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U.S.-Pakistan Centers for Advanced Studies in Water MUET Jamshoro

Final Report

12 Dec 2014 – 11 Dec 2019

Cooperative Agreement No. AID-391-A-15-00003

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U.S.-Pakistan Centers for Advanced Studies in Water
MUET Jamshoro

Final Report: 12 December 2014 – 11 December 2019

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<p>DISCLAIMERThe authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.</p>
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LIST OF ACRONYMS

AOR	Agreement Officer Representative
BoG	Board of Governors
CA	Cooperative Agreement
CAS	Center for Advanced Studies
CAS-W	Center for Advanced Studies in Water
CSU	Colorado State University
CUNY	City University of New York
EE	Environmental Engineering
FAR	Faculty Activity Report
FPCCI	Federation of Pakistan Chamber of Commerce and Industries
GB	Gilgit Baltistan
GEP	Gender Equity Plan
GIS	Geographical Information System
HEC	Higher Education Commission
HID	Hydraulics, Irrigation and Drainage Engineering
ICT	Information and Communication Technology
IWRM	Integrated Water Resources Management
KPIs	Key Performance Indicators
KPK	Khyber Pakhtunkhwa
LUMS	Lahore University of Management Sciences
M&E	Monitoring & Evaluation
MoU	Memorandum of Understanding
MS	Masters of Science
MSF	Mission Strategic Framework
MSI	Management Systems International
MUET	Mehran University of Engineering and Technology
NGO	Non-Governmental Organization
NUST	National University of Science and Technology
Ph.D.	Doctor of Philosophy
PIRS	Performance Indicator Reference Sheet
PMU	Project Management Unit
QPR	Quarterly Progress Report
Rs.	Rupees

SDGs	Sustainable Development Goals
SoP	Standard Operating Procedures
TVC	Technology Venture Commercialization
UAF	University of Agriculture Faisalabad
UETP	University of Engineering and Technology Peshawar
UNLV	University of Nevada, Las Vegas
US	United States
USA	United States of America
USAID	United States Agency for International Development
USD	US Dollar
USPCAS-W	U.S.-Pakistan Center for Advanced Studies in Water
UU	University of Utah
VC	Vice Chancellor
WASA	Water and Sanitation Authority
WaSH	Water, Sanitation and Health
WWF	World Wide Fund for Nature

EXECUTIVE SUMMARY

**SUSTAINABLE
DEVELOPMENT GOAL – 6:**

**“ENSURE
AVAILABILITY AND
SUSTAINABLE
MANAGEMENT OF
WATER AND
SANITATION FOR
ALL”**

EXECUTIVE SUMMARY

U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W) has been established at Mehran University of Engineering & Technology (MUET) Jamshoro with the financial support of USAID/Pakistan under the Cooperative Agreement signed on December 12, 2014, for five years ending on December 11, 2019. The total cost of the project is USD 14.782 M. The University of Utah (UU), along with other partnering universities (Colorado State University (CSU) and University of Nevada Las Vegas (UNLV)), of USA has provided technical assistance and built the capacity of the Center. It includes the areas of curriculum development, applied research, training, exchanges, governance, and cross-cutting issues like women empowerment, outreach & networking, research project writing, technology commercialization, and institutional sustainability.

USPCAS-W intended to train present and future faculty, young scientists, engineers, managers and other water professionals with state of the art techniques and cutting edge knowledge in the water sector. Through collaboration with academia, government and industry, the Center aimed to pursue applied research solutions to water sector problems and bring about policy reforms aiming to strengthen the economy of Pakistan. To achieve this, the Center adopted its implementation strategy, which focused on creating four capitals, i.e., human capital, social capital, manufactured/physical capital, and financial capital. Implementing the project around these four capitals was meant to develop enough capital stocks across four types to continue post-USAID funding, to advance the Water SDG agenda, and resolve the water challenges of Pakistan.

The expertise of faculty members and technical staff has been developed through an integrated twinning training approach supported by the University of Utah and other USA based universities. Laboratory facilities that are among the best in Pakistan provide unique instruments and equipment. The professional development and laboratory services are made available through capacity building programs and commercialization of facilities.

The Center is state of the art, modern applied and policy research National Center in the water sector in Pakistan. USPCAS-W is dedicated to generating cost-effective and sustainable solutions to resolve Pakistan's water crises through applied research, developing specialist human resource and technologies, academia-industry collaboration, and policy formulation. The Center highly encourages and empowers women scientists and researchers to participate in the academic and research programs actively.

USPCAS-W research and the Pakistan water sector are supported by MS and PhD students trained in interdisciplinary degree programs in four streams viz. Hydraulics, Irrigation, and Drainage (HID); Integrated Water Resource Management (IWRM); Environmental Engineering (EE); and Water, Sanitation and Health (WaSH) Sciences. Among these, IWRM and WaSH are unique programs in Pakistan. The curriculum and co-curricular elements of the degree programs have been designed based on market needs and international benchmarking in consultation with the USA based partner universities. Extending the quality graduate education, the Center has also developed a Training Unit for capacity building of the water sector professionals. The Center achieved the target of 250 students, including 87 females (35%) from across the country. Being the National Water Center, students from all over the country are encouraged to apply for admissions. Consistent with this policy, the enrolled students of the Center not only belong to Sindh but 10% of the students belong to Punjab, KPK, Balochistan and Gilgit Baltistan.

The central aim of the Center is to deliver research-driven solutions with focal strengths addressing water challenges associated with SDG-6. In pursuance of this objective, the Center

has conducted studies in areas such as: providing clean water and reducing risk to microbial threats, industrial wastewater treatment, soil salinity management, equity and efficiency of urban and agricultural water supply systems, water management of river basins, water infrastructure system resilience to climate change and population growth, and societal-ecosystem restoration of the Indus Delta region. Since its inception, the Center has conducted 60 research projects with the funding support of around Rs. 244 million. A hallmark of the Center's research is that nearly all projects have been implemented with the participation of national and international partners. Following the client-driven research model, the Center's research activities are co-created through the active involvement of stakeholders and products are linked to local and global needs. For example, USPCAS-W has worked in this fashion with Karachi-based textile and fisheries industries, and sugar industries on wastewater treatment and recycling projects; Australian Centre for International Agricultural Research on water-logging and salinity projects; Sindh Irrigation and Drainage Authority, Sindh Irrigation Department, and LUMS Lahore on ICT integrated projects for canal water and groundwater management projects; and Government of Sindh Public Health and WASA, Hyderabad on projects to alleviate risk from antibiotic-resistant microorganisms.

Furthermore, the Center has significantly contributed in terms of research publications whereby the faculty has published 185 peer-reviewed research papers, including 73 (39%) in impact factor journals in collaboration with national and international experts. Since these works focus one or other aspect of SDG-6, it would help in resolving critical challenges in the field of water and environment besides enhancing the academic knowledge base. Many of these publications have been cited in high impact factor journals internationally. Moreover, the interventions introduced by the Center on research innovation, entrepreneurship and technology commercialization remained successful in terms of raising faculty awareness about critical challenges and opportunities, which may come with aligning research to innovation and technology development. With these efforts, the Center has established a reasonable momentum to prosper and succeed towards intentional, quantifiable entrepreneurship and innovation.

The Center has progressed well in developing networks and partnerships at national and international levels by the implementation of collaborative research projects, and offering of short-term and long-term training and consulting services. These partnerships of the Center are essential for institutional sustainability because they are helping to build the reputation of the Center, which leads to more opportunities for collaboration, resource mobilization and fundraising while resolving water-related issues and challenges of mutual concern.

The Center has been able to achieve almost all targets set-out in the cooperative agreement with USAID. And in keeping with the commitment towards sustainability, the MUET has already made institutional arrangements through the syndicate. Accordingly, the Center will continue operating as an independent entity under the Board of Governors. Alongside, the syndicate has also approved the post-USAID organizational structure of the Center, which will be rolled out gradually. Moreover, the Center, in consultation with the University of Utah, has already developed a comprehensive sustainability plan that is enabling the Center to sustain its momentum and quality after the USAID funding is ceased. The sustainability plan is organized around three sustainability pillars: financial, technical and social. The financial pillar defines the expenditure and income streams, including the potential funding sources to meet the budget requirements. Technical and social sustainability pillars examine conditions necessary for maintaining the quality of the programs launched during the project life in such a way that they continue to respond to market needs, based on sustained inputs of stakeholders. The sustainability plan has also been developed based on an assessment of

internal and external needs, including the experiences gained regarding the feasibility of various initiatives launched during the project life, and new ideas evolved from ongoing discussions with many stakeholders. The sustainability goal of the Center emphasizes not only for continuing with the successful efforts and initiatives but also to aspire for continuous improvement and enrichment of these initiatives.

Minimum Mandatory Results/Outputs as per Cooperative Agreement

Mandatory Result/Output	Target	Achievement
Students Enrolled	250	250
Degrees Awarded	250	142
Exchange Training Beneficiaries	250	169
Partnership with American University	1	1
Female Participation	50%	36%
Research Seed Grant Awards	28	30
Externally Funded Projects Won	22	29
Public-private partnerships (PPPs) or Global Development Alliances (GDAs)	5	29
Professional certification, Degree Programs established	2	7
Courses Designed and/or Improved	20	43
Library Established	1	1
Specialized research /lab facilities established	6	6

It is highly acknowledged that accomplishing the above stated mandatory targets and progressing towards achieving the objectives of the program as described in the coming sections of the report would have never been possible without all assistance and support provided by the University of Utah (UU) and other USA Universities, especially Colorado State University (CSU) and University of Nevada – Los Vegas (UNLV). The UU team lead by Dr. Steven J. Burian, Dr. M. Aslam Chaudhry and Dr. Tariq Banuri extended services with their full commitment and dedication beyond the agreed terms and conditions of MoU signed between the two universities. Apart a large number of professors of these universities were mobilized and engaged for the capacity enhancement of MUET faculty, students and staff.

Dr. Steve J. Burian, Professor of Civil Engineering & Environmental Engineering and the Director of U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W) at University of Utah Awarded Civilian Honor of Sitar-e-Imtiaz by President of Pakistan.



In recognition of his outstanding services to Pakistan, the president of the Islamic republic of Pakistan has been pleased to confer upon Mr. Steven J. Burian the award of Sitara-e-Imtiaz (Star of Excellence) – one of Pakistan’s highest civilian honors.

The citation of services of Dr. Burian as read during the award ceremony is transcribed here; “Dr. Steven J. Burian has lasting impact on research and development and higher education in Pakistan. He has dedicated his tireless efforts to establish Mehran University of Engineering & Technology as a recognized higher education authority on water, research and learning programs in Pakistan. He has delivered workshops across Pakistan to inculcate quality in teaching, research and services. The culmination of his efforts have catalyzed new collaborative alliances between higher education, industries, civil society and government research and education to drive sustainable development in Pakistan.

INTRODUCTION

TARGET SDG – 6.1:

**“BY 2030, ACHIEVE
UNIVERSAL AND
EQUITABLE ACCESS
TO SAFE AND
AFFORDABLE
DRINKING WATER
FOR ALL”**

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 & 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 project connected three US universities with expertise in the above disciplines with four Pakistani universities. The Water 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. Similarly, 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 Center and Agriculture and Food Security Center, respectively.

The Cooperative Agreement (CA) between the USAID and selected universities for Water Center was signed in December 2014 for the five years, and project implementation started from 12th December 2014. Total project cost under cooperative agreement was 14.782 USD for a period of five years i.e. Dec 12, 2014 to Dec 11, 2019.

The Water Center was established at MUET aimed at to fill part of this void 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, the center was expected to develop 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.

RATIONALE

During the development of the CAS project, USAID and Pakistan's Higher Education Commission (HEC) considered not only the needs of Pakistan’s universities, but also their relationship with the U.S. higher education community and HEC. In addition, USAID and HEC also placed an emphasis on science, technology, innovation and commercialization to improve the efficacy of development. USAID’s agency-wide effort embodies these same principles. USAID encouraged its partners to help develop and use similar practices to strengthen their assistance programs. USAID has created the Higher Education Solutions Network (HESN) for this purpose. There is a potentially powerful nexus between the CAS project and the Agency’s direction toward stronger and more productive university relationships. How this nexus can be used for the mutual benefit of both activities is discussed below.

Four Pakistani universities were identified by the HEC as top tier universities and promising “homes” for a CAS. In November 2011, USAID commissioned a feasibility assessment that

examined the capacity of these top tier Pakistani institutions to determine their potential to host a CAS in the fields of food security/agriculture, energy, or water resource management. The feasibility assessment report informed USAID and HEC in the process to select the four Pakistani universities i.e. MUET, NUST, UETP, and UAF to host a CASs.

A Center for Advanced Studies (CAS) is defined as a state of the art, modern applied and policy research center located in a selected Pakistani public university and widely recognized both for its excellence and as a repository for knowledge and expertise in its specialty area. A CAS is characterized by five dimensions: (i) efficient governance and leadership; (ii) effective curriculum reform; (iii) identification, design and dissemination of the most relevant and highest quality applied and policy research to meet a particular sector's present and future needs; (iv) internationally competitive multidisciplinary graduate and post graduate training programs; and (v) technical and financial sustainability of CAS interventions through strong links with industry, civil society and government. The purpose of each CAS was to serve industry and government needs for relevant research and skilled professionals in the areas of water, energy, and food security & agriculture to meet development challenges and support Pakistan's economic growth.

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. Public sector institutions, by and large, failed to address these challenges due to weak institutional capacities, while informed decision-making was severely constrained by evidence-based analysis and information (or applied research).

Program Goal

The overall goal was to substantially improve the capacity of MUET to find innovative solutions to some of Pakistan's greatest development challenges in water sector through applied research; graduates who are better prepared to meet the needs of industry, government and their communities; and leadership in policy dialogue.

Objectives

- (i) Establish governance structures for sustainability and improved capacity of the USPCAS-W.
- (ii) Improve curricula quality and strengthen use of effective teaching methods
- (iii) Apply relevant research to meet clients (industry, civil society, government) needs
- (iv) Increase access for talented and economically disadvantaged students, especially women.

Components to achieve the objectives

To achieve these objectives, the USPCAS-W focuses upon the following six(6) main components:

- (i) **Governance** of the USPCAS-W and the Higher Education:
- (ii) **Curriculum reforms**: To provide revised curricula as well as financial management, governance, teaching, and other reforms necessary to make university education and research more relevant to the needs of industry and government.

- (iii) **High Quality Applied Research:** To construct, rehabilitate, and upgrade world-class research facilities, including laboratories, classrooms, and libraries. To Facilitate relevant policy dialogue and reforms for water sector led by the policy think tanks
- (iv) **Graduate and Post Graduate Training:** To develop robust scholarship and exchange programs.
- (v) **Sustainability** through Industry/Private Sector Links: Lead networking activities and develop strong links to the private sector.
- (vi) **Gender Equity:** To provide equal opportunities for women and men that is different but which is considered equivalent in terms of rights, benefits, obligations and opportunities.

Partnering Institutions

Four institutions partnered in establishing the Water Center at MUET, including development and implementation of its capacity building program. These included: USAID, the HEC of Pakistan, MUET, and the UU. The role of each partner is outlined below.

USAID provided the necessary funding to both Pakistani and US universities for establishing the Water 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 on-going higher education initiatives to maximize the overall economic impact of US assistance to Pakistan.

Higher Education Commission (HEC), as the Government of Pakistan entity, was principally responsible for funding, overseeing, regulating, and ensuring the quality of higher education, supported in this initiative 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 in the country.

University of Utah(UU), USA 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 UU mobilized the expertise and support of the following three US universities: (i) Colorado State University (CSU), (ii) University of Nevada, Las Vegas (UNLV), and (iii) City University of New York (CUNY).

Mehran University of Engineering and Technology (MUET) was the major recipient of financial and technical assistance. MUET has implemented the CAS-W program in line with the provisions of the Cooperative Agreement (CA) signed with USAID.

MISSION, VISION, VALUES

The **mission** of the US-Pakistan Center for Advanced Studies in Water (USPCAS-W) is to empower graduates and water sector professionals to advance water security in Pakistan with practical problem-solving skills, state-of-the-art techniques, and cutting-edge tools.

USPCAS-W is motivated by the **vision** of being a recognized leader in water research and education, catalyzing collaborative partnerships with academia, government, industry, and civil society to innovate technology and policy solutions to the most pressing water security problems in Pakistan and the world.

The Center operationalizes its **values** of equity, transparency, accountability, and efficiency through its governance structures and procedures, programs to empower women scientists and engineers, and educational opportunities to underrepresented people. Embodying this spirit, the Center's main crosscutting strategy is to achieve gender equity, and with student enrollment of 36% female and a women's hostel the Center is trending toward gender parity levels not found in engineering and technology programs related to water

MUET – UU Partnership

The University of Utah (UU), USA (www.water.utah.edu) had been partnered by USAID as the technical assistance partner of MUET for advancing the development and growth of USPCAS-W. The MUET-UU partnership was focused in the areas of curriculum development, applied research, training, exchanges, governance, and cross-cutting issues (gender empowerment, outreach and networking, fundraising, technology commercialization, and institutional sustainability). On August 11, 2015, UU hosted the delegation of MUET led by the Vice Chancellor and the formal partnership MoU was signed between the two universities.



