional activities and short-term training will also be incorporated to address desired capacity building.

Advisory Meetings

<table>
<tr><th>Time/day</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thurs</th><th>Fri</th></tr>
<tr><td>8 – 9</td><td rowspan="2">Thesis Research and Training (2)</td><td rowspan="2">Writing Class (3,6) (9:00-11:00)</td><td rowspan="2">Thesis Research and Training (2)</td><td rowspan="2">Writing Class (3,6) 9:00 to 11:00</td><td>Thesis Research and Training (2)</td></tr>
<tr><td rowspan="2">9 – 10
10 – 11</td><td rowspan="2">Integrated Learning --- Field Trips or Professional Development (1, 3, 6, 7, 8) (9am-11pm)</td></tr>
<tr><td>11 – 12</td><td>Writing Practicum (3) 11:00 to 12:00</td><td>Writing Practicum (3) (11:00-12:00)</td><td>Writing Practicum (11:00-12:00)</td><td>Writing Practicum (3) (11:00-12:00)</td></tr>
<tr><td>12 – 1</td><td rowspan="2">Thesis Research and Training (2)</td><td rowspan="5">Thesis Research and Training (2)</td><td rowspan="2">Thesis Research and Training (2)</td><td rowspan="5">Thesis Research and Training (2)</td><td rowspan="4">Thesis Research and Training (2)</td></tr>
<tr><td>1 – 2</td></tr>
<tr><td>2 – 3</td><td>Advisory Meetings (3, 5, 7, 8) (2:00pm-3:00pm)</td></tr>
<tr><td>3 – 4
4 – 5</td><td rowspan="2">Thesis Research and Training (2)</td><td>Water Seminar (1, 3, 4, 5, 6) (3:00-4:30pm)</td></tr>
<tr><td>5 – 6</td><td>Thesis Research and Training (2)</td></tr>
<tr><td>6 – 8
8 – 10</td><td>Homework, Thesis Writing, and Other Assignments (1,2,3)</td><td>Homework, Thesis Writing, and Other Assignments (1,2,3)</td><td>Homework, Thesis Writing, and Other Assignments (1,2,3)</td><td>Homework, Thesis Writing, and Other Assignments (1,2,3)</td><td>Homework, Thesis Writing, and Other Assignments (1,2,3)</td></tr>
</table>

Exchange Visitors will meet once per week (day and room TBD) with the SEP Coordinator and invited guests for progress reporting, discussion about program elements, clarification of activities, brainstorming ideas to improve the experience, and workshops on relevant topics. Planned meeting activities will build Communication Skills (3), Cross-Cultural Interaction Skills (5), Leadership Skills (7), and Professional Skills (8).

Thesis Research Mentoring

Students are selected by a faculty member at UU or CSU to be mentored. The faculty member will have expertise and time to provide general research guidance, review thesis research plan and deliverables, provide recommendations and collaboration, and edit written products. Students will also submit a weekly report to their faculty advisor at MUET, copying their advisor at the U and the exchange coordinator. This should include a brief summary of research activities completing in the previous week, as well as a plan for the following week. Thesis

Research Mentoring will build Substantive Knowledge (1), Applied Research Skills (2), Communication Skills (3), and Network and Collaboration Skills (6).

Coursework
Exchange Visitors will participate in one semester-length technical course. The course will build Substantive Knowledge (1). The expectations for Exchange Visitors participating in the SEP are the same for UU students enrolled in the class. SEP participants will receive a grade based on their performance in the course.

Seminar
The USPCASW Seminar will meet weekly (Day and Room TBD). The goal of the seminar is to create a diverse exposure to water resources challenges and solutions and help the students relate the experiences to challenges and solutions in Pakistan. The Seminar will build Substantive Knowledge (1), Communication Skills (3), Global Perspectives (4), Cross-Cultural Interaction Skills (5), and Network and Collaboration Skills (6). A syllabus will be provided.

Writing Workshop and Practicum
The Writing Workshop will meet twice weekly (days and Room TBD) and will provide instruction on technical writing. A syllabus will be provided. Accompanying the Writing Workshop is a Writing Practicum scheduled for four days per week (TBD). The Writing Workshop and Practicum will build Communication Skills (3) and Network and Collaboration Skills (6).

Integrated Learning
Integrated learning activities will include technical field trips, social and networking activities, professional development, and cultural events. Field trips will be organized to visit water infrastructure including treatment facilities, reservoirs, and more. These events will seek to involve students from U/CSU and water professionals to create networking opportunities in addition to learning experiences. The integrated learning will build Substantive Knowledge (1), Communication Skills (3), Global Perspectives (4), Cross-Cultural Interaction Skills (5), and Network and Collaboration Skills (6).

Cultural Diplomacy Award
As part of the USPCASW Exchange Program, the participants will have the chance to earn a Cultural Diplomat Award and receive a Pin. This pin is meant to reflect program participants going beyond planned activities and engaging in a range of cultural activities that take them outside of USPCASW and get them engaged with other people, institutions, and learning opportunities. We have identified 6 areas of interest, along with a Wildcard for those who may find activities that don't fit well in our existing categories. This activity will aid in increasing Global Perspectives (4) and Cross-Cultural Interaction Skills (5).

Expectations
Exchange Visitors are expected to achieve the required performance levels to remain on the exchange program and to receive a passing grade. Students are required to adhere to the institutions code of conduct (e.g., University of Utah, http://regulations.utah.edu/academics/6-400.php) and the exchange plagiarism policy. Violations for cheating, plagiarism, unacceptable

behavior will lead to dismissal from the SEP. Additionally, lack of attendance, failing performance in the course or other activities, and lack of progress on research will also lead to dismissal from the SEP. The included evaluation below will be used both to track progress across the semester as well as evaluating performance at the end of the semester. Dismissal or failure will lead to a failure mark for the SEP for the student.

Fall 2019 Exchange Participant Evaluation

Participant Name: _____

Summary of Evaluation:

Exchange Element	Rubric	Pass	Fail	Grade/Rating
Activity Attendance	☐ Attend ALL Cultural Activities ☐ Attend ALL Technical Field Trips ☐ Attend ALL Professional Development Workshops ☐ Attend ALL Additional Activities as Assigned ☐ Arrive on time to ALL Activities as Assigned	☐	☐	
Exchange Evaluation	☐ Attend ALL exchange meetings ☐ Arrive on time to ALL exchange meetings ☐ Complete Weekly Progress Surveys ☐ Complete Assigned Presentations in Exchange Meetings ☐ Follow ALL Rules of the Exchange	☐	☐	
Thesis Research & Training	☐ Work on Research Goals as defined in Goal Setting Worksheet ☐ Participation in All Research Activities Assigned	☐	☐	
Seminar	☐ Attend ALL Seminars ☐ Arrive on time to ALL Seminars ☐ On Time Completion of Assigned Coursework ☐ Participate in Seminar Discussions	☐	☐	
Technical Course	☐ Attend ALL Classes ☐ C or Better in Course Work	☐	☐	
Writing	☐ Attend ALL Writing Classes and Practicum ☐ Arrive on time to ALL Writing Classes and Practicum ☐ Complete ALL Writing Assignments ☐ Evident Progress in English & Professional Writing ☐ C or Better on Final Project ☐ Active Participation in Writing Practicum	☐	☐	

Annex 22. Goal-setting approach to Student Exchange Program

USPCAS-W Student Exchange Program: Becoming Agents of Change

Capacity development is "the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time" (UNDP, *Capacity Development: A UNDP Primer*, 2009, p. 5).

Purpose of the Goal-Setting Process

The USPCAS-W Student Exchange Program (SEP) is designed to develop students' capacities in a holistic way, because in order to advance global water security for Pakistan there must be significant innovation and transformation of existing systems. Therefore, graduates must be more than technically competent – they must be agents of change.