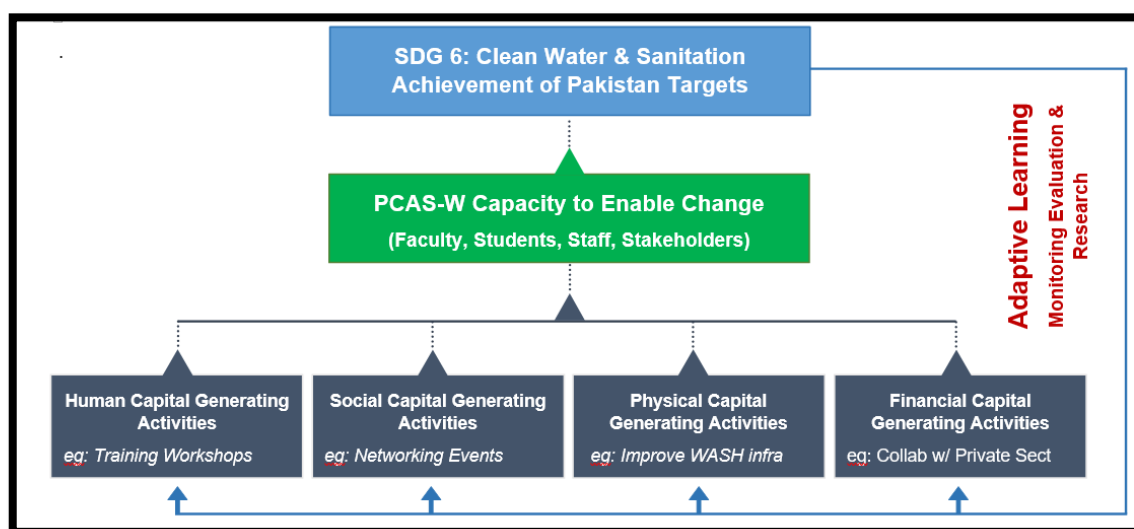
Under this partnership, many of the promising graduate students and faculty availed the opportunity of benefitting from the most modern teaching and research infrastructure and experienced faculty available at the UU and other USA based universities. More than 70 faculty of USA universities was engaged in research on water related issues from different disciplinary perspectives, especially urban water, wastewater treatment, sanitation & health, and policy & law, water resources management, climate change and numerical modeling. Many of these faculty members were directly engaged in supporting USPCAS-W activities at MUET. The UU also applied a Peer Teacher Partnering Program – the Twining Model, and trained the faculty members of MUET. It connected MUET faculty to UU faculty for seeking support in the design and delivery of courses and research projects. As a part of MUET-UU partnership, faculty as well as students went for exchange training to UU, CSO and UNLV.

M&E FRAMEWORK

USPCAS-W intend to train present and future faculty, young scientists, engineers, managers and other water professional with state of the art techniques and cutting edge knowledge in the water sector. Through collaboration with academia, government and industry the center aimed to pursue applied research solutions to water sector problems and bring about policy reforms aiming to strengthen economy of Pakistan. With this backdrop, the center adopted its implementation strategy and developed its M&E Framework which focused to create four capitals i.e. human capital, social capital, manufactured/physical capital, and financial

capital. Implementing the project around these four capitals was meant to develop enough capital stocks across four types to continue, post-USAID funding, to advance the Water SDG agenda in Pakistan. 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. Linking the program objectives with the SDG-6 agenda gave a strategic direction to organize its activities towards addressing the water challenges of Pakistan. Based on this framework, an adaptive learning process was designed to use feedback from quantitative and qualitative methods to help ensure activities were contributing to the program objectives.

Figure 1. M&E Framework: Theory of Change for USPCAS-W



Human Capital generating activities include degree programs, training workshops, and exchange programs to develop faculty and student capacities across both technical and soft skills.

Social Capital generating activities include networking events, such as executive seminars, that bring together key stakeholders from academia, government, business, and civil society.

Physical Capital generating activities include the construction of a new building to house the Center at MUET, along with the establishment of laboratories and libraries.

Financial Capital generating activities include external grant writing, collaborations with the private sector, and fee-based workshops for water professionals seeking additional training.

In many ways, however, human capital development in terms of developing the Center's internal capacity to increase the four capitals is the most fundamental element of this project because social, manufactured/physical, and financial capital are ultimately derivatives of human and/or natural capital.

Theory of Change Model for Sustainable Development

Capital	Description
Human Capital	<ul style="list-style-type: none"> Represent the enhanced capacities of faculty, students, staff and other stakeholders. This is done in an equitable manner that is inclusive of women and financially disadvantaged students. Development of this capital involves activities implemented under component 1 & 4.
Social Capital	<ul style="list-style-type: none"> Represent the strong institutional ties between the center and universities within country and outside Pakistan. This shall also include productive linkages with private and public sector organizations and gender equity

	<p>organizations. Strong institutional arrangements to reinforce good governance of the Center would also augment the social capital.</p> <ul style="list-style-type: none"> ▪ Development of this capital involves activities implemented under component 3 & 5.
Physical Capital	<ul style="list-style-type: none"> ▪ Also called manufactured capital comprises of all basic infrastructure that provides an enabling environment to achieve the ultimate goal of the center. This includes; laboratories and their relevant equipment, libraries, classrooms and other utility articles. ▪ Development of this capital involves activities implemented under component 3 & 5.
Financial Capital	<ul style="list-style-type: none"> ▪ Represent the financial resources available for long-term financial sustainability of the center. ▪ Development of this capital involves activities implemented under component 5.

A results-based performance management framework was followed with emphasis on: establishing sound monitoring and evaluation systems to support decision-making; identifying performance gaps and promoting accountability for managing results; supporting stakeholders' engagement in project planning and management; identifying and managing risks; and reporting/reviewing performance at regular intervals. The outcomes of USPCAS-W efforts were aimed at sustainable applied research program, new expertise in business development, and an engaged water sector in Pakistan, all culminating in advanced degrees and international development programs, and renewed enthusiasm for teaching, learning, and researching on water in Pakistan.

USPCAS-W BUILDING

The ground-breaking ceremony of laying the foundation of USPCAS-W building was performed by Mr. John P. Groarke – the then USAID Mission Director to Pakistan along with the Vice Chancellor of Mehran University of Engineering & Technology Prof. Dr. M. Aslam Uqaili in September 2015. Later on, in July 2017, the then Mission Director Mr. Jerry Bisson and Deputy Mission Director Ms. Denise Herbol of USAID along with then Sindh Education Minister Mr. Jam Mehtab Hussain Dahar inaugurated the new building of U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W).

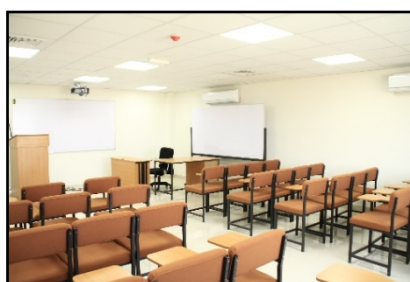


USAID Mission Director Mr. Jerry Bisson along with Sindh Education Minister Mr. Jam Mehtab Hussain Dahar inaugurated the new building of USPCAS-W (July 2017)

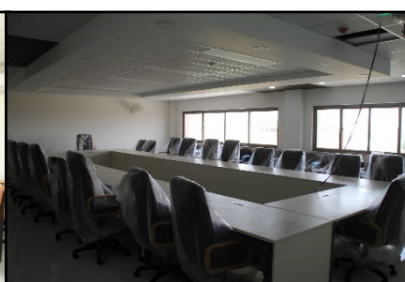
This is an energy- and space-efficient three- story building (ground + 2) comprised of a total covered area of 54,721 square feet and includes the following facilities:

Six State-of-the-art Research Laboratories	
Hydraulics Lab.	Soil & Water Analysis Lab.
Advanced Water & Waste Water Quality Control Lab.	Pilot Scale Water & Waste Water Treatment Lab.
GIS & Remote Sensing Lab.	Computer & Software Lab.
Other Facilities	
Library equipped with more than 4,000 books and journals	Six class rooms (4 on 2 nd floor and 2 on 1 st)
Lecture Theater Hall (Auditorium)	Lounges (1 female and 1 faculty)
Conference room;	Cafeteria
Faculty/Admin/Research Scholar and other support staff Offices	

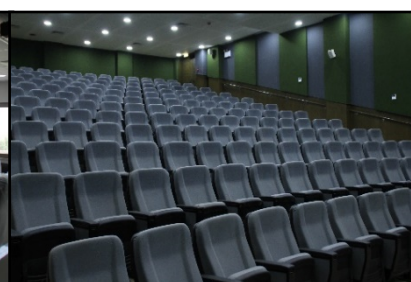
Pictures of Building Facilities



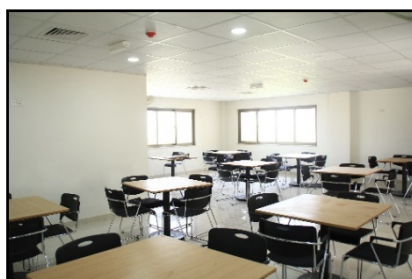
Class Room



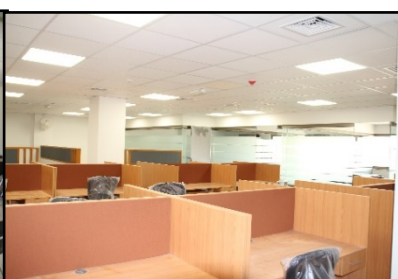
Conference Room



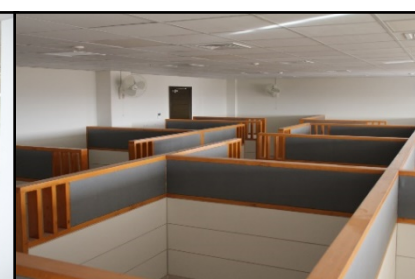
Theater Hall (Audi)



Cafeteria



Admin Cubicles



Faculty Offices



Hydraulics Lab



Pilot Scale Water & Waste Water Treatment Lab



Advanced Water & Waste Water Quality Control Lab



Soil & Water Analysis Lab



GIS & Remote Sensing Lab



Computer & Software Lab

MINIMUM MANDATORY RESULTS

As per cooperative agreement, the center was to achieve minimum mandatory results. Following matrix provides the status of achievement against those targets.

Minimum Mandatory Results (MMR)	Overall Progress
At least 250 degrees awarded	250 students have been enrolled at USPCAS-W. So far, 151 students including 142 MS and 9 PhD students have been awarded degrees.
At least 250 faculty and students participated in exchange training program.	In total 169 individuals, including 19 faculty (4 females), 148 students (58 females) and 2 staff have completed their exchange training program.
At least 50% of USPCAS-W graduates employed in a field related to water activities.	As per MSF PIRS, the data on this indicator is to be collected by USAID's 3 rd party and reported by USAID. However; the data collected by USPCAS-W informs that among 75 graduated students of 2015 and 2016 batches, 30 are employed including 1 abroad, and 20 pursuing PhD in USA, China and at USPCAS-W.
At least one strong American-Pakistani university linkage established	MUET has formally entered into a partnership with University of Utah (UU) under an agreement. Moreover; linkage with Colorado State University (CSU), and University of Nevada Los Vegas (UNLV) has also been developed.
The wide regional diversity of students trained, of whom at least 50% falls under economically disadvantaged criteria.	The center considered all enrolled students as from disadvantaged group so as to promote higher education in the field of water.
Percentage of female participation in USPCAS-W activities exceeds by 50%.	The female ratio in staff including faculty continue to stand at 20% and the ratio in students stands at 36%.
At least 50 advanced research projects conducted by CAS-W. - 28 Research Seed Grants to be awarded by center. - 22 projects won by the center through external funding.	- The center obtained funding of 28 projects from outside the center. - The center awarded seed grants for 30 research projects to its faculty and other research institutions.
At least 50% CAS-W students placed in internships with private sector entities.	In total, 80 students have benefitted from the internship opportunity.
The Council for Research and Policy (CRP) think tank made operational.	The council was established in the name of National Water Research Network.
At least five public-private partnerships (PPPs) or Global Development Alliances (GDAs) established through CAS-W.	Against this target, the center has partnered with 21 national and international organizations through MoUs and project agreements.
Three professional certification, degrees or programs established at CAS-W.	Seven (07) degree programs; 4 MS and 3 Ph.D. programs in four stream i.e. HID, IWRM, EnvEng and WaSH Sciences have launched.

At least 20 CAS-W courses designed and/or improved that meet international standards.	43 new and improved courses have been developed and introduced.
A dedicated library established to support CAS-W priorities.	A dedicated library has been established to support CAS-W priorities with over 4,000 books & journals.
Specialized research/laboratory facilities established or upgraded that supports the service and problem-solving focus of the center.	<p>Six laboratories have been established and are operational;</p> <ul style="list-style-type: none"> i) GIS & Remote Sensing Lab ii) Computer & Software Lab iii) Advanced Water Quality Lab iv) Soil & Water Lab v) Pilot Scale Water Quality Lab vi) Hydraulics Lab

GOVERNANCE

TARGET SDG – 6.2:

**“BY 2030, ACHIEVE
ACCESS TO
ADEQUATE AND
EQUITABLE
SANITATION AND
HYGIENE FOR ALL
AND END OPEN
DEFECATION,
PAYING SPECIAL
ATTENTION TO THE
NEEDS OF WOMEN
AND GIRLS AND
THOSE IN
VULNERABLE
SITUATIONS”**

GOVERNANCE (COMPONENT – 1)

The focus of this component was to develop governance structures within MUET with clearly defined roles and responsibilities to allow for smooth implementation of the project and institutionalization and sustainability of the Center. All along, the University of Utah has provided technical assistance and capacity building to establish appropriate governance bodies, processes and instruments for managing the activities of the Center.

Although the Center was administratively placed in MUET's Faculty of Architecture and Civil Engineering, the Project Director USPCAS-W was directly reporting to the Vice Chancellor rather than to Dean of the Faculty. However, the Dean's administrative approval was essential in all academic matters. This autonomy of the Center proved to be successful during the project period, given that the Center was not dependent on the regular university budget. Additionally, the university leadership and senior management exhibited strong commitment towards achieving the objectives of the program.

Furthermore, two leading bodies were put in place to govern and manage the Center programs and activities. These are, the Board of Governors (BoG) and the Project Management Unit (PMU). The BoG was constituted by MUET authorities to provide strategic guidance to the project management, approve Center programs, and ensure the program alignment with the objectives of the Center. The PMU, led by the Project Director, carried out its operations actively and implemented the mandatory activities, as per the cooperative agreement, towards achieving the overall goal of the project.

Board of Governors

The Center is governed by an independent Board of Governors (BoGs) headed by the Vice Chancellor of Mehran University of Engineering & Technology (MUET). All major programmatic decisions were approved by the BOG, which was set up to garner institutional support for the Center at national and international levels. Further, the BoG was to ensure good governance, provide strategic leadership and was also mandated to review the performance of the Center and provide strategic guidance while meeting on a bi-annual basis. The BOG has been expanded over time to bring in external experts, and currently, 7 of 13 members are from outside the MUET. During the project period, the BoG could hold eight meetings, and the present composition of BoG is given as under:

S. #	Name	Designation and Affiliation	Status in BoG
1	Prof. Dr. Muhammad Aslam Uqaili	Vice Chancellor, Mehran University of Engineering & Technology, Jamshoro	Chairperson
2	Prof. Dr. Mujeeb-Ud-ddin Memon	Vice Chancellor, Sindh Agricultural University, Tandojam	Member from outside
3	Senator Mr. Nisar Ahmed Memon	Chairman, Water Environment Forum, Islamabad	Member from outside
4	Dr. Muhammad Ashraf	Chairman, Pakistan Council of Research in Water Resources, Islamabad	Member from outside
5	Ms. Khawar Mumtaz	Chairperson, National Commission on the Status of Women, Islamabad	Member from outside
6	Dr. Arjumand Nizami	Country Director, HELVETAS Swiss Intercooperation Pakistan, Islamabad	Member from outside
7	Prof. Dr. Muhammad Jamal Khan	Vice Chancellor, University of Swat, Saidu Sharif, KPK	Member from outside
8	Dr. Abubakar Muhammad	Director, Center for Water Informatics and Technology, LUMS Lahore	Member from outside
9	Prof. Dr. Tauha Hussain Ali	Pro-Vice Chancellor, Mehran University of Engineering & Technology, Jamshoro	Member from MUET

10	Prof. Dr. Khan Muhammad Brohi	Dean, Faculty of Architecture and Civil Engineering, MUET Jamshoro	Member from MUET
11	Prof. Dr. Abdul Waheed Umrani	Registrar, Mehran University of Engineering & Technology, Jamshoro	Member from MUET
12	Mr. Munir Ahmed Shaikh	Director Finance, Mehran University of Engineering & Technology, Jamshoro	Member from MUET
13	Prof. Dr. Bakhshal Khan Lashari	Project Director, USPCAS-W, MUET Jamshoro	Member/Secretary



Group Picture of Board of Governors along with UU, USAID and MUET Team (July 2019)

Project Management

The Project Management Unit (PMU) comprised of five key persons. At the time of closure of the project, four key persons viz. Project Director, Deputy Director (Academic & Research), M&E Specialist, and Finance and Grants Manager were continuing with the program. These managerial positions were supported by 20 professional and general service staff assigned with different responsibilities. All this staff reported either directly or through the line managers (key personnel) to the Project Director who, in turn, reported to the Vice Chancellor (VC) concerning the Center's operations and its progress on deliverables. The second major staff category represents 33 faculty and research/technical staff responsible for managing the academic degree programs in four disciplines and the applied research component. They report directly to the Deputy Director (Academic & Research) whose office is responsible for managing students' affairs (admissions, scheduling of classes, students' research and examination etc.) and the overall research portfolio.