An important precursor to becoming an agent of change is taking ownership for one's own intellectual and professional growth. The **Goal-Setting Worksheet** is designed to facilitate that process while at the same time providing an integrative structure to the entire experience.

Since the SEP is designed to be tailored to each student's needs and interests, students will have different specific goals and inputs (e.g., students are taking different technical classes). Thus, the form will summarize the different components of the SEP and align student and mentor expectations. Although some changes may be necessary as the semester proceeds, the information provided on this form will serve as a tool to help students and mentors—as well as the broader USPCAS-W team—monitor progress throughout the semester, identify gaps, suggest additional resources, and assess the quality and value of the SEP itself.

Instructions

Using the definitions for the different areas of human capital development provided below, students should complete the specific goals, inputs, and outputs on the **Goal-Setting Worksheet**. Then students should share the Worksheet with the Exchange Coordinator, their mentors, and instructors, who will review them, discuss any issues, and help identify appropriate deliverables/outputs and ePortfolio content. Students should upload the reviewed and completed forms to the Canvas Learning Management System. These worksheets will be revisited regularly throughout the semester, and students will be required to complete several short surveys about their progress in each of the 8 areas listed below. This information will be used by the Exchange Coordinator to identify and help resolve problems to ensure student success.

Additionally, in order to help support students as agents of change, the pro-forma also includes a section where students identify a specific **training they will deliver** on return to MUET. This

could include training faculty, students, staff, professionals, etc. at MUET or elsewhere. Students must work with available resources at UU/CSU and MUET to plan and execute the transfer.

Students will also be required to submit a **Final Report** that will require narrative descriptions of the progress made towards each goal and an implementation plan for at least one training or intervention to transfer knowledge and/or skills to the USPCASW community. Further details including the **Final Report Template** will be provided at a later date.

The 8 Areas of Capacity Development

1) *Substantive knowledge* – scholarly mastery of a particular subject or topic
2) *Applied research skills* – ability to carry out the technical and analytical aspects of applied research design, data collection, and analysis
3) *Communication skills* – ability to convey ideas effectively in both speaking and writing
4) *Global perspectives* – awareness of issues affecting people in different countries and how these intersect with each other
5) *Cross-cultural interaction skills* – ability to engage professionally with those who come from a different cultural background
6) *Networking & collaboration skills* – ability to make new contacts and establish meaningful professional relationships
7) *Leadership skills* – ability to set goals and generate collective enthusiasm to work towards them
8) *Professional skills* – ability to manage time, organize activities, be inclusive, and produce quality work

You will receive further guidance on the completion of these forms (i.e., see the Guidelines) during the weekly advisory meetings with the Exchange Coordinator, Davey Stevenson (davey.stevenson@utah.edu).

USPCASW Student Exchange Program
Goal-Setting Worksheet
Fall 2019

Name of Student:

Name of UU Mentor (if applicable):

Human Capital Development Area	**Specific Goals** (e.g., be able to use x technology)	**Inputs** (i.e., activities like classes, labs, etc.)	**Outputs** (i.e., tangible products like proposal, paper, etc.)	**ePortfolio Content Creation** (e.g., what will you add to ePortfolio to represent progress toward Goal)
1) Substantive knowledge				
2) Applied research skills				
3) Communication skills				
4) Global perspectives				
5) Cross-cultural interaction skills				
6) Networking & collaboration skills				
7) Leadership skills				
8) Professional skills				

Describe the training you will deliver on returning to MUET:

What is the training you will deliver?

Who will you deliver the training to?

How many people will your training reach?

What support do you need at the U to prepare for this training?

What support do you need at MUET to facilitate the training on your return?

Annex 23. Listing of USPCASW faculty from 2014 to present

S#	Employee Name	Designation	Gender	Date of joining	Date of Leaving	Program Area	Degree	Institute	Total Experience	Status
1	Dr. Bakhshal Khan	Project Director	Male	12-Dec-14	Continue	IWRM	Ph.D.	Agriculture University, Cracow, Poland	38 Years	Was professor in IWREM at inception
2	Dr. Muhammad Munir	Professor	Male	12-Dec-14	Continue	HID	Ph.D.	Kyoto University, Japan	30 Years	Was professor in IWREM at inception
3	Dr. Abdul Latif Qureshi	Professor	Male	12-Dec-14	Continue	HID	Ph.D.	IWREM, MUET, Jamshoro	30 Years	Was professor in IWREM at inception
4	Dr. Shafi Muhammad Kori	Professor	Male	12-Dec-14	31-Dec-16	HID	Ph.D.	IWREM, MUET, Jamshoro	31 Years	Was professor in IWREM at inception
5	Dr. Rasool Bux Mahar	Professor	Male	12-Dec-14	Continue	EE	Ph.D.	Tsinghua University Beijing China	26 Years	Was professor in IEE at inception
6	Mr. Waqas Ahmed	Assistant Professor	Male	7-May-15	Continue	HID	MS	University of Stuttgart, Germany	5 Years	
7	Dr. Kamran Ansari	Deputy Director	Male	7-May-15	Continue	HID	Ph.D.	The University of Nottingham, UK	21 Years	
8	Mr. Awais Anwar Chandio	Assistant Professor	Male	8-May-15	30-Jun-17	EE	MS	MUET, Jamshoro		No longer with Center
9	Dr. Altaf Ali Siyal	Professor	Male	15-May-15	Continue	IWRM	Ph.D.	Cranfield University, United Kingdom	29 Years	
10	Mr. Ghulam Hussain Dars	Assistant Professor	Male	18-May-15	Continue	IWRM	MS	Portland State University, USA	13 Years	
11	Mr. Wali Muhammad	Assistant Professor	Male	25-May-15	31-Dec-16	HID	ME	SAU, Tandojam		No longer with Center
12	Ms. Zahida Jamali	Assistant Professor	Female	26-May-15	15-Oct-15	IWRM	MSc	SALU, Khairpur		No longer with Center
13	Ms. Rakshanda Bano	Assistant Professor	Female	27-May-15	20-Aug-18	IWRM	MS	State University of New York, USA	5 Years	Study Leave
14	Dr. Syeda Sara Hasan	Assistant Professor	Female	28-May-15	Continue	EE	Ph.D.	NCEAC, University of Sindh, Jamshoro	4 Years	
15	Mr. Muhammad Ali	Assistant Professor	Male	28-May-15	Continue	IWRM	M.A	University of Tskuba, Japan	13 Years	
16	Ms. Uzma Imran	Assistant Professor	Female	6-Jul-15	Continue	EE	M.E	NED University, Karachi	19 Years	
17	Dr. Asmat Ullah	Assistant Professor	Male	4-Jan-16	1-Jul-18	IWRM	Ph.D.	Asian Institute of Technology(AIT), Thailand	04 Years	Study Leave