The PMU continued its operations actively for the project period and held planning and review meetings regularly for efficient project implementation. It also maintained close liaison with the University of Utah, USAID, and HEC and interacted periodically with them for the smooth functioning of the program. In this connection; formal meetings were arranged with UU teams, faculty and staff to obtain feedback on various ongoing activities and planning of new initiatives.

Financial and Procurement Management

USAID conducted a detailed institutional assessment of MUET (pre-award assessment) as a pre-requisite for the cooperative agreement for USPCAS-W in year 2014. In line with the pre-award condition of the cooperative agreement coming out from the pre-award assessment report, MUET developed a financial and procurement management manual to manage the USAID funds and procurements independently. The Finance and Account section of the PMU smoothly carried out the financial management of the project and facilitated annual external audits through Chartered Accountant firms. Summary of project budget and expenditure is

given at **Annex-1**. Procurement section under PMU smoothly carried out the national and international procurement for the Center and also facilitated annual external asset verification. Summary of assets purchased under USAID funding is given at **Annex-2**.

Campus Management System (CMS)

It was initially part of the pre-award condition that the Center will integrate with the CMS of MUET. Since MUET was late in the deployment of the CMS, the Center successfully implemented separate modules for each function of the project management, i.e. Finance, HR, Store & Inventory, Admissions, and Enrollment.

Human Resource Management

As a whole, the Center executed the project much efficiently with a limited number of staff as compared to the budgeted positions. In total, at the end of the project, the Center was operating with a staff of 47. The project staff consisted of three categories, i.e., management staff, faculty & technical staff and administration staff, as shown in the table below. List of the entire staff of the project is given at **Annex-3**.

Staff Category	Number of Staff
Management (Key Personnel)	4
Faculty & Technical Staff	21
Admin	22
Total Staff	47
Leveraging Staff+	05

+ Leveraging staff was the human resource who was transferred to the project from MUET and was not charged to the USAID. This staff worked for the project but was on MUET's regular payroll.

Governance Instruments

The Center, during the project period, developed various governance instruments to ensure delivery of intended project results and impacts on administration and program side.

The list of SOPs and committees established by the Center to serve different purposes is provided below. In addition to using these instruments, the Center continues to draw guidance from MUET and HEC regulations, as and when needed.

Committees

- 1) Board of Governors
- 2) HR Selection Board
- 3) Curriculum Review Committees
- 4) Admission Committee
- 5) Procurement Committee
- 6) Research Grants Management Committee
- 7) Students Research Grant Committee
- 8) Gender Equity Committee

- 9) Endowment Fund Committee
- 10) Standing Committee on Business-Academia Collaboration under FPCCI

Standard Operating Procedures

- 1) Students Handbook: A manual describing the rights and responsibilities of students.
- 2) Terms and Conditions of the Exchange Program
- 3) Building Management Committee
- 4) Store/Inventory Management
- 5) SOPs for different Laboratories

Web-based Portals

In addition to the above SOPs, the following web-based systems have also 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) Faculty Activity Report (FAR): An instrument to report and evaluate faculty performance
- 5) Inventory Management System: For record-keeping of all equipment, furniture, consumables, and other material
- 6) Students Information System: Reporting on data of admissions, enrollment, drop-outs, and alumni
- 7) Learning Management System: An open-source interactive system primarily used by students and faculty for management of courses

National Steering Committee for CAS Project

National Steering Committee for the four CAS projects was established in HEC Islamabad under the chairmanship of HEC Chairman. The purpose of the steering committee was to review the progress of all four CAS projects in Pakistan and develop synergies among four CASs. The committee was planned to meet on an annual basis, and USAID also attended its meetings.

Monitoring & Evaluation

A results-based performance management framework was followed with emphasis on the following: establishing sound monitoring and evaluation systems to support decision-making, identifying performance gaps and promoting accountability for managing results, supporting stakeholders' engagement in project planning and management, identifying and managing risks, and reporting/reviewing performance at regular intervals. The performance management framework of the project established the following systems for its progress tracking and periodic evaluations.

Annual Implementation Plans

The Center developed the implementation plan every year following the cooperative agreement and submitted to USAID and executed the activities accordingly. These annual implementation plans were prepared component-wise while describing the activities for the planned year on a monthly basis.

PMU and Faculty Meetings

The progress in implementation of the annual plan was reviewed on a fortnightly basis with faculty, and quarterly, with PMU of the Center. Necessary course corrections were made as and when required.

Reporting

As per CA, a detailed performance report, describing all activities, was submitted to AOR at the end of each quarter. Moreover, other customized reports were also presented to AOR as and when needed. Alongside, the quarterly progress made against MSF indicators was also updated in **Pakinfo data portal**. The Center has been reporting on the following indicators in Pakinfo data portal. The numbers reported in Pakinfo system may differ from the numbers updated periodically in QPRs and given in this report. The reporting on various indicators in Pakinfo system varied during the project period, and the status is given as under:

Ref #	MSF Indicator	Remarks
4b.	Percentage of graduates from USG-supported workforce development or tertiary education programs reporting themselves as employed	As per PIRS, the data on the indicator is to be collected by USAID's 3 rd party contractor and reported by USAID.
4.1.2a.	Number of individuals from underserved and/or disadvantaged groups accessing workforce development or tertiary education programs	Reporting on the indicator started from the start of the project and continued till Dec 2019.
4.1.2b.	Number of students receiving a US-funded scholarship to attend Pakistani institutions of higher education	Reporting on the indicator started from the start of the project and continued till Dec 2019.
4.2b.	Number of U.S.-host country joint development research projects	Earlier from the start of the project, MUET was reporting on the indicator, but since Q3 2017, UU was assigned this indicator for reporting.
4.2.3a.	Number of host-country individuals who completed USG-funded short-term training or exchange programs involving higher education institutions	Earlier from the start of the project, MUET was reporting on the indicator, but since Q3 2017, UU was assigned this indicator for reporting.
4.2.3b.	Number of USG funded tertiary education and workforce development programs that include experiential and/or applied learning opportunities	Removed from the system from Q3 2017.
4.2.3c.	Number of academic research initiatives whose findings have been replicated, applied or taken to market	Removed from the system from Q3 2017.
4.3b.	Percentage of employers expressing satisfaction with USG supported graduates	The data is to be collected by USAID's 3 rd party contractor and reported by USAID.

4.3c.	Percentage of stakeholders expressing satisfaction with research at USG supported universities	The data is to be collected by USAID's 3 rd party contractor and reported by USAID.
PPR ES.2-1.	Number of host country higher education institutions receiving capacity development support with USG assistance	New indicator included from Q4 2019 and continued till Dec 2019.
PPR STIR-12.	Number of peer-reviewed scientific publications resulting from USG support to research and implementation programs	New indicator included from Q4 2019 and continued till Dec 2019.

As clearly mentioned in the above table, the data reporting was distributed between MUET and UU in Quarter-3 of 2017. Moreover, the reporting on MSF indicators in Pakinfo is not being done for Quarter-4 2019; due to the reason that Pakinfo was undergoing some adjustments and no indicators were available to report at the end of the said reporting period.

Teacher and Course Evaluation

Teacher & course evaluation through student feedback is a regular feature conducted with students at the end of each semester. The assessment using the standard tool was performed manually in the first two years and subsequently moved on to LMS implemented by the Center. The results of such evaluations are confidential and shared with each faculty member separately and discussed by management individually. The results are used to improve teaching and course contents.

Student Exit Survey

The Center started conducting an exit survey with the passing out students. It was meant to learn about the overall experience of graduating students at the Center and the quality of teaching, research and other mentoring of students. The results of the exit survey are meant for improving the overall services and facilities at the Center.

Learning Management System (LMS)

A Learning Management System (LMS) using "Moodle" was introduced in the Center. Moodle is a learning platform designed to provide educators, learners and administrators with a single robust, secure and integrated system to create a personalized learning environment. Through LMS, the teachers, students, and mentors interact with each other and can create, share and edit the courses online. The system also provides support to the office of academics and research to monitor academic activities during the semester.

Governance Review Meetings

Almost every quarter, UU missions visited the Center for capacity building activities of faculty and students. During missions, PMU of Utah held meetings with PMU of MUET and the faculty and reviewed the progress on matters related to governance, research, curricula, trainings, and other performance-related activities.

Third-Party Evaluation

USAID conducted 3rd party evaluation of the project through MSI for which MSI team visited the Center from 16 – 25 April 2018 and held different activities for the purpose. The MSI team met with faculty, students, and management of the Center along with various stakeholders and partners of the program. Subsequently, on 11th June, MSI once again visited the Center and conducted a data validation workshop. Final report of the evaluation was received in April 2019.

Performance Audit by OIG

OIG audit team of USAID Islamabad, comprising of Mr. Benjamin Owusu and Mr. David Clark, visited the Center for two days on 2 – 3 May 2018. The audit team visited the building, verified the lab equipment, and held meetings with faculty, PMU staff, and students of the Center.

Market Needs Assessment

The Center conducted a market survey (market needs assessment), through a third party, to assess the alignment of CAS-W curriculum and research agenda with the market/industry needs. The project was awarded to Ipsos – a consulting firm based in Islamabad. The report was finalized, and the Center developed an action plan to address the findings and recommendations of the study.

Assessment of Governance of the Center

Board of Governors, being the highest level of Center's governance, has primarily been involved in making and endorsing programmatic decisions regarding project planning and progress review. The Center could not progress towards achieving the financial sustainability of the Center by the end of the project period, which remains a challenge. The need was to create a pathway for the sustainability of the Center by defining strategic priorities, supporting resource mobilization efforts, strengthening productive linkages with the private sector, and promoting its services, among a broader range of stakeholders at country level.

Maintaining the Center's operational autonomy was critical for its sustainability. The university syndicate recently approved the autonomous and national status of the Center, which indeed has enabled the Center to continue operating as an independent entity under the BoG and proceed towards its sustainability. From the very outset, the university leadership and senior management exhibited strong commitment towards promoting collegiality of purpose towards the success of the Center.

Although the Center started with decentralized and completely independent financial, procurement, and HR management, it faced other procedural challenges impeding the performance. Realizing the situation, the Center resolved that it needed to have its own governance instruments and SOPs to ensure delivery of intended project results. Subsequently, the Center developed its standard operating procedures (SOPs) and guidelines and established some web-based portal for improved efficiency and accountability. These SoPs and web portal are listed above under section 7.1.

The institutional arrangements of governance discussed above are going to enable the Center to achieve its social, technical and financial sustainability.

Lessons Learnt

- 1) **Autonomy of the Center:** Autonomy of the Center by design of the project proved to be successful strategy in delivering the project activities in a time bound framework. This helped center establish its own systems and procedures especially administrative, financial and procurement procedures.
- 2) **Role of BoG:** Role of BoG: Board of Governors of the Center would have been more vibrant if there were members from more diversified fields especially from industry, business community, private sector and policy-making circles. Having on board, members from diversified fields would have helped in recognition of the center among larger stakeholders at national levels and generation of funds and resources.
- 3) **Communication and Outreach Strategy:** Despite the fact that center was able to get a reasonable coverage in the national newspapers which definitely helped center in outreaching its existence and work across the country but otherwise its communication and outreach efforts lacked the capacity and the strategy 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.

- 4) **Productive Networking:** The center held a number of successful events during the project period which were attended by experts and representatives of various national and international organizations. The center could not build on those networking events and translate those networks into long-term productive partnerships. This was a specialized job and despite budgeted positions of “Industry Liaison Officer” and “Career Advisor”, the center could not fill those positions throughout the project period.
- 5) **Recruitment of Faculty, Students and Key staff:** The geographical location of the center – being located in a relatively remote area of the country in relation to the major educational hubs like; Karachi, Lahore and Islamabad remained a continuous challenge in attracting diverse staff especially faculty and students. The project funding, and unique features like; exchange training program and scholarships reasonable helped center to attract faculty and students of diverse fields from across the country.
- 6) **University of Utah Partnership:** Partnering MUET with UU for technical assistance and capacity building highly proved to be a successful model. Given the state of higher education in the country, especially in the public sector universities, without UU support this project could have never progressed so well especially in the areas of setting up institutional systems, design of curriculum and creating a research culture.
- 7) **USAID Support:** USAID was the funding agency for the project but it was fully engaged with the center in providing all kinds of support not only to meet the targets but also progress towards achieving the objectives. This included day to day guidance in all programmatic and financial matters, trainings in different areas of project’s operations, developing institutional manuals and expediting the process of exchange training beneficiaries from approval of the specific DS forms to the Visa interviews.
- 8) **Commercialization of Building Facilities:** Commercialization of labs and other building facilities is a specialized field and the center lacked capacity to achieve this target within the project period. This task required dedicated team to deal with the requirements involved in the process and market the facilities accordingly.

ACADEMICS AND CURRICULA

TARGET SDG – 6.3:

“BY 2030, IMPROVE WATER QUALITY BY REDUCING POLLUTION, ELIMINATING DUMPING AND MINIMIZING RELEASE OF HAZARDOUS CHEMICALS AND MATERIALS, HALVING THE PROPORTION OF UNTREATED WASTEWATER AND SUBSTANTIALLY INCREASING RECYCLING AND SAFE REUSE GLOBALLY”

ACADEMIC PROGRAM AND CURRICULA (COMPONENT – 2)

Academic Program

Three major activities were covered under this component: (i) launching of MS and PhD degree programs in different water-related disciplines, (ii) development of courses and syllabi for each of the degree programs and aligning the academic training to market needs, and (iii) capacity building of faculty in teaching methods and mentoring of graduate students

The academic program of USPCAS-W at MUET was built on the foundation of two institutes, the Institute of Water Resources Engineering and Management (IWREM) and the Institute of Environmental Engineering and Management (IEEM). The curriculum offered in IWREM and IEEM were well designed and approved by the Academic Council at MUET, which followed standard protocol for Higher Education Institutions in Pakistan. While addressing the sustainable development framework, the courses for all degree programs were designed and improved such that they addressed the Sustainable Development Goal -6 (**SDG-6**): **Ensure access to water and sanitation for all** – along with its six targets. Moreover, experiential learning, capacity development through twinning of Pak-US faculty, organization of several useful teaching workshops, regular teaching evaluations, efforts for linking curriculum to market needs, and introduction of a seminar series were the key features of the academic program offered at the Center.

As per the cooperative agreement, the Center was required to start three degree programs in the field of water, but the Center managed to start seven degree programs in four disciplines, as given below:

S. #	Degree	SDG Water Targets	Relationship to Previous Degree Programs
1	MS : Water, Sanitation, and Hygiene (WASH) Sciences	6.1: Access to safe drinking water 6.2: Access to basic sanitation	New program
2	MS : Environmental Engineering	6.3: Pollution control and water quality management	Modified from IEEM degree program
3	PhD : Environmental Engineering	6.3: Pollution control and water quality management	Modified from IEEM degree program
4	MS : Hydraulics, Irrigation, and Drainage	6.4: Improving water system efficiency	Modified from IWREM degree program
5	PhD : Hydraulics, Irrigation, and Drainage	6.4: Improving water system efficiency	Modified from IWREM degree program
6	MS : Integrated Water Resources Management	6.5: Integrated water resources management	New program
7	PhD : Integrated Water Resources Management	6.5: Integrated water resources management	New program

The Center built upon two existing programs of the university, i.e., HID and EE, which were reviewed and adapted for offering MS and PhD in 2015 in collaboration with the University of Utah. Alongside, in the same year, the Center also started MS and PhD degree programs in a new discipline of IWRM. This program was benchmarked against international programs and developed through a collaborative effort between MUET faculty and international experts.

Subsequently, another new degree program in WaSH Sciences was designed and launched at the MS level alone in 2016. The scope of each one of these four streams is described below.

Hydraulics, Irrigation, and Drainage (HID)

The HID program educates students in the field of open channel and groundwater hydraulics in combination with engineering principles and to support useful plant life, with minimum degradation of soil and water resources. HID program is structured to be interdisciplinary. Students develop interest and feel encouraged to explore and appreciate the environmental and ecological effects of irrigated agriculture.

Integrated Water Resource Management (IWRM)

The IWRM program enhances students' knowledge and capacities to deal with multi-disciplinary aspects of water resource allocation and use under uncertainties. Key topics constituting the program include: principles of IWRM, hazard planning and management, inter-sectoral allocation and use, water governance, institutions and policies, water dispute management, water valuation, economics of water management, and GIS and remote sensing in water resources.

Environmental Engineering (EE)

The Environmental Engineering program focuses on the fundamental and applied understanding of the processes which govern natural and engineered treatment systems and the effects that they have on human and ecosystem health. This program emphasizes learning in conventional environmental engineering, physical, chemical and biological processes, water quality management, water and wastewater treatment design, air and noise pollution control, hazardous and solid waste management, and environmental impact assessment.

Water, Sanitation and Health (WaSH) Sciences

This program deals with the skills and knowledge to effectively implement water and sanitation interventions and work with the community and community-based organizations and the local political structure. It assesses the functioning and impacts of these systems and implements solutions to improve the effectiveness and sustainability of existing systems.

Curricula

Curriculum reform was one of the main components of the project to enhance the quality of the curriculum to a world-class level while making it compatible with the market needs. Since the beginning of the project, the University of Utah and MUET faculty and management have been very keen to introduce such market-oriented programs which shall attract all the stakeholders and create a market for the graduates. This involved a range of initiatives, reviews, inquiries, renewed debates and practicalities of the curriculum both at MUET and University of Utah. After detailed deliberations within specific working groups on course development involving faculty of both MUET and UU, curricula had been finalized for all Masters and PhD programs. However; this remained an on-going activity during the project period and curricula were periodically reviewed for their improvement. As a whole, the Center introduced and/or improved 43 courses under all the four streams of MS and PhD program. List of the courses is given as **Annex-4**.

Admissions and Enrollment

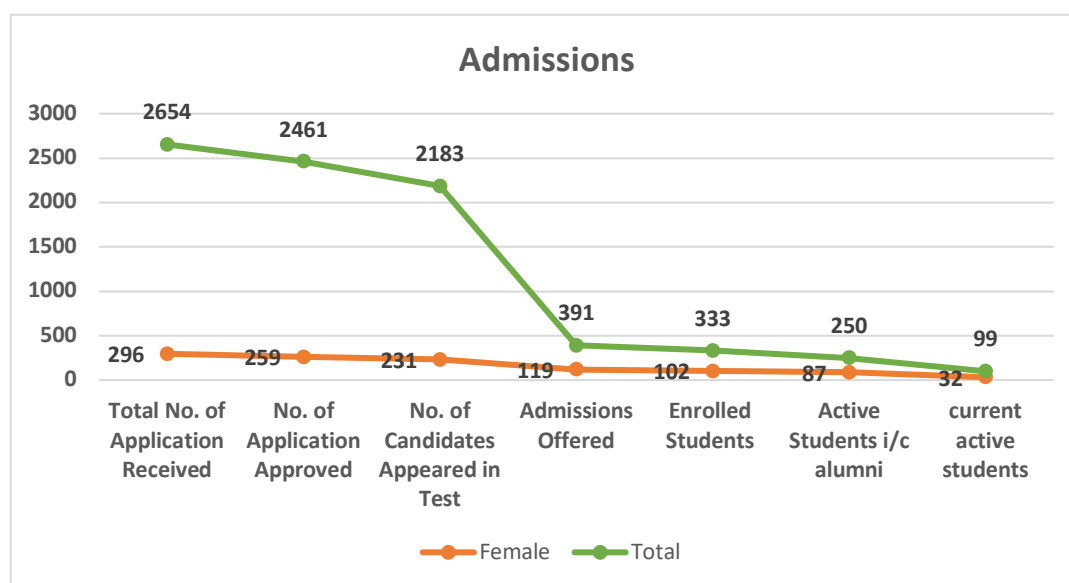
USPCAS-W is a national water center and invites admissions from all over the country. During the project period, the Center steered an outreach program to introduce the Center. It encouraged students from different parts of the country to avail the exclusive opportunity of degree programs offered by the Center under USAID funded scholarship. The Center achieved the target of 250 students including 87 females (35%) from Sindh, Punjab, KPK, Baluchistan and GB. Admission tests were organized in different cities of the country to facilitate students to compete for the admissions at their convenience. These cities included Islamabad (ICT), Peshawar (KPK), Multan (Punjab), Quetta (Baluchistan), and Jamshoro (Sindh). It is worth mentioning that the Center succeeded in enrolling 10% students from outside the province. In total, 231 students were enrolled in MS degree programs, and 19 students joined the PhD program.

Scholarship and Benefits

During the project period, the center provided following benefits to the students, enrolled in the center:

- Full tuition fee for all semesters (4 semesters for MS and 6 semesters for PhD)
- A stipend of Rs. 15,000 per month to cover living and accommodation costs
- Free transport through university buses
- Training and research opportunity at Universities in USA
- Female students are provided free accommodation at the campus.

Admissions were made purely on open merit basis without any seat allocations. However, following the policy of admitting 50% females, the Center could achieve female admissions to 35% of the total admitted. Overall, 2,654 students applied for admission (296 females and 2358 males) in all five batches (fall 2015, fall 2016, fall 2017, spring 2018 and fall 2018) and 2,183 candidates appeared in the admission tests. Subsequently, 391 successful students were given the provisional offer of admission in all the four degree programs while 333 (231 males and 102 females) of these got enrolled/registered in their respective programs. For various personal reasons, 83 students, including 15 females, did not continue their studies and at some stage during the first semester left the Center.



Batch-wise Number of Students (MS and PhD)

Total Number of Students (MS and PhD)						
	Fall 2015	Fall 2016	Fall 2017	Spring 2018	Fall 2018	Total Enrollment
Female	12	13	20	21	20	87 (35%)
Male	36	25	27	30	41	163
Total	48	38	47	51	61	250
Ph.D. Students						
Female	1	0	0	2	0	3 (16%)
Male	9	0	4	3	0	16
Total	10	0	4	5	0	19
MS Students						
Female	11	13	20	19	21	84 (36%)
Male	27	25	24	29	42	147
Total	38	38	44	48	63	231

Discipline wise Total Number of Students

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%)

Complete list of MS and PhD students enrolled under USAID funding is given at **Annex-5**.

Batch-wise Status

1st Batch: Fall 2015

Out of 38 MS students, 36 have graduated, and against 10 PhD scholars of the batch, 9 have successfully graduated and awarded degrees.

2nd Batch: Fall 2016

Out of 38 MS students, 34 have successfully graduated and awarded degrees. One PhD student of the batch continues with his research. This PhD student is on HEC Scholarship and not funded by USAID.

3rd Batch: Fall 2017

This batch is comprised of 44 MS and 3 PhD students. Out of 44 MS students, 37, including 18 females, have graduated and awarded degrees.

4th Batch: Spring 2018

This batch is comprised of 48 students including 5 PhD scholars. Out of 48 MS students, 30 including 12 females have graduated and awarded degrees.

5th Batch: Fall 2018

Fall 2018 batch is comprised 63 MS students and are to graduate in August 2020.

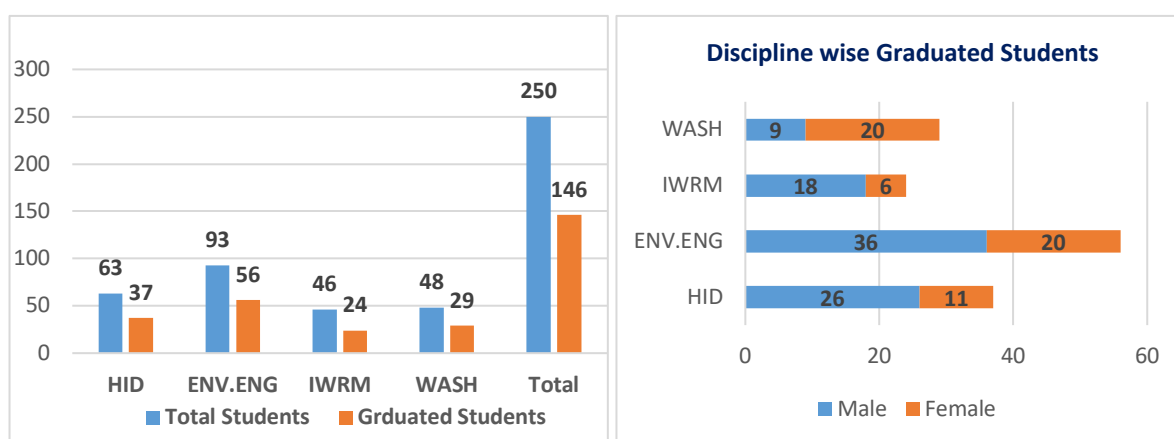
6th Batch: Fall 2019

The Center continues with its academic program beyond USAID funding and enrolled fall 2019 batch as per the details given below. The MUET also continues with the scholarship for all enrolled students from its own resources with reduced stipend for MS scholars from Rs. 15,000 to Rs. 7,000 and with same stipend of Rs. 15,000 for PhD scholars.

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%)

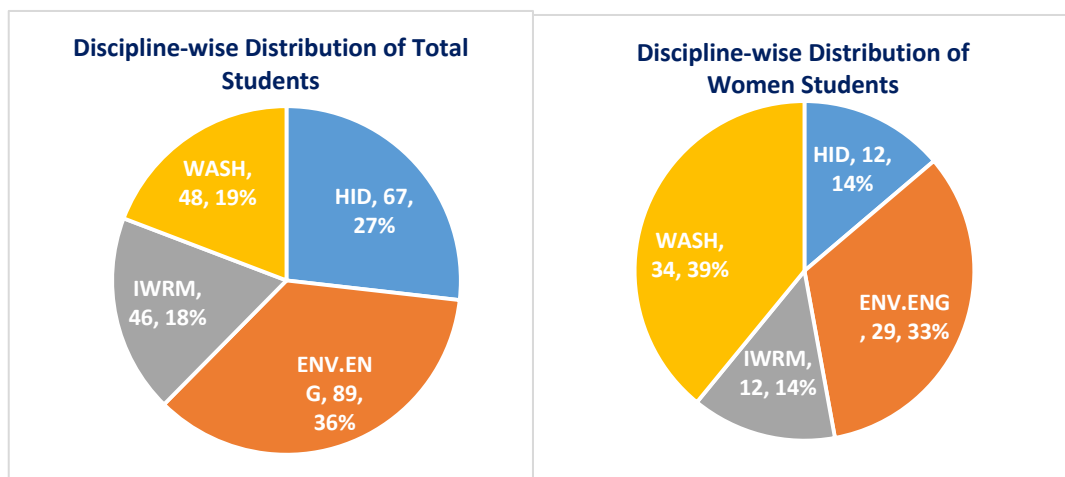
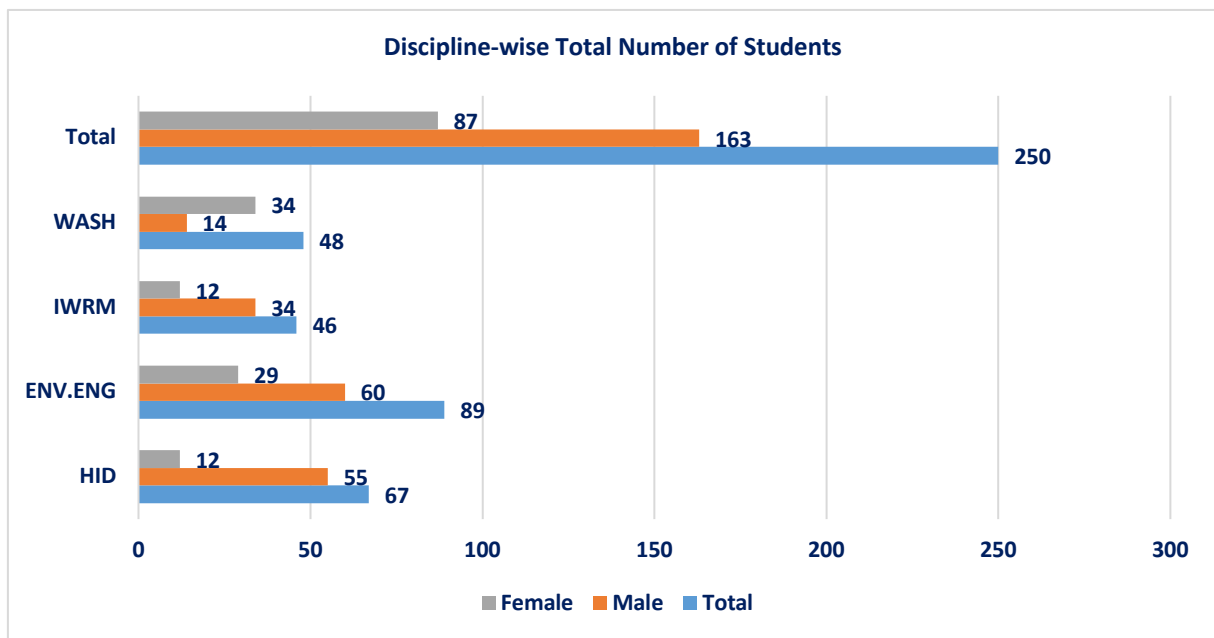
Alumni

Till December 2019, out of total 250 students 146 including 57 females and 9 Ph.D scholars graduated from the Center in four disciplines. The break-up of graduated students is given in below charts.

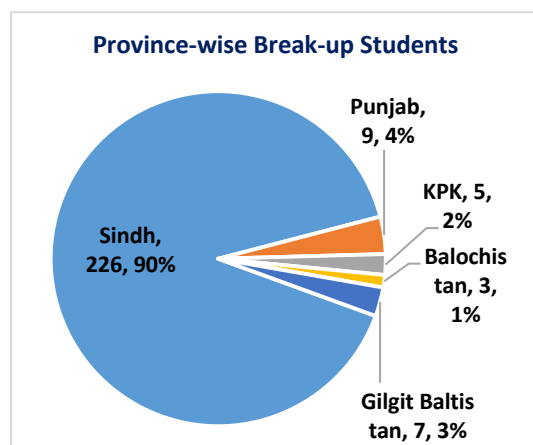


Assessment of Academic Program

The charts given below describe the distribution of the students' enrollment among the four degree programs. It showed the highest percentage of 36% in Env.Eng, 27% in HID, 19% in WaSH and 18% in IWRM programs. However, the enrollment of female students is inclined more towards the WaSH program, with 39%, followed by Env.Eng, HID and IWRM with 33%, 12%, and 12%, respectively. However, within each program stream, the proportion of female students was highest (71%) in WaSH, followed by EE, IWRM and HID with 31%, 26% and 19% females, respectively.



USPCAS-W is a national Water Center and encourages student admissions from all over the country. For that purpose, the Center held outreach programs in different universities in all provinces of the country to encourage students to join the Center. The given figure tells that the 10% students from outside Sindh province joined the Center for their higher education with 9 students from Punjab, 7 students from GB, 5 from KPK and 3 from Baluchistan. It worth mentioning here that among 7 students coming from GB, 6 are females.



The Center, after finalizing the MS and PhD degree programs, initiated an extensive curriculum reform program to design the courses that meets needs of public and private sector. The process involved setting-up of curriculum advisory committee and sub-committees and working groups to identify and design courses with international standards and market

applicability. Consultation with University of Utah (UU) began through regular interaction through email exchanges and skype meetings. The working groups agreed upon the new courses including mandatory, common, elective course for the four disciplines and 7 degree programs (4 MS and 3 PhD). The curriculum reform program continued and the syllabi were reviewed every year during UU missions and the courses designed in first years were improved with passage of time and new courses introduced.

The partner University of USA, believes that the prescribed courses in general match with what would be provided in internationally comparable programs. However, the students are not exposed to second and third levels of advancement to build deeper skills and knowledge in areas of strength attributable to the Center. Though, the Center has introduced a few modules of professional development students' skills can further be strengthened in fundamental research methods in statistics, technical writing, lab safety/methods, informatics, and computer programming etc. This is partly a problem with student's intake which reflects the insufficient skills of students upon entry into the MS or PhD programs and partly a problem with the effectiveness of the courses and extra-curricular training programs. These skills need to be developed by a revised advanced research methods course sequence, inclusion of these concepts into other course work, and in the creation of new training workshops organized as co-curricular experiences.

There is a missed opportunity in the area of using existing courses for offering the certificate and diploma courses. To date only two diploma courses have been designed and delivered for a specific client (Sindh irrigation Department) and there has not been a linkage between courses in the degree programs and the training modules of the diploma courses. There is a reasonable potential to expand this window of opportunity to attract working professionals, perhaps through the introduction of certificate courses, other diploma courses and evening programs.

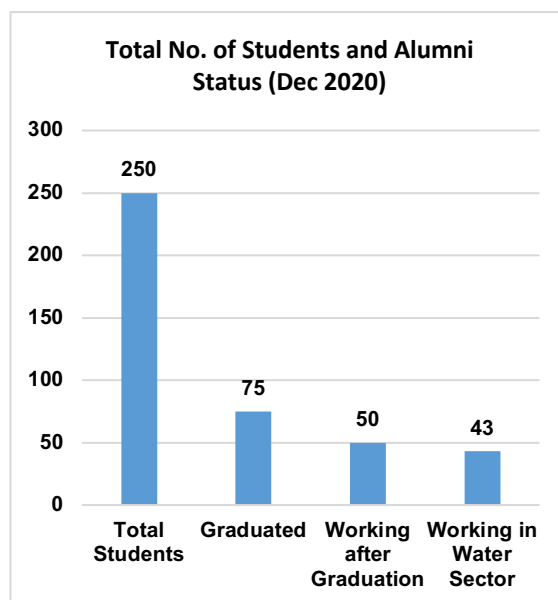
The Market Needs Assessment Survey, mentioned above, also gave a conclusion that "there is a general view that the education program of USPCAS-W, while essentially aligned with the market needs, requires to be further refined and fine-tuned to meet national and regional requirements."

Job Status of Alumni

As stated above that in total 146 students (137 MS and 9 Ph.D.) including 57 females have been awarded degrees from the Center. This include 70 scholars who graduated in year 2018 and other 76 scholars have graduated in 2019 and awarded degrees in February 2020.

While looking at the data of 70 graduated scholars in year 2018, it is learnt that 29 are employed in different government and non-government organizations in the country, 20 pursuing PhD in USA, China and at USPCAS-W. Moreover, it is important to mention that 43 graduate of the Center are directly or indirectly working in the water sector. Updated summary of status on alumni engagement is given in below table.

Status	No. of Graduates
Alumni Pursuing PhD	20
Abroad	16
In Country	4
Alumni in Jobs	30
Abroad	1
In Country	29
Academia	9
Government	8
NGO	2
Private	9
Entrepreneurship	1
Grand Total	50



Lessons Learnt

- 1) Curriculum Review: Joint periodic review of curriculum by MUET and UU team helped improve the curriculum design and contents. Stakeholder consultation was also part of the review process to incorporate needs and demands of the field into the curriculum. The review process system is already in place hence the center must continue with this curriculum review practice so that the curriculum is updated with the time in future.

APPLIED RESEARCH

TARGET SDG – 6.4:

**“BY 2030,
SUBSTANTIALLY
INCREASE WATER-USE
EFFICIENCY ACROSS
ALL SECTORS AND
ENSURE SUSTAINABLE
WITHDRAWALS AND
SUPPLY OF
FRESHWATER TO
ADDRESS WATER
SCARCITY AND
SUBSTANTIALLY
REDUCE THE NUMBER
OF PEOPLE SUFFERING
FROM WATER
SCARCITY”**

RESEARCH PROGRAM (COMPONENT – 3)

USPCAS-W research component was aimed at seeking practical solutions to Pakistan's water-related challenges. The overall goal of the center's research program was to stimulate competitive and innovative applied research with a key objective to develop and implement a self-sustaining applied research program in water. Furthermore, it has to be multi-disciplinary in nature and developed within the broader context of the water-development nexus to support the achievement of sustainable development goal on water (SDG-6). For achieving this aim, the water research agenda was developed and prioritized through an extensive consultative process with the participation of a broader range of stakeholders from private and government sectors to ensure relevance and attract private sector funding for advanced research in water issues.

The Center advances water research capacity and impact in Pakistan with a sustainable, high-impact applied research program that bridges expertise among USPCAS-W and other researchers & practitioners.

Applied research agenda includes;

- Overcoming water scarcity
- Developing and maintaining water infrastructure
- Improving water quality
- Improving water use efficiency and agricultural productivity
- Enhancing access to drinking water and sanitation
- Bridging disparities in access and coverage
- Reversing groundwater depletion
- Reclaiming degraded lands
- Strengthening water governance
- Improving performance of water utilities
- Protecting water ecosystems

USPCAS-W Research and SDG 6

All research projects initiated by the center in collaboration with various partner organizations are contributing towards achieving the SDG-6 targets.

- 6.1 Drinking water
- 6.2 Sanitation and hygiene
- 6.3 Improve water quality
- 6.4 Water-use efficiency
- 6.5 Integrated water resources management
- 6.6 Water-related ecosystems

As per CA, the Center was to implement 50 projects including 28 research seed grants to be awarded by the Center to faculty of MUET and other researchers in the country and 22 projects to be won by the Center from external funding/donor agencies. As a result, the Center awarded 30 research seed grants and won funding of 30 projects from different national and international organizations. A summary of these projects is given below.

Research Seed Grants

The target of the Center was to award 28 research seed grants on a competitive basis, with each research grant not exceeding Rs. 3.0 million for a project period of one year. However, the grant amount and the period of the project were flexible depending upon the nature of the project. All registered research institutes, HEC approved universities, NGOs, civil society organizations and individuals with applied research experience and publications in research journals were eligible to apply for these grants. The evaluation criteria included qualification of investigators, facilities available, previous experience of working with national and international organizations of repute, and international collaboration /partnerships achieved particularly in

water-related research. A joint review committee comprised of faculty members from MUET and UU evaluated the proposals, and the research grants management committee awarded the grants based on recommendations of the proposal review committee.

As a result, the Center awarded 30 research grants in three rounds. The details and status of the research grant projects are given as under.

Summary of Research Seed Grant Awards

Call Number	No. of Proposals Evaluated	Number of Projects Awarded	Total Approved Grant Amount (PKR)
1 st	30	6	13.85
2 nd	24	7	20.82
3 rd	89	17	41.95
Total	143	30	76.62

Status of the Research Seed Grant Awards

Project #	Principal Investigator (PI) and Affiliation	Project Title	Cost (M PKR)	Status
1	Mr. Zamir Ahmed Soomro, PCRWR	Assessment of Environmental Degradation of Manchar Lake	2.752	Completed
2	Mr. Waqas Ahmed, USPCAS-W	Decision Support System for Water Resources Planning and Management	1.823	Completed
3	Dr. Altaf Ali Sial, USPCAS-W	Climate Change: Assessing Impact of Seawater Intrusion on Soil, Water & Environment in Indus delta using GIS & Remote Sensing	2.484	Completed
4	Mr. Ghulam Hussain Dars, USPCAS-W	Managing Uncertainties in Projected Impacts of Climate Change on Precipitation Patterns in the Indus Basin, Pakistan	1.647	Completed
5	Dr. Abida Farooqi, Quaid-i-Azam University	Water Conservation and Mitigation of Arsenic in Rice through Sprinkler Irrigation System	2.381	Completed
6	Dr. Rasool Bux Mahar, USPCAS-W	Identification of Antibiotic Resistant Bacteria in Different Source Waters in Hyderabad City and its Surroundings	2.76	Completed
7	Mr. Ghulam Hussain Dars, USPCAS-W	Changing Climate in Pakistan: Food Security and Water Management Implications – Provide high resolution climate simulations for complex terrain: An action to protect our asset	3.15	Completed
8	Dr. Munir Babar, USPCAS-W	Assessing Effectiveness of Linear Anionic Polyacrylamide (LA-PAM) to Reduce Seepage Losses in Unlined Canals	2.949	Completed
9	Mr. Mohammad Ali, USPCAS-W	Crop Water Productivity Assessment of Major Crops in Sindh and Punjab	2.98	Completed
10	Ms. Uzma Imran, USPCAS-W	Keenjhar Lake Water Quality Assessment and Valuing Ecosystems Services (KL-WAVES)	2.89	Completed
11	Dr. Ashfaq Ahmed Sheikh, PCRWR	Monitoring Seawater Intrusion in the Indus Delta for Climate Change Adaptation	2.835	Completed
12	Dr. Jamil Ahmed, USPCAS-W	Assessment of water, sanitation and hygiene services in primary schools of Sindh, addressing Sustainable Development Goal -6	3.019	Completed
13	Dr. Altaf Ali Sial, USPCAS-W	Use of Multi-Level Remote Sensing to Evaluate Salinity on Irrigated Lands	2.999	Completed
14	IPSOS Consulting	Assessing relevance of CAS-W program outputs to Sector/Industry needs	4.949 (1.949 from UU)	Completed

15	Dr. Zubair Ahmed, USPCAS-W	Treatment and reuse of wastewater of fish processing industry (<i>Client driven project</i>)	3	Completed
16	National Rural Support Program (NRSP)	An Integrated Development Plan for the Barani Areas of the Punjab Province (Barani-2 Report)	2.889	Completed
17	Maha Ahmed, NUST	Governance and Civic Capacity for the Provision of Drinking Water in Urban Sindh	2.742	Completed
18	Dr. Ayaz Ahmed, Karachi University	Isolation and Characterization of Antimicrobial Resistant Water Contaminant and Bacteriophage Remedy to Improve Water Quality	2.789	Completed
19	Dr. Ghulam Mustafa, Karachi University	2D Materials Design and Discovery in Water Treatment	2.939	Completed
20	Dr. Imran Mehmood, NUST	Simulation Modeling and Analysis of Household Water Consumption in Pakistan using Hybrid Approach	2.283	Completed
21	Dr. Mohsin Zafar, University of Poonch AJK	Assessment of sediment pollution in a diverse (Goi Nala) catchment of River Jhelum, Azad Jammu and Kashmir	2.672	Completed
22	Dr. Farha Masood, COMSATS	Multifunctional nanocomposite membranes for wastewater treatment	2.998	Completed
23	Dr. Tanveer Ahmed Gadhi, USPCAS-W	Wastewater Treatment and Reuse to approach zero water discharge in Al-Rahim Textile industries: substantial increase in water use efficiency in Textile processing (<i>Client driven project</i>)	2.838	Completed
24	Dr. Abdul Latif Qureshi, USPCAS-W	Closed-loop secondary-level canal monitoring for equitable and reliable distribution of water (<i>Client driven project</i>)	3	Completed
25	Dr. Jamil Ahmed, USPCAS-W	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.	2.878	Completed
26	Dr. Zubair Ahmed, USPCAS-W	Eco-innovation in textile processing industry of KITE for sustainable product processing (<i>Client driven project</i>)	2.999	Completed
27	Dr. Zubair Ahmed, USPCAS-W	Production of drinking water from Indus River through Canal bank filtration for Mehran University Jamshoro: Estimation of yield, pumping requirements, bio-clogging, and characterization of water quality.	2.999	Completed
28	Mr. Ghulam Hussain Dars, USPCAS-W	Improved Hydro meteorological forecast under changing climate by using robust modeling techniques	2.59	Completed
29	Dr. Arjumand Zaidi, USPCAS-W	Indus River Water Level Monitoring in Sindh using Satellite Radar Altimetry	2.866	Completed
30	Dr. Kamran Ansari, USPCAS-W	Estimating Sustainability Cost of Urban Water Supply for Hyderabad City, Sindh, Pakistan	2.272	Completed
		Total Projects' Cost (PKR)	76.62	

Besides printing the final project reports, the Center has disseminated the results of these seed grant research projects through project completion seminars and policy dialogues. These seminars were quite useful in that the results were directly shared with stakeholders besides their wide circulation by the print media.

External Funded Projects

During the project period, the center succeeded in obtaining funding amount to Rs. 167.698 million through 30 projects from different national and international organizations. These projects included research, consulting services and capacity building. The details and status of these projects are given as under.

Detail of external funded projects won by center

S#	Project Title	Supervisor/PI	Sponsor	Amount (Rs. in M)	Status
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 BOLL STIFTUNG – a German foundation	2.0	Completed.
2	Sustainable Fresh Groundwater Management for Irrigated Agriculture in Lower Indus Basin (LIB) using PMWIN model	Dr. Abdul Latif Qureshi	HEC	4.7	Completed
3	Improving groundwater management to enhance Agriculture and farming livelihood in Pakistan	Dr. Bakhshal Lashari	ACIAR	2.88	Completed
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	1.3	Completed
5	Capacity Building at MUET, Jamshoro to address drinking water issues in Pakistan	Dr. R.B Mahar	US-Pak (HEC)	50.0	Ongoing
6	Optimization of anaerobic digestion process using co-digestion of crop residues and buffalo dung.”	Dr. R.B Mahar	HEC	4.4	Ongoing
7	Efficient, participatory irrigation institutions to support productive and sustainable agriculture in South Asia.	Dr. Bakhshal Lashari	ACIAR	7.161	Completed
8	Capacity Building Of The Officers / Officials Of Sindh Irrigation Department	Dr. Bakhshal Lashari	Sindh Irrigation Department	42.0	Ongoing
9	Role and loss of biodiversity: implications for the local community of Hangu District, KPK	Dr. Asmatullah	HEC	1.044	Completed
10	Baseline Survey of Existing WaSH Conditions in Thatta City (Ward No. 3)	Muhammad Ali	NRSP	0.5	Completed
11	Proposal for Rehabilitation of sewage treatment plant (STP) installed at Niamat gas Field, United Energy Pakistan limited	Dr. R.B Mahar	UEPL	1.016	Completed
12	Smart groundwater monitoring for sustainable groundwater extraction in Sindh	Waqas Ahmed	NRPU-HEC	2.988	Ongoing

	(Client driven project)				
13	Situation Analysis of Waste Management at processing facilities of United Energy Pakistan (UEP)	Dr. Zubair Ahmed, Dr. R.B Mahar	UEPL	1.1	Completed
14	Impact of Climate Change in the Indus River Delta and Coastal Region of Pakistan	Dr. Altaf Siyal	GCISC	1.5	Completed
15	The Impact of Informal Institutions on Participatory Irrigation Management Outcomes	Dr. Mercedes Ward	Water Sector Improvement Program	1.9	Completed
16	Exploratory Study "Water Scarcity is a Myth or Reality"	Muhammad Ali	Oxfam Pakistan	1.2	Completed
17	Assessment of methane gas production potential of the primary effluent treatment plant	Dr. R.B. Mahar	MATOL (PVT) Ltd.	0.3	Completed
18	Technical support to the program on turning Solid waste into compost, biogas and other products.	Dr. R.B. Mahar	Tearfund – UK based NGO	0.5	On-going
19	Calibration of Gauges and Development of Rating Curves of 115 distributaries/minors of Nara Canal AWB for Flow Measurement	Dr. Bakhshal Lashari	WISP, P&D Dept. GoS	8.376	On-going
20	Study on Water Balance of Sindh Water Resources Management	Dr. Arjumand	WISP, P&D Dept. GoS	1.38	Completed
22	Situation Analysis of the Wetlands of Sindh	Dr. Altaf Siyal	WISP, P&D Dept. GoS	1.38	Completed
22	Numerical Modelling of T-Head Spur along Moria Loop Bund, Larkana	Mr. Baber Naeem	Irrigation Department, GoS	1.596	Completed
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	TDF-HEC	13.717	On-going
24	Development of a Prototype for treatment of spent wash produced by distilleries of sugar industry	Dr. Naveed Qambrani	MATOL (Pvt) Ltd.	3	On-going
25	Undertaking a water quality assessment of the water points in UC31 to identify the contaminated water points	Dr. Bakhshal Lashari	MDC/UNICEF	7	Completed
26	Project Endline Survey: "Women and Marginalized Groups, Natural Resource Management and bring harmony: exploring the Potential".	Mr. Muhammad Ali	Oxfam	0.97	On-going
27	Community Training on Climate Smart Agriculture	Mr. Muhammad Ali	SAFCO	0.25	Completed
28	Baseline Survey for Spate Irrigation Project	Dr. Bakhshal Lashari	MetaMeta/RDF	1.19	On-going

29	IoT integrated Canal Flow Measurement <i>(Client driven project)</i>	Dr. A. Latif Qureshi	RDF	1.3	On-going
30	Development of comprehensive water safely plan for the water supply distribution system to be used for Hyderabad	Dr. Bakhshal Lashari	MDC/UNICEF	1.05	Completed
				167.698	

The amount of funding varied rather widely, from as small as Rs. 0.3 million to a maximum of Rs. 50 million. All these projects have contributed in many ways: besides bringing in funding support to the Center, it has helped develop collaborations and professional networks at national and international levels. Furthermore, a couple of relatively larger projects are in the pipeline with the Australian Government, World Bank and ADB for approval and funding.

Flagship projects

Three “flagship projects” were conceived as significant, visionary initiatives to contribute in resolution of water-related problems and to establish credibility and national stature of the Center. These projects were:

- 1) Indus River Basin Decision Support System Project
- 2) MUET Clean Water Project
- 3) Pakistan Water Development Report (PWDR)

The most successful of the three was the Indus River Basin Decision Support System Project, which was meant to develop USPCAS-W capacity for decision support of Indus River water management. A team comprised of researchers from Mehran University of Engineering and Technology, University of Utah, and the University of Nevada, Las Vegas collaborated to develop the database and models and apply them to answer related research questions. The work reported under this project provides an overview of the completed research products, publications, and recommendations for future work.

The second flagship project, the MUET Clean Water Project, was conceived to create a real-world impact as part of its initial vision. It was meant to deliver clean water to the entire campus by improving the water treatment plant. This vision could not be realized as the funding, requested from the Government of Sindh (especially for the implementation of works), could not be made available.

The third flagship project, the PWDR was envisioned as a way to showcase the expertise at the Center while at the same time building a national and international reputation as a sound source of information on Pakistan’s water crisis and solutions. It was planned to engage external technical experts who will contribute to the report, and it would be produced every two years but could not be achieved. Lastly, the Center was able to manage with the participation of a few experts who have written various chapters of the report, which is under review and would be published soon.

Client-Driven Projects

Learning from the experience of implementing different research projects, it became clear that “the idea of researchers developing solutions on their own, and then taking it to the relevant stakeholders to adopt” often fell short of matching the on-ground realities in solving stakeholder

problems. In realization of these limitations, the research approach was changed; and a more collaborative model, involving the ultimate end-user as a part of the co-creation and co-design process, was adopted. Subsequently, a few industry/client-driven projects were initiated in collaboration with textile, fisheries, and distilleries industry to have more promise for real-world impact. Such projects are listed in Tables 5 and 6, and further details are mentioned as under;

S. #	Project	Client/Partner Industry
1	Treatment and reuse of wastewater	Fish Processing Industry Karachi
2	Wastewater Treatment and Reuse to approach zero water discharge: : substantial increase water use efficiency in Textile processing	Al-Rahim Textile industries, Nooriabad
3	Closed-loop secondary-level canal monitoring for equitable and reliable distribution of water	Sindh Irrigation Department
4	Eco-innovation in textile processing industry for sustainable product processing	Karachi Industrial and Trade Estate (KITE)
5	Smart groundwater monitoring for sustainable groundwater extraction in Sindh	Sindh Irrigation and Drainage Authority (SIDA)
6	IoT integrated Canal Flow Measurement	Sindh Irrigation & Drainage Authority and Research & Development Foundation

Research Publications

During the project period, the Center has published 185 peer-reviewed research papers including 73 (39%) in impact factor journals. These publications are the outcome of the research conducted at the Center. These research papers categorically address the pressing issues of water in the country and have been produced by faculty and students of the Center with the collaboration of UU faculty. These papers mainly focus on the problems of water quality, water governance & management, wastewater treatment, environmental pollution and control, crop water productivity, irrigation efficiency, deltaic and freshwater ecosystem, hydraulic modelling, GIS & remote sensing, molecular biology, health & hygiene and climate change. These research publications would help in resolving critical challenges in the field of water and environment besides enhancing the academic knowledge base. Many of the Center's publications have been cited in high impact factor journals internationally, which is evident from the data available on the google-scholar database. List of research papers published during the project period is given in **Annex-6**.

NWRN and SCBAC-W

As per the cooperative agreement, the Center was to establish a Council for Research and Policy. After consultations, the same was established in the name of National Water Research Network (NWRN). The network was intended to serve as an important platform for developing a shared understanding of water sector



agenda, supporting the achievement of water SDG, and sharing of knowledge and best practices for capacity building of water sector professionals. Further, it is mandated to provide a platform for undertaking joint research, establishing a central water database, developing an inventory of research work and providing policy advice to the Government. USPCAS-W is

serving as the secretariat of the network to facilitate its operations. The network is participated by representatives of academia, water sector organizations and other stakeholders.

The Standing Committee on Business-Academia collaboration on Water (SCBAC-W) was established under FPCCI to serve as an interactive and collaborative arrangement between scientists/researchers and business entities for proposing technology-led solutions to overcome challenges of water scarcity, quality, access and management. The Standing Committee will facilitate building and strengthening this relationship and ensure its sustainability. The rationale underlying this Standing Committee is future-oriented; the scientists can tap new research and funding networks, while the business will see the merit of cutting research costs by having access to top scientists and academic laboratories.

The above two formal institutional arrangements (NWRN and BAC-W) made by the Center, to facilitate research collaboration and networking, have been struggling to thrive and reap the results as envisaged at the outset. The establishment of these platforms itself is a milestone achieved by the Center towards addressing the water challenges through collaborative research, innovation and technology commercialization. The interactions developed through these networks are already helping shape up the research portfolio of the Center, with particular reference to the academia-industry research partnerships.

Technology Commercialization and Entrepreneurship

In a competitive global environment, it has become necessary for universities to change their orientation towards entrepreneurship and innovation for their success and for addressing societal needs. Developing countries continue to struggle in this regard because of the absence of the necessary institutional arrangements and faculty incentives.

Aligned with the objectives, the Center, in collaboration with the University of Utah USA, has strived to create an environment whereby the research is linked with the market needs and focused towards resolving the water-related problems of the country. To promote the concept of technology commercialization and entrepreneurship, the Center has taken the following initiatives.

- Introduced a course of Entrepreneurship
- Launched an exclusive exchange training program on entrepreneurship at the University of Utah
- Established a standing committee on Water under FPCCI to bridge the gap between academia and industry
- Initiated client-driven projects with textile, fishing and sugar industries as confidence building measures to enhance productive linkages with the industry.
- Developed linkages with KATI and Pakistan Business Council to initiate applied research projects on a pilot basis
- Organized seminars and workshops to create awareness on the subjects of entrepreneurship, transformation of ideas into viable businesses, innovation and technology commercialization, and intellectual property rights.

These activities were introduced and organized to raise awareness and initiate a dialogue among academicians, the business community, legal experts, and entrepreneurs to produce viable recommendations for addressing the existing barriers to entrepreneurship, technology, and venture commercialization at higher education institutions. These events also focused on

the sharing of experiences and best practices relevant to the creation of an enabling environment for advancing research pertinent to technology development.

The Center has not been able to achieve big milestones under this component. Still, the orientation of the Center towards technology commercialization has resulted in a couple of achievements as given below:

- 1) Students of USPCAS-W won five start-ups under the 2nd cohort of Research Incubation in Public Universities (RINU) project through a competitive process for 15 start-ups. RINU project is a social entrepreneurship program initiated by MUET in collaboration with Information Science & Technology Department, Government of Sindh. Each start-up award amounts Rs. 600,000. The winning start-ups were:
 - i. A green technology to purify water
 - ii. Fixgrey: Fixtures for economical and onsite greywater reuse
 - iii. Cost-effective wastewater treatment
 - iv. Solar assisted desalination
 - v. Affordable solar-based prototype for drinking water purification
- 2) Alongside, the Center also won one entrepreneur award for “best health solution” in the health category, presented by IBA leadership club Karachi in 2019. The team of MS Scholars stood first out of 600 participants and were awarded appreciation shield, a certificate for members and two tokens of 100\$ for an online course.

Assessment of Research Program

The literature on higher education of Pakistan informs that the research culture in the country is in its transition from quantity towards quality. In the past, almost two decades, the higher education of Pakistan was focused on producing PhDs and research publications, and the career line of faculty was linked with the number of research publications besides experience in teaching. This encouraged the poor quality of research which went after fulfilling the numbers alone and did not bother about the quality of research and its impact on society. Although HEC also enhanced research funding, it was not impact-oriented and often failed to resolve the real-time problems of the country through research. Industry-academia gap is another challenge in Pakistan wherein industry lacks confidence in universities for addressing their real-time issues and providing solutions through research.

The research focus and linkage with the SDGs was a brilliant idea, and it has been very well-received by faculty, students, and stakeholders in Pakistan and beyond. The purpose was to advance water security through applied research that meets the needs of the public and private sectors. Although the Center could not achieve much in this regard, there are pieces of evidence of progress towards achieving this objective. Establishment of a Standing Committee on Water under FPCCI, collaborations with some vital industry, government, and civil society organizations are some encouraging examples towards this end.

As a whole, the Center carried out 60 projects which included 30 research seed grants awarded by the Center and 30 externally funded projects won by the Center from different donor organizations. These include the projects carried out jointly with USA universities (UU, CSU and/or UNLV). Although the faculty is more comfortable in standard PI-led research projects, it is need of the day to pursue research interests in collaboration and partnership with industry and other organizations. Under the scenario, when each faculty member continues

his/her interests individually, the Center would not well-positioned to win larger grants that often require collaboration. Indeed, the larger grants that the Center did win from external sources involved collaborations among several faculty members, including those from UU, and sometimes among research institutions but not with the industry.

Pursuing the achievement of the targets laid out under SDG-6, the Center has oriented its research to the solution of water-related problems falling in this domain. Besides research publications and seminars, the Center has been successful in dissemination of the research findings beyond the academic community. The Center is now moving into a phase whereby the impact of research on society and policy-making should receive more attention.

Looking at the country's dire need and mandate of the Center, the efforts were made to initiate and support collaborative R&D activities towards the transformation of basic research into applied research to the benefit of the stakeholders, the society, and the country. The Center tried to foster the development of some research partnerships between academia and industries aimed at narrowing down the industry-academia gap. The Center has made reasonable progress in changing the research culture and directing it towards resolving real problems of the industry and gradually broadening its scope to reach to a wider range of the stakeholders. Few examples are: developing IoT based sensors for canal discharge measurement and soil moisture, demonstration of textile wastewater treatment and reuse technology, and prototype development of spent wash treatment from distilleries etc. Despite these developments, it is still a great challenge for the Center to enhance its credibility towards resolving real-time problems of the industry and establish a reputation for its sustainability.

Moreover, the interventions introduced by the Center on research innovation, entrepreneurship and technology commercialization remained successful in terms of raising faculty awareness about critical challenges and opportunities, which may come with aligning research to innovation and technology development. It is evident from the fact that research conducted over the last five years has not resulted in any invention or innovation with reference to technology development but the center has established a reasonable momentum to prosper and succeed towards intentional, quantifiable entrepreneurship and innovation.

Lessons Learnt

1. **Research Culture:** Changing a deep-rooted culture takes time and involves a lot of efforts. Transforming academic research culture of a public sector university into an applied research culture within a project life is highly ambitious. However, two factors contributed greatly in creating a research culture at the center which is directed towards resolving water challenges of the country. One was the technical assistance and support of Utah University and the other was research seed grants. UU team brought together faculty, management, students and staff to instill and energize the philosophy of what "excellence" means in an academic and research setting. This enabled MUET creating a work environment conducive to the professional growth. Research seed grants encouraged faculty to write proposals in supervision of UU professors and engage industry to develop client-driven projects and exhibit prototypes. Such client-driven projects helped narrow-down the industry-academia collaborations in resolving their water related problems.
2. **Business-Academia Committee:** The Standing Committee on Business-Academia collaboration on Water (SCBAC-W) was established under FPCCI. This committee provided center a pathway to interact with the core water intensive industry and make them understand the role and capacity of academia in resolving their water specific problems. As a result, collaborative projects were initiated with textile, fisheries, distilleries.

3. Translation of Research into Action: Like many universities in the country, MUET is also inclined towards academic research. Translating research into action and policy is a specialized skill and many of the MUET faculty including center's faculty has limited capacities to translate research reports into policy briefs and then share those reports with the relevant stakeholders. The subject remained in discussion between MUET and UU teams but somehow no concrete actions were taken to enhance this capacity of faculty or other related staff. In the very last 6 months of the projects, UU imparted an exclusive training on the subject. Translating research into action is a key component of research portfolio for which the center need to enhance its capacity.
4. Management of Research Portfolio: Research Grants Management Committee was key in not only managing the overall research seed grants portfolio of the project but also proved to be a useful component in providing support to the faculty and researchers in developing proposals, improving the project reports and managing the project funds.
5. Water Research Agenda and SDG-6: Research component was aimed at seeking practical solutions to Pakistan's water-related challenges for which the water research agenda was developed through a consultative process with key stakeholders. The research agenda has been developed within the broader context of the water-development nexus to support the achievement of sustainable development goal on water (SDG-6). As the agenda was developed through stakeholder consultation so it shall be considered national water research agenda and not the agenda of USPCAS-W alone. The center is to once again sensitize the key relevant stakeholders to adopt this research agenda and implement it in collaboration.
6. The Center advances water research capacity and impact in Pakistan with a sustainable, high-impact applied research program that bridges expertise among USPCAS-W and other researchers & practitioners.

CAPACITY BUILDING AND TRAINING

TARGET SDG – 6.5:

**“BY 2030, IMPLEMENT
INTEGRATED WATER
RESOURCES
MANAGEMENT AT ALL
LEVELS, INCLUDING
THROUGH
TRANSBOUNDARY
COOPERATION AS
APPROPRIATE”**

CAPACITY BUILDING AND TRAINING (COMPONENT – 4)

The Center is mandated to broaden the perspective and enhance the human resource capacity of the water sector in Pakistan. The capacity development program launched under the project targeted all faculty, students, staff, and practitioners in the water sector. It was delivered in partnership with USA universities including; University of Utah (UU), University of Nevada Las Vegas (UNLV), and Colorado State University (CSU). The USA universities imparted several trainings to faculty, staff and students at MUET during the UU missions and through the student and faculty exchange program in USA universities. The central element of the exchange and training programs was the Peer Teacher Partnering (PTP) program which linked USPCAS-W faculty with faculty of American universities to support the design & delivery of courses and enhance applied research techniques.

UU Missions

Following a thrice-a-year schedule, 15 UU Missions were held during the project period of five years. These missions comprised of Professors and experts from the partnering University of Utah, Colorado State University and the University of Nevada USA and conducted the following theme-specific training programs focused primarily in the areas of teaching and research.

Table-7: Detail of UU missions in descending order

Month & Theme	Training Workshops	No. of Beneficiaries
Dec 2019 Expanding the Impact	<ul style="list-style-type: none"> - Advanced Research Training: (a) Microbial Tools and (b) Data Science - Workshop on Preparing Policy Briefs - USPCAS-W Retreat - New Faculty Boot Camp - Community of Practice Dialog: Strengthening Service Delivery in the Water Sector 	- 28 faculty and students of the center
Jul-Aug 2019 Transition	<ul style="list-style-type: none"> - Workshop 1: Developing and Communicating the USPCAS-W Brand - Workshop 2: Advanced Statistical Analysis - Workshop 3: New Faculty Boot Camp - Industrial Wastewater Management Executive Seminar - IWRM and HID Specialized Program Training - EnvEng and WaSH Specialized Program Training - Workshop 1 for Students: Technical Writing - Workshop 2 for Students: Statistical Analysis 	- 16 faculty and students of the center
Mar 2019 Transition	<ul style="list-style-type: none"> - Sustainability and Transition Planning Meeting - WaSH Specific Training: To finalize sampling and analysis procedures for two related studies of the risks of environmental transmission of antibiotic-resistant organisms via fecal-oral transmission pathways. 	- 8 faculty and students of the center
Dec – 2018 Improving Quality of Research	<ul style="list-style-type: none"> - Workshop: Experimental Design - Workshop: Mentoring Graduate Student Writing 	- 18 faculty and students of the center

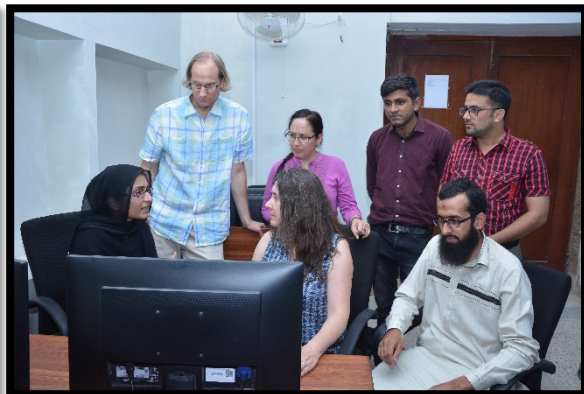
Jul – 2018 Sustaining Processes and Practices of USPCAS-W	<ul style="list-style-type: none"> - Faculty Performance Evaluation Process - Workshop: Proposal Review and Critique - WASH-Focused Training 	- 16 faculty and students of the center
May – 2018 Improving Research with Attention to Detail	<ul style="list-style-type: none"> - Workshop: Applied Statistics for Research - Workshop: Research Proposal Development 	- 16 faculty and students of the center
Dec – 2017 Taking the Next Step	<ul style="list-style-type: none"> - Workshop: Research Mentoring - Workshop: Modernizing the Curriculum - Workshop: Communicating Research Results 	- 16 faculty and students of the center
Jul-August – 2017 Building Collaborative Research Partnerships	<ul style="list-style-type: none"> - Collaborative Research Development Workshop on Water Efficiency, IWRM, WASH and Environmental Engineering - Human Subjects Research Workshop 	- 16 faculty and students of the center
May – 2017 Innovation for Impact	<ul style="list-style-type: none"> - Climate Vulnerability Assessment and Adaptation of Water Systems Workshop - Flipped Classroom Workshop - Graduate Student Development Workshop 	- 16 faculty and students of the center
Dec – 2016 Building a Collaborative Water Centers Network	<ul style="list-style-type: none"> - Research Collaboration Workshop - Grant Writing Workshop - Teaching Workshop - Graduate Student Workshop - Technical Training Workshop – Community-Engaged Research 	- 16 faculty and students of the center
Jul – 2016	<ul style="list-style-type: none"> - Effective Teaching Workshop - Research Coordination Workshop - Graduate Students Workshop 	- 16 faculty and students of the center
May – 2016	<ul style="list-style-type: none"> - Brainstorming meeting on the status of water data in Pakistan - Curriculum reform review and streamlining - Boot camp on research data management and analysis 	- 12 faculty and students of the center
Dec – 2015 Faculty Workshops and Boot Camps	<ul style="list-style-type: none"> - Faculty Evaluation: Teaching, Research, Service - Graduate Student Workshop - Entrepreneurship & TVC Workshop 	- 14 faculty and students of the center
Jul-Aug – 2015	<ul style="list-style-type: none"> - Systems Modeling + Stella training - WEAP Training (SEI) - Advancing Research with Curriculum – program review - Linking Teaching to Research – discussion - Stimulating Gender Equity Through Research – discussion 	- 14 faculty and students of the center

	<ul style="list-style-type: none"> - Water Quality and Climate (WaQC) Workshop - Grant Writing Workshop - TVC group meeting 	
May-Jun – 2015	<ul style="list-style-type: none"> - Curriculum development workshop - Governance and M&E Workshop - Innovative teaching workshop - Gender workshop 	- 12 faculty and students of the center

Following faculty from different universities of USA visited USPCAS-W during UU missions and delivered training workshops and hands-on-trainings to faculty, students and staff in the above mentioned areas.

#	Name and University	Expertise
1	Prof. Steve Burian	University of Utah
2	Prof. Tariq Banuri	University of Utah
3	Prof. M. Aslam Chaudhry	University of Utah
4	Dr. Mercedes Ward	University of Utah
5	Prof. Sajjad Ahmad	University of Nevada
6	Prof. Mike Barber	University of Utah
7	Dr. Jeff Ullman	University of Utah
8	Prof. Christine Pomeroy	University of Utah
9	Prof. Krista Carlson	University of Utah
10	Prof. Jennifer Weidhaas	University of Utah
11	Prof. Jose Chavez	Colorado State University
12	Prof. Allan Andales	Colorado State University
13	Prof. Tim Gates	Colorado State University
14	Prof. Jim VanDerslice	University of Utah
15	Prof. Pat Shea	University of Utah
16	Prof. Lowell Scott Benson	University of Utah
17	Prof. Mallory Spencer Leetham	University of Utah
18	Prof. Windy Dawn Tanner	University of Utah
19	Prof. Joshua Val Garn	University of Utah
20	Prof. Caleb Griffin	University of Utah
21	Prof. Ansley Joseph Brown	University of Utah
22	Dr. Timothy Neal Edger	University of Utah
23	Dr. Marie Kathrine Wintriss	University of Utah
24	Dr. Eddie Bryan Gilcrease	University of Utah

Pictorial View of UU Missions



Exchange Training Program

The exchange program was a central feature of the academic program that provided an opportunity of training and capacity building for the faculty and students to visit partner universities in the USA viz. the University of Utah (UU) and Colorado State University (CSU). The student selection process involved an assessment of grades, a personal statement and essay, class attendance, and faculty evaluation/recommendation. The final selection was made by the UU team based on the data provided by MUET on the criteria mentioned above.

The exchange program has been a significant success of the USPCAS-W project with high direct impact on the participants and indirectly by reputation building and attracting top students and faculty to the Center at MUET. The Center carried out five types of exchange programs as given below:

- 1) Student Semester Exchange:** This semester-long 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 program emphasized comprehensive capacity building in research methods, thesis writing, global competencies, and comprehension of US-based research programs and water management systems. The deliverables were completed thesis chapters.
- 2) Student Summer Exchange:** This program included business mentoring and training, entrepreneurship course, prototyping course, writing class, field trips, skill-building workshops in technical and professional areas, and social/cultural activities. The emphasis of this program was developing technology or venture that can 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.
- 3) Comprehensive Faculty Development:** This program was a semester-long program aimed at exposing the faculty members to research methods, innovative teaching techniques, student mentoring, academic governance, leadership, networking, and other aspects of effective teaching and research. 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.

- 4) **Specialized Faculty Training:** This program was short-term either in summer or during a period typically less than one semester. It 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.

A total of 169 students, faculty and staff including 62 females, availed exchange program in UU, CSU and UNLV under the four program streams during the project period of five years (8 semesters and 3 summer sessions). Summary of exchange training program beneficiaries is given below, and a detailed list of beneficiaries is given at **Annex-7**.



Table-8: Summary of exchange training program

Category	Female	Male	Total
Faculty	4 (21%)	15	19
Students	58 (39%)	90	148
Staff	-	02	02
	62 (37%)	107	169

As per CA, 250 exchanges were planned to be completed during the project period but the center could achieve 169. A revision on adjusting the target number for exchanges from 250 to 150 was discussed and agreed with UU and USAID and an amendment request was also sent to USAID but it was not approved for some reasons.

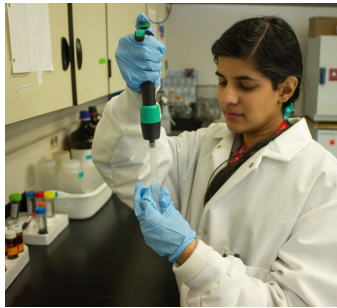
The status on completion of the exchange training program for 169 individuals as reported in the online system TraiNet is given as under.

Status on completion of Exchange Program	No. of Beneficiaries
Achieved: Completed Program & Achieved Goals	164
Male	103
Female	61
Not Achieved: Completed Program but did not Achieve Goals	3
Male	2
Female	1
Terminated: USAID Terminated Participant	2
Male	2
Grand Total	169

The exchange program helped faculty and student beneficiaries in establishing strong peer-to-peer linkages through joint research project and publications. Moreover, the mechanism of the exchange program was aimed at building long term relationship and future collaborative opportunities. The purpose of the exchange program was to facilitate the transfer of knowledge, improve quality of academic programs, applied research projects, provide synergies in research and develop an international outlook for the Center.

All participants, except Mr. Munir Memon, returned back to MUET after completing their respective exchange program. Mr. Munir Memon was a soil scientist and was staffed at the center in Soil & Water Lab who did not come back on his own. The incident has already been reported to USAID at the time it happened in August 2018. However; one individual Mr. Awais (faculty) was sent back by the host university in the first month of his exchange program who could not progress and returned without fully attending the program.

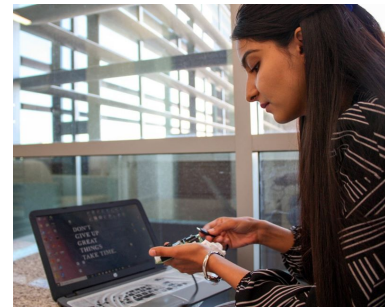
Views of Exchange Training Program Student Beneficiaries



"I worked in The University of Utah Microbiology lab for more than 2.5 months. I learnt media preparation, culturing of bacteria, TSI Agar and Urease Test, Disc diffusion test, sampling of contaminated surfaces, DNA Extraction, PCR, QPCR, Gel electrophoresis and many small things like usage of Autoclave, DNA Kit. I attended 2 lab safety trainings and due to which now I am working in the lab more carefully than before." - Sadaf



"My research topic [is] 'Nutrients Recovery from Synthetic Wastewater using Struvite Precipitation Method'. When I first arrived here at The University of Utah, I was not sure the methodology which I will adopt to complete my objectives. While working with Dr. Ramesh Goel and Dr. Naveed, I learnt different aspects of literature review; how to design a work plan and how to use online sources to master literature review. I have learnt a lot at The University of Utah." - Tayyab Qureshi



"I didn't have any parts or know how to conduct the experiment or what processes I would need to have my prototype developed. My product is an ultra-sonic sensor, that will be deployed at the inlet and outlet of the agricultural lands. It will be comprising of an SD card, as well as a chip. The SD card will retrieve the data from the sensor, and will be sent to the database that we will develop as well." –Nayyab Agha



"I [had] a wonderful experience measur[ing] real-time water discharge and water quality from Red Butte Creek using an instrument called #FlowTracker. The University of Utah has done great work in terms of conservation of resources for present and future populations. This type of system must be implemented in Pakistan, to solve water scarcity issues." - Tarique Aziz



"The things that inspired me the most in the city were the use of old metal in decorat[ing the] city, the running of energy efficient cars and antique conservation were seen inside stores. People were utilizing every single resource to make Moab beautiful." -Tayyaba Sohail



"There are many memorable people who I met, but the most memorable and interesting personality for me is, Patrick A Shea. He is a biology professor, multi-talented and intelligent. I like the way he thinks about problems in different perspectives." -Sadia Ditta

Graduate Seminar Series and Field Visits

Graduate Seminar series was one of the key features of the Center in which renowned national and international water experts and practitioners were invited to deliver talks to the students and faculty of the Center. The purpose of the seminars was to give a broader view and understanding of the national water-related issues and solutions within the context of sustainable development. The list of graduate seminars organized by the center during the project period is given at **Annex-8**.

Internship

The Center provided internship opportunities for students for their learning through real-time work experiences and field exposure. The student internship program was aimed at furnishing the students' professional skills in a work environment. For that purpose, they were placed at different public, private and non-government organizations. Given below is the list of organizations where students were placed for the summer internship.

Table-9: List of organizations where students were placed for internship

No.	Name of Organization	Type	No. of Interns
1	Pakistan Council of Research in Water Resources (PCRWR)	Government	9
2	Water and Sanitation Agency (WASA) Hyderabad	Government	5
3	Pakistan Council of Scientific and Industrial Research (PCSIR)	Government	4
4	DRIP, Tando Jam	Government	3
5	DRIP, PCRWR	Government	2
6	National Centre of Excellence in Analytical Chemistry (NCEAC)	Government	2
7	NESPAK	Government	2
8	Pakistan Meteorological Department (PMD)	Government	2
9	Water and Power Development Authority (WAPDA)	Government	2
10	Sindh Irrigation and Drainage Authority (SIDA)	Government	15
11	Institute of Space Technology	Government	1
12	Irrigation Department Balochistan	Government	1
13	Pakistan Oil Field Limited	Government	1
14	Sindh Irrigation Department	Government	5
15	Space and Upper Atmosphere Research Commission (SUPARCO)	Government	1
16	Textile Dept. MUET	Government	1
17	Associated Consulting Engineers	Private (for profit)	2
18	UNiCol	Private (for profit)	1
19	National Rural Support Program (NRSP)	Private (NGO)	4
20	Research and Development Foundation (RDF)	Private (NGO)	4
21	AWARE	Private (NGO)	2
22	International Union for Conservation of Nature (IUCN)	Private (NGO)	2
23	World Wide Fund for Nature (WWF)	Private (NGO)	2

24	Orangi Pilot Project	Private (NGO)	1
25	Isra Hospital	Private (not-for-profit)	2
26	Punjab Irrigation Department, Jhang	Government	1
27	Water Management Research Center, Faisalabad	Government	1
28	Irrigation Department, Small Dams, Jamshoro	Government	1
29	Irrigation Department, Nara Canal Subdivision, Sukkur	Government	1
			80

Assessment of Capacity Building and Training Program

USAID conducted a pre-award assessment of MUET through a Chartered Accountant firm before awarding the USPCAS-W Cooperative Agreement in Dec 2014. The evaluation rated the overall risk level of the university as “Moderate to High”. Among six areas reviewed for the pre-award assessment, organizational capacity was also ranked at moderate to high risk. This reflected that a project of USD 14.7 million magnitude was a challenge for the university to implement with some unique features like: real-time problem solving applied research, fundraising, institution building, network building, global partnerships, gender equity, industry partnerships, and technology commercialization etc. The management team of the Center had reasonable administrative and managerial experience, but no experience in managing a national Center of excellence of the magnitude of USPCAS-W. Also, the faculty of the Center was narrowly focused on their research objectives and areas of interest. Simultaneously, faculty were expected to deliver on teaching, application of research and its commercialization, mentoring of graduate students, and providing consultancy and training services.

At the start of the project, the management, faculty, and staff of the Center had limited experience in several of the above noted areas. The scope of USPCAS-W was so broad that the existing capacities of the Center were not adequate to advance the Center to a level of excellence as envisaged in the CAS's design. To bridge these gaps, a comprehensive capacity development plan was prepared with the technical support of the partnering University of Utah, consisting of the following elements:

- 1) Hiring and training of faculty
- 2) Faculty visits to the US universities under the exchange program
- 3) Implementation of subject-specific training workshops by international experts
- 4) Organization of stakeholder consultations, seminars, and guest lectures
- 5) Participation in national and international conferences
- 6) Mentoring of local faculty by US-based faculty – one-to-one basis.
- 7) Introduction of FAR (Faculty Activity Report) as a performance-based evaluation system for faculty

In addition to the above capacity development plan, a comprehensive and specialized training program was also designed that was tailored to the needs of individual faculty members, keeping in view their strengths and weaknesses. This training program was implemented under the exchange program. To complement this, specialized training sessions were also planned and delivered by USA based experts/faculty who visited USPCAS-W at MUET three times a year as a part of UU Missions. These training programs laid particular emphasis on

the following areas of capacity building: development of skills in pedagogical approaches employing active and project-based learning, grant writing, experimental design, use of advanced research instrumentation and software, applied and client-driven research development, technology and venture commercialization, creating impact through policy research, communicating research results effectively and writing journal articles, among others.

Capacity building of the students included improved curriculum delivery, research training, extra-curricular opportunities, training workshops by international experts, seminars by renowned national and international practitioners and extensive training under the exchange program. The process for updating and adjusting the capacity needs assessment of student continued throughout the project life, which revolved around identifying their academic and research needs. The continuous adjustment of capacity needs of students, especially for the exchange program, also created unrest among students of different batches as the selection criteria for the exchange program kept changing. The modifications in the selection criteria of students for the exchange program were based on the performance of the previous batch of students during the exchange program in the USA. In general, primary gaps in the capacity of students were primarily identified in the areas for research and professional practice including English writing, research design, statistical analysis, computer programming, data science, and entrepreneurship.

One significant outcome of the exchange program was PhD scholarship opportunities by the most promising exchange program students. Those students who demonstrated their potential in research and commitment towards higher education during their exchange training at UU, CSU and UNLV were offered PhD scholarship from their mentors at USA universities. Some seven students have already joined their respective PhD degree programs at UU, CSU and UNLV. Additionally, some other students have also been successful in winning Fulbright and other scholarships and are pursuing their PhD studies at USA universities.

The capacity building efforts primarily focused on training of senior managers, faculty, technical lab staff, and students, with little attention paid to the training of financial, communication and other personnel actively engaged in the project management. For such staff, their training has been through collaborative works related to operations, events, and programmatic delivery where the UU team provided side-by-side support. This remains a major gap that needs attention in future similar opportunities.

Lessons Learnt

1. **Twining Model:** Another great feature of UU support was Peer Teacher Partnering Program – the Twining Model. It connected MUET faculty to UU faculty for seeking support in the design and delivery of courses and research projects. Moreover, this “twinning” approach helped MUET faculty build connection and long-term relationships with USA based professors.
2. **Graduate Seminar Series:** One very unique feature of the project which provided a broader view and understanding of the national water-related issues and solutions within the context of sustainable development through renowned national and international water experts. The center must continue with these seminars and do not lose the momentum.
3. **Exchange Training Program:** Exchange program was one key feature of the program which attracted students to join the center for their higher education. Continuous

interaction of students with the professors of US based universities and the exposure of exchange training program indeed transformed many of the students' attitude towards higher education and their career development. The research culture of the center convinced many of the students to continue with their research work and pursue their careers in academia.

NETWORKING & PARTNERSHIPS

TARGET SDG – 6.6:

**“BY 2020, PROTECT
AND RESTORE WATER-
RELATED
ECOSYSTEMS,
INCLUDING MOUNTAINS,
FORESTS, WETLANDS,
RIVERS, AQUIFERS AND
LAKES”**

NETWORKING AND PARTNERSHIPS (COMPONENT – 5)

It was envisaged at the start of the project that the Center's sustainability depended on the establishment of enduring partnerships with top-ranking universities within and outside Pakistan to exchange ideas, collaborate on research and continue to raise the standards of higher education in Pakistan. The ability of the Center to develop partnerships and make alliances with stakeholders was another essential aspect of the project's sustainability wherein Center's research solves problems of government, community and industry. The Center firmly believed in building partnerships and linkages with the academic institutions, government and the business community to seek applied research solutions that strengthen the effectiveness of policy-making and drive Innovation, Competitiveness and Economic Growth.

Over the past five years, the Center has launched several initiatives designed to strengthen collaborations. These efforts include the signing of Memorandums of Understanding (MOUs), project agreements for consulting services, setting up committees, establishing networks, stakeholder consultation on development of research agenda and client-driven projects, facilitating student internships, and supporting joint research activities. Some of the specific initiatives include the establishment of a Gender Equity Committee for implementation of gender equity policy, graduate seminar series, national water research network, and business-academia collaboration committee. In the last five years, the Center has been able to build the following partnerships.

List MoUs and Agreements signed with different organizations

Name of the client/ Partner organization	Partnership Type	Area of collaboration
National		
Government		
Higher Education Commission (HEC), Pakistan	HE Regulatory Body and research funding agency	Accreditation and research projects' funding
Pakistan Council Of Research In Water Resources (PCRWR)	Collaborative MoU and Project Agreements	Water quality, environmental Degradation
Irrigation Department, Government of Sindh	Projects agreement	Capacity building of engineers and irrigation management
Water Sector Improvement Program, Sindh	Project Agreement	Participatory irrigation management
Global Change Impact Study Center (GCISC), Islamabad	Project agreement	Climate change
Agency for Barani Area Development (ABAD), Government Punjab	Project agreement	Barani Area Development Action Plan
Water and Power Development Authority (WAPDA) , Pakistan	Collaborative MoU	Research Agenda Development
Sindh Irrigation Drainage Authority (SIDA)	Collaborative MoU and project Agreement	Participatory irrigation management
Pakistan Council of Scientific and Industrial Research (PCSIR)	Research collaboration	Water quality

Sindh Agriculture University, Tandojam	Collaborative MoU	Collaboration on use of lab facilities
Non-Government/Private		
Lahore University of Management Sciences (LUMS)	Research Collaboration	Technical assistance and joint research projects
Institute of Space Technology (IST), Islamabad	Collaborative MoU	
National Rural Support Program (NRSP)	Project Agreement	Baseline of a WaSH Project, Situation Analysis and impact Assessment Studies
Oxfam Pakistan	Collaborative MoU and Project Agreement	Assessment of Participatory irrigation management
World Wide Funds for Nature (WWF) Pakistan	Collaborative MoU	Wastewater management and joint activities
Sustainable Development Policy Institute	Collaborative MoU	Media communication and outreach
Indus Earth Trust	Collaborative MoU	Drinking water management
MDC/UNICEF	Project Agreement	Water quality
SAFCO Sindh	Project Agreement	Community Training
Research and Development Foundation	Project Agreement	IoT based water management
Private Industry		
M.A. Mohammadi & Co. – A Fish Processing Industry	Project agreement	Wastewater Management
Abrahim Textile Industry	Project agreement	Wastewater recycling and use
United Energy Pakistan Limited	Project agreement	Sewage treatment and waste management
MATOL (Pvt.) Limited	Project Agreement	Waste water treatment
International Collaboration		
University of Utah	Technical Support	Technical assistant and joint research projects
Colorado State University		
Australian Center for International Agriculture Research (ACIAR)	Project Agreement	Participatory irrigation management
International Center for Agricultural Research in the Dry Areas (ICARDA)	Project Agreement	Efficient irrigation technologies
Heinrich Boll Foundation – A German Foundation	Project agreement	That Coal Project – Water Quality
University of Nevada, Las Vegas	Technical Support	Water Resources Management
University of Victoria, Canada	Technical support	Climate change

Tearfund – UK based NGO	Collaborative MoU and Project Agreement	Solid waste management
MetaMeta, Netherlands	Project Agreement	Spate Irrigation
Emory University, USA	Technical support	School WaSH Services

The networks and partnerships of the Center are essential for institutional sustainability which indeed have helped build the reputation of the Center and led it to more opportunities for collaboration and fundraising while resolving water-related issues and challenges of mutual concern.

Conferences, Workshops and Executive Events

National and international seminars and conferences organized by the center during the project life have played an important role in making the Center visible on the national canvas. List of key events is given below; however, the detailed report on each of these events is available and already shared with USAID.

- 1) An expert group meeting on “Strengthening Service Delivery in the Water Sector” was organized in December 2019. The meeting was aimed to focus on the capacity development needs of stakeholders – especially the service delivery entities.
- 2) Sindh Agriculture University Tandojam organized 2-day “1st International Conference on Agricultural Engineering and Technologies” in November 2019. USPCAS-W collaborated Agriculture University in organizing the conference and faculty and students of the center actively participated in it.
- 3) 3rd 2-Day Young Researchers` National Conference on “Water and Environment” (NCWE-19) was held on 5-6 September 2019.
- 4) The Center, in collaboration with the University of Utah, organized an Executive Seminar on Industrial Wastewater Management in August 2019.
- 5) A dialogue session on “Water Trends, Challenges and Sustainable Strategy for its Security” was held in collaboration with Government of Sindh, The Asia Foundation, Australian Government, Water Environment Forum and Hashoo Foundation on 5th July 2019.
- 6) The Center organized the 2nd graduation ceremony on 8th March 2019. Sindh Chief Minister Syed Murad Ali Shah was Chief Guest on the occasion whereas; US Consul General JoAnne Wagner and Project Director USPCAS-W University of Utah Dr. Steve Burian attended the ceremony as guests of honor.
- 7) The Water Center and the Institute of Environment Engineering and Management (IEEM) MUET jointly organized the World Water Day in March 2019.
- 8) A three day International Science-Policy Conference on “Climate Change” was organized by Global Change Impact Studies Center (GCISC) in collaboration with USCAS-W and the University of Utah in Islamabad in December 2018.
- 9) A Dialogue on the subject “Water and Women – Does the Water Sector Development have a gender?” was organized in collaboration with the Center for Social Change (CSC) in August 2018. A panel discussion was held, which was chaired by the Chairperson Sindh Human Rights Commission Justice (Rtd.) Majida Rizvi.
- 10) 2nd 2-Day Young Researchers` National Conference on Water and Environment (NCWE-18) was held on 2-3 August 2018.

- 11) A Consultative meeting was held in May 2018 to review and discuss the National Water Policy. The meeting was chaired by Dr. Tariq Banuri of the University of Utah, USA, and attended by several national experts and visiting delegation of the University of Utah, USA.
- 12) Dialogue on “Water SDG: Challenges and Opportunities” was organized in collaboration with Oxfam/Pakistan. The dialogue was attended by Mr. Mohammed Qazilbash, Country Director Oxfam and Mr. Francisco Catardo, Director International Program.
- 13) “Sindh Development Dialogue 2018: Contextualizing the past, envisaging the future” was organized in March 2018. Former State Bank of Pakistan (SBP) Governor Dr. Ishrat Hussain and eminent economist Dr. Kaiser Bengali were keynote speakers. MUET Vice Chancellor (VC) Dr. M. Aslam Uqaili, former VC Dr. Rajab Memon, Mr. Abrar Kazi, noted civil rights campaigner, Shahab Usto, and social activist Mr. Zulfiqar Halepoto were among the speakers.
- 14) The Center organized a National Workshop on Assessment of Environmental Degradation of Manchar Lake with the cooperation of Pakistan Council of Research in Water Resources (PCRWR), Government of Pakistan in September 2017. This workshop was aimed to share the finding of the study and sensitize the stakeholders for rehabilitation and restoration of the lake. Then Senior Sindh Minister for Planning and Development (Late) Mir Hazar Khan Bijarani was the chief guest on the occasion and said that Manchar Lake is an economic and cultural asset of Sindh and all the stakeholders must come forward for its rehabilitation.
- 15) The Center organized a National Seminar on Indus delta in March 2018. The seminar was organized in order to share the results of the research study, funded by the Center “Shrinking Indus Delta: Current Status and Way Forward”.
- 16) 1st Graduation Ceremony for awarding degrees to the 1st batch of Center was held on 8th January 2018. Vice Chancellor MUET Prof. Dr. Mohammad Aslam Uqaili chaired the ceremony whereas Her Excellency Grace Shelton, US Consul General Karachi and Dr. Tariq Banuri, Professor from the University of Utah attended the ceremony as the guests of honor.
- 17) USPCAS-W was honored with the allocation of a full session in 18th Sustainable Development Conference titled “Securing Peace & Prosperity” on Water, Sustainability, Equity, and Security organized by Sustainable Development Policy Institute (SDPI), Islamabad.
- 18) Sindh Irrigation and Drainage Authority (SIDA) in collaboration with the Water Center organized 2nd consultative meeting of water experts on Formulation of Sindh Water Policy (SWP) in December 2017.
- 19) Strengthening Participatory Organization (SPO), Hyderabad in collaboration with the Water Center organized a Seminar on “Importance of Women and Marginalized Groups in Water Governance and Peace Building Process” in December 2017.
- 20) A three-day workshop on Ground Water Data Analysis and Modeling was held in November 2017. The workshop was part of a four-year project on Improving Ground Water Management to Enhance Agriculture and Farming Livelihood in Pakistan signed by the Australian Government through ACIAR.
- 21) The Center, in collaboration with WWF Pakistan, marked the celebration of World Water Week (Stockholm) by paying a joint visit to Keenjhar Lake in September 2017. WWF-Pakistan hosted the trip at their Keenjhar Conservation and Information Center.

- 22) The Center in collaboration with Institute of Environment Engineering and Management (IEEM) MUET celebrated World Environment Day in June 2017. That year the theme was, "Connecting People to Nature."
- 23) The 1st Young Researchers' National Conference on Water & Environment was organized by the Center on 22-23 May 2017.
- 24) The Center celebrated Earth Day in April 2017 by planting trees in the new building of Center followed by a badminton tournament organized at MUET Gymnasium.
- 25) USPCAS-W in collaboration with National Rural Support Program (NRSP) and Pakistan Council of Research in Water Resources (PCRWR) celebrated World Water Day along with communities in district Badin in March 2017.
- 26) MUET in collaboration with Coventry University, United Kingdom, organized a three day "4th International Conference on Energy, Environment and Sustainable Development (EESD)" in November 2016. USPCAS-W also collaborated in the conference.
- 27) An Executive Seminar on "Achieving Water Sustainable Development Goal-6 in Pakistan: Challenges and Opportunities" was held by the Center at Karachi in July 2016
- 28) The Center in collaboration with Pakistan Council of Research in Water Resources (PCRWR) and Higher Education Commission (HEC) of Pakistan organized a national consultative workshop on "Developing Water Research Agenda in Pakistan" in May 2016 at HEC Islamabad.
- 29) An Executive Seminar on Water Governance was organized in August 2015. The honorable Syed Murad Ali Shah, the current Chief Minister of Sindh and then Sindh Minister for Finance and Energy chaired the session. US Consul-General Brian Heath and Dr. Randy Hatfield, USAID's Senior Policy Advisor and Program Manager (Sindh Basic Education Program) were also present on the occasion.

Stakeholder Capacity Building

The Center is dedicated to building the capacity of a new generation of engineers and water professionals to solve the water security challenges of the 21st century. Alongside the training and capacity building of graduate students, the Center also designed and provided long and short term trainings to the various stakeholders in the water sector. These trainings ranged from 6-month diploma programs to week-long classroom trainings involving experiential learning for the participants. During the project period, the center conducted the following trainings.

Table-11: List of Trainings Organized by the Center for Various Stakeholders

S. No.	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 on Reservoir Modeling and Management Engineers of Sindh Irrigation Department	Nov 2019 – May 2020	20

Assessment of Networking and Partnership Program

The Center has launched several initiatives over the past five years to strengthen collaborations. These efforts can be grouped as MoUs, committees, networks, student internships, and joint research activities. These collaborative initiatives with different local and international organizations were geared towards creating productive linkages in the field of research and service delivery and also to earn the national status for the center. In particular, there are 11 collaborative MOUs at the national or international scale and 19 project agreements.

Of the 11 MoUs, four collaborative MOUs, signed PCRWR, Sindh Irrigation Department, Oxfam-Pakistan, and WWF-Pakistan, have produced significant outcomes. For the remaining seven MoUs, an institutional relationship needs to be geared up to harness the tangible

benefits for the mutual benefit of the signing parties. Detailed mapping of the MoUs and other partnering tools has been made, which will help the Center to analyze what is working and why, and vice-versa. Another important finding coming out of this mapping is that many of the MOUs were for 5 years or less hence they will expire by default after the duration, thus need to be renewed – if a partnership is beneficial for both parties. Alongside, it is also imperative for the Center to understand why some of the MOUs were not successful and never materialized.

The graduate seminar series conducted through renowned speakers, invited from across the country and abroad, has been a successful initiative that has helped in building a reputation for the Center. Most importantly, this seminar series has been institutionalized as a regular feature of life at the Center. Similarly, the Young Researchers' National Conference is another good initiative to mention that the Center has organized for three consecutive years since 2017.

Furthermore, other national and international events organized by the Center independently and in collaboration with other national organizations have also played a vital role in enhancing the visibility, image, and enduring professional partnerships of the Center at the national level. However, it is a grave challenge for the Center to continue organizing such events without USAID or other sources of funding.

DELEGATES VISITED CENTER

USAID Delegates

- 1) USAID Mission Director Julie Koenen along with Mr. Shabir Ali Bijarani, Minister Government of Sindh participated in the 3rd Graduation Ceremony of USPCAS-W held on 4th February 2020.



- 2) US Consul General Karachi JoAnne Wagner along with Sindh Chief Minister Syed Murad Ali Shah participated in the 2nd Graduation Ceremony of USPCAS-W held on 8th March 2019.



- 3) USAID Deputy Mission Director for Sindh & Baluchistan Mr. John Smith-Sreen and USAID Deputy Office Director Michael Hryshchyn visited the center on 6th September 2018.



- 4) US Consul General Karachi Grace Shelton along with Dr. Tariq Banuri, Professor from University of Utah participated in 1st Graduation Ceremony of USPCAS-W held on 8th January 2018.



- 5) USAID Mission Director Mr. Jerry Bisson & Deputy Mission Director Ms. Denise Herbol along with Sindh Education Minister Mr. Jam Mehtab Hussain Dahar inaugurated the new building of USPCAS-W on 5th July 2017.



- 6) U.S. Consul General Mr. Brian Heath visited USPCAS-W on 15th July 2016 and interacted with the students and faculty of the Center selected for Fall Exchange Training to University of Utah.



- 7) U.S. Consul General Karachi Ms. Grace W. Shelton visited USPCAS-W on 20th January 2017 and met with students and the faculty of the Center who recently returned back after spending one semester at University of Utah (UU) in the USA under exchange training program.



- 8) USAID Deputy Mission Director Sindh and Baluchistan Mr. Craig C. Buck along with Dr. Rochelle Rainey, USAID Senior Technical Advisor on Drinking Water Quality, Sanitation & Hygiene, and Mr. Hafeezullah Samo, Agreement Officer's Representative visited the on-going construction work of USPCAS-W building in April 2016 and had meeting with Vice Chancellor MUET and with senior management of USPCAS-W & MUET.



- 9) USAID Pakistan's Office of Financial Management team led by Mr. H. Waheed Imam, Deputy Director accompanied with Mr. Hafeez Samo, AOR and Mr. Amir Munir, Financial Analyst paid a visit to the center on 27th January 2016. The purpose of the visit was to give overview on the financial performance of the CAS-W and reiterate the financial management and reporting requirements of USAID.



- 10) USAID Mission Director to Pakistan Mr. John P. Groarke along with Prof. Dr. M. Aslam Uqaili Vice Chancellor of the University did the Ground Breaking Ceremony of USPCASW on 17th Sept, 2015.



Other Delegates

- 1) An Asian Development Bank (ADB) mission led by Ms. Noriko Sato, Natural Resources Specialist visited center in November 2019 and discussed the scope of an upcoming project “Sindh Integrated Water Resources and Agriculture Management Project (SIWRAMP) and possible role of CAS-W in the project.
- 2) Major General (R) Akber Saeed Awan, Chairman National Technology Council at HEC Pakistan visited center and had a meeting with Deputy Director USPCAS-W Prof. Dr. Rasool Bux Mahar on September 13, 2019.
- 3) Dr. Tariq Banuri, Chairman HEC Pakistan had an interactive session with faculty and students of four universities of Sindh in September 2019. These universities included; MUET, University of Sindh, LUMHS and SAU Tandojam.
- 4) A World Bank delegation facilitated by Water Sector Improvement Project (WISP) of Government of Sindh visited center and discussed potential projects to be awarded to center under WISP. The WB delegation was led by Dr. Toru Konishi Senior Water Economist from Water Global Practice, World Bank.
- 5) Prof. Dr. Craig Phelan, Dean, School of Arts, Humanities, and Social Sciences, Habib University Karachi visited USPCAS-W in May 2018. He held meeting with Project Director and UU team and shared ideas of common interest pertaining to the academic and research opportunities for future collaboration.
- 6) A delegation comprising of Engr. Saindad Khan Solangi, Member Sindh Public Service Commission (SPSC), Syed Junaid Ahmed Zaidi, Additional Secretary to Governor Sindh visited the Center in January 2018.
- 7) A delegation of a British NGO TearFund visited the center on 15th May 2018 and held a meeting with the faculty of the environmental engineering department. The purpose of the meeting was to develop a partnership between the center and the TearFund.
- 8) Mr. Ahsan Iqbal, Federal Minister for Planning, Development, and Reform, Government of Pakistan visited CAS-W in April 2017.
- 9) A Senior Advisory Board (SAB) of University of Utah, USA comprising of Dr. Bob Adler - Professor & Dean College of Law, Mr. Steve Urquhart, Global Ambassador - University of Utah & State Senator Mr. Juan Carlos Negrette - Director of Global Health Program, Dr. Richard Brown - Professor & Dean College of Engineering, Ms. Khawar Mumtaz - Former Chairperson National Commission of Status of Women Pakistan, Mr. Khalid Mohatdullah – Former Deputy DG IWMI/Former Member (Water) WAPDA and led by Dr. Michael

Hardman - Professor and Chief Global Officer University of Utah USA visited CAS-W in July 2016 and held number of meetings and participated in the executive seminar on water SDG.

- 10) Australian High Commissioner to Pakistan, Her Excellency Margaret Adamson visited USPCAS-Won 26th February 2016 and had meeting with officials of MUET and the center at vice chancellor secretariat.
- 11) Chairman of Charter Inspection and Evaluation Committee (CIEC), Government of Sindh and Former MUET Vice Chancellor Prof. Dr. Abdul Qadeer Khan Rajput visited the Center in October 2017.
- 12) Prof. Dr. Arshad Ali, Executive Director Higher Education Commission (HEC) Pakistan, visited the Water Center on Thursday, October 24, 2017.

GENDER EQUITY

TARGET SDG – 6.6(A):

“BY 2030, EXPAND INTERNATIONAL COOPERATION AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRIES IN WATER- AND SANITATION-RELATED ACTIVITIES AND PROGRAMMES, INCLUDING WATER HARVESTING, DESALINATION, WATER EFFICIENCY, WASTEWATER TREATMENT, RECYCLING AND REUSE TECHNOLOGIES”

GENDER EQUITY (COMPONENT – 6)

The Center focused on increasing the participation of women in higher education and research in water-related disciplines. This was seen as an essential element for advancing the development of human capital in the water sector. Against this objective, the target set under this cross-cutting component was to realize 50% participation of women across all activities. This expectation was very well aligned with the SDG 5 on Gender Equality. Resultantly, the Center has been able to achieve the 36% female students' enrollment, and 20% in staff, including faculty. To attract more women, the Center offered free on-campus accommodation to all women joining the program in any capacity.

Activities implemented under this component were geared towards establishing the supporting environment at MUET to attract, retain, and empower women in academics, research, and training programs. Specific measures taken by MUET included the development and adoption of a "Gender Policy", the creation of a "Women's Resource Unit", and the "construction of a women's hostel". The MUET became first public sector university in the country with an approved gender equity policy; however, implementation of the policy in its fullest letter and spirit is yet to be achieved to realize its results towards