S#	Employee Name	Designation	Gender	Date of joining	Date of Leaving	Program Area	Degree	Institute	Total Experience	Status
18	Ms. Hadiqa Maqsood	Assistant Professor	Female	1-May-16	31-Jul-17	HID	MS	University of Brighton, UK		No longer with Center
19	Dr. Jamil Ahmed Soomro	Assistant Professor	Male	08-Jun-16	Continue	WASH	M.Phil	University of Oslo, Norway	08 Years	
20	Dr. Arjumand Zaidi	Senior Research Fellow	Female	19-Aug-16	Continue	IWRM	Ph.D.	School of Information Technology, George Mason University, Fairfax, Virginia, USA	15 Years	
21	Dr. Muneer Ahmed Qazi	Assistant Professor	Male	02-Jan-17	31-Aug-17	EE	Ph.D.	Quaid-e-Azam University, Islamaabd		No longer with Center
22	Dr. Zubair Ahmed	Professor	Male	05-Jan-17	Continue	EE	Ph.D.	University of Science & Technology, South Korea	23 Years	
23	Dr. Naveed Ahmed	Assistant Professor	Male	08-Jan-18	Continue	EE	Ph.D.	Kangwon National University, South Korea		
24	Mr. Tanveer Ahmed Gadhi	Research Associate	Male	08-Jan-18	Continue	EE	Ph.D.	Politecnico di Torino, Italy	4 Years	
25	Dr. Ayesha Tajammul	Assistant Professor	Female	09-Jan-18	Continue	WASH	Ph.D.	University of Karachi	9 Years	
26	Dr. Muhammad Rizwan	Assistant Professor	Male	16-Jan-18	Continue	EE	Ph.D.	Myongji University, South Korea	8.5 Years	
27	Dr. Aneela Yasmin	Associate Professor	Female	24-Jan-18	23-Jan-19	WASH	Ph.D.	University of Hannover, Germany	19 Years	No longer with Center

Annex 24. Status report on all Pakistani institutions with which the U-led team worked to a significant degree

This is a summary table. More details can be found throughout the report. Note that this list is not comprehensive and USPCASW had many additional partnerships for which the U-led team provided various levels of technical assistance (e.g., advice on research proposals, policy briefs, etc.).

Institution	Status
Mehran University of Engineering and Technology (MUET)	Highly active – second 5-year MOU signed; ongoing faculty-to-faculty collaborations (writing research papers and grant proposals).
Higher Education Commission (HEC)	Highly active – most recent collaboration involved the National Academy of Higher Education (NAHE) Six Weeks Skills Training Program for Faculty.
Sindh Irrigation Department (SID)	Highly active – most significant and ongoing collaboration involves diploma courses for irrigation engineers.
Sindh Irrigation and Drainage Authority (SIDA)	Highly active – ongoing research collaborations.
Water Sector Improvement Project (WSIP), P&D Department, GoS	Significant but concluded – WSIP was a project itself that ended December 2019. Four WSIP-funded applied research projects.
Global Change Impact Studies Centre (GCISC)	Somewhat active – An international conference on climate change was organized with GCISC in 2017; currently a USPCASW faculty member is collaborating with researchers at GCISC.
National University of Technology (NUTECH)	Highly active – An MOU was signed for multi-year collaboration for research capacity building and exchanges to the U.
Habib University	Highly active – collaborated on Workshop, submitted joint research proposal, and working on new faculty training program.
Lahore University of Management Sciences (LUMS)	Somewhat active – working on a co-authored book chapter.
National University of Sciences and Technology (NUST)	Somewhat active – submitted joint proposal with NUST and ASU, working on follow-up.
Aga Khan University	Somewhat active – submitted joint proposal, collaborations with separate project.
Industry Partners • M.S. Mohammedi & Co. (fishery industry; private sector). • Al-Rahim Textile Industry (private sector). • Sindh Irrigation and Drainage Authority (public sector). • Artistic Millinners and Artistic Fabric and Garments Pvt Ltd. (private sector).	Highly active – these partnerships have strengthened through the Industry-Academia Seed Grant collaborative experience and are pursuing further ways to collaborate.

Annex 25. Host country, international donor, and financial institution contacts

Name	Position	Organization	Type	Email
Umair Abdullah	Senior Sales Manager	Greaves Pakistan	Business	umair.abdullah@gfg.com.pk
Muhammad Abubakr	Associate Professor	LUMS	Academia	abubakr@lums.edu.pk
Arshad Ahmad	Vice Chancellor	LUMS	Academia	arshad@lums.edu.pk
Karamat Ali	CEO	Pakistan Institute of Labour Education and Research	NGO	karamatorama@gmail.com
Khalid Asghar	Executive Director	National University of Technology	Academia	asghar.khalid@gmail.com
Muhammad Ashraf	Chairman	Pakistan Council for Research in Water Resources	Government	muhammad_ashraf63@ yahoo.com
Rashid Bajwa	CEO	National Rural Support Programme	NGO	ceo@nrsp.org.pk
Tariq Banuri	Chairman	HEC	Government	tariq.banuri@hec.gov.pk
Sajid Ali Bhutto	Superintending Engineer	Sindh Irrigation Department	Government	bhuttosajid@hotmail.com
Rafiq Chandio	Director General	Planning and Development Department, Government of Sindh	Government	rafiq.chandio@gmail.com
Mahmood Akhtar Cheema	Country Representative	IUCN Pakistan	NGO	mahmood.cheema@iucn.org
Nazeer Essani	Deputy Project Director	Karachi Neighborhood Project	Government	nzessani@gmail.com
Zulfiqar Gorar	Engineer	USAID	Donor	zagorar@usaid.gov
Muhammad Zia ur Rahman Hashmi	Section Head	Global Change Impact Studies Centre	Government	ziahashmi77@gmail.com
Nazeer Hussain	Director General	HEC	Government	nhussain@hec.gov.pk
Hassaan Khan	Assistant Professor	Habib University	Academia	hassaan.khan@sse.habib.edu.pk
Waqar Ahmad Khan	CEO	Star Hydro	Industry	waqar@patrind.com
Iqbal Khemane	Executive Vice President	MagTech Limited	Industry	ikhemane@magtech.com.pk
Fateh Marri	Member	HEC	Government	fateh.marri@hec.gov.pk
Mahboob Mahmood	CEO	Knowledge Platform	Business	mmahmood@ knowledgeplatform.com

Zeeshan Mazahir	Manager EHS & Sustainability	Artistic Fabric Mills	Industry	sustainability@ artisticgarment.com
Nisar A. Memon	Chairman	Water Environment Federation	NGO	namemon@gmail.com
Muslim S. Mohamedi	Vice President	M.A. Mohamedi & Co.	Industry	muslimm@super.et.pk
Saqib Najam	CEO	Orient Water Technologies	Industry	saqibnajam@ orientwatertechnologies.com
Tahir Rafique	Senior Scientific Officer	Ministry of Science & Technology	Government	tahirrafique92@yahoo.com
Amjad Rashid	Chief Executive Officer	Taraqee Foundation	NGO	amjad@taraqee.pk
Mujeeb Sahrai	Vice Chancellor	Sindh Agriculture University Tandojam	Academia	vicechancellor@sau.edu.pk
Hamid Sarfraz	Managing Partner	Dev-consult	Business	hsarfraz@devconsult.pk
Mome Saleem	Program Coordinator	Heinrich Boll Stiftung Pakistan	NGO	mome.saleem@pk.boell.org
Badarudin Shah	General Manager (Distillery)	Matol Limited	Industry	bada_hsm@hotmail.com
Ali Tauqeer Sheikh	CEO	LEAD Pakistan	NGO	atsheikh@lead.org.pk
Manzoor H. Soomro	President	ECO Science Foundation	NGO	manzoorsoomro@gmail.com
Mark Sorenson	Education Director	USAID	Donor	msorensen@usaid.gov
Muhammad Waseem Vohra	CEO	Eastern Enterprises	Industry	vohra.waseem73@gmail.com

Annex 26. Financial Analysis of Program

Summary of project funds, expenditures, and allocations.

	Obligated Budget	Expended PTD	Unobligated	% of Budget Committed
Total direct cost	$8,227,579	$8,006,755.17	$220,823.83	97%
F&A	$1,771,267	$1,739,033.46	$32,233.54	98%
Total expenditure	$9,998,846	$9,745,788.63	$253,057.37	97%

Budget to actuals financial report for USAID USPCAS-W (CA AID-391-A-15-00004).

	Obligated Budget	Expended PTD	Unobligated	% of Budget Committed
Personnel				
UU salaries & wages	$2,135,007	$2,737,207.99	($602,200.99)	128%
UU fringe benefits	$865,324	$802,676.04	$62,647.96	93%
UU personnel subtotal	$3,000,331	$3,539,884.03	($539,553.03)	118%
Operations expenditures				
Travel and transportation	$520,097	$519,219.15	$877.85	100%
Overseas allowance	$562,213	$145,574.50	$416,638.50	26%
Equipment	$110,000	$0.00	$110,000.00	0%
Materials & supplies	$52,690	$36,761.22	$15,928.78	70%
Contractual	$2,636,464	$2,192,136.36	$444,237.64	84%
Training/exchange	$73,150	$806,380.43	($733,230.43)	1102%
Research grants	$1,000,000	$608,695.17	$391,304.83	61%
Branding and public comm	$80,914	$14,938.13	$65,975.87	18%
Other direct costs	$191,720	$143,166.06	$48,553.94	75%
Total direct costs	**$8,227,579**	**$8,006,755**	**$220,823.95**	**97%**
Indirect costs	$1,771,267	$1,739,033.46	$32,233.54	98%
Total budget	**$9,998,846**	**$9,745,788.51**	**$253,057.49**	**97%**

Trainings at University of Utah.

	Obligated Budget	Expended PTD	Unobligated	% of Budget Committed
Exchange visit	$73,150	$806,380.43	$733,230.43	1102%

Subawards/contractual.

	Obligated Budget	Expended PTD	Unobligated	% of Budget Committed
Subaward - CSU	---	$1,419,774.23	---	%
Subaward - CUNY	---	$153,205.95	---	%
Subaward - UNLV	---	$188,943.92	---	%
Subaward - UNR	---	$90,060.15	---	%

Consultant: SEI	---	$6000.00	---	%
Consultant: UNESCO	---	$12,056.00	---	%
Consultant: Arif Pervaiz	---	$16,159.11	---	%
Consultant: Sajjad Ahmad	---	$199,449	---	%
Consultant: Shabnam Balouch	---	$35,200.00	---	%
Consultant: Shahid Qureshi	---	$6,000.00	---	%
Consultant: Thomas Fisher	---	$9,000.00	---	%
Consultant: Joshua Garn	---	$5,000.00	---	%
Consultant: Mark Halle	---	$21,500.00	---	%
Consultant: Lexington Blood	---	$6,000.00	---	%
Consultant: Mohamadali Sharbatmaleki	---	$10,888.00	---	%
Consultant: Hassaan Furqan Khan	---	$11,400.00	---	%
Consultant: Catherine Arnold	---	$1,500.00	---	%
Totals:	**$2,636,464**	**$2,192,136.36**	**$444,327.64**	**83%**

Research grants at University of Utah.

	Obligated Budget	Expended PTD	Unobligated	% of Budget Committed
Scott Benson	---	$3,989.05	---	%
Gabe Bowen	---	$14,474.82	---	%
Steve Burian	---	$112,926.70	---	%
Krista Carlson	---	$59,705.23	---	%
Robin Craig	---	$31,573.80	---	%
Ramesh Goel	---	$58,561.61	---	%
Shelley Minteer	---	$36,943.47	---	%
Carlos Oroza	---	$8,055.18	---	%
Pratt Rogers	---	$15,388.47	---	%
Summer Rupper	---	$36,187.71	---	%
Court Strong	---	$111,493.09	---	%
Jim VanDerslice	---	$81,782.18	---	%
Dennis Wei	---	$15,666.16	---	%
Darrin Young	---	$4,947.70	---	%
Market Study	---	$17,000.00	---	%
Totals:	**$1,000,000**	**$608,695.17**	**$391,304.83**	**61%**

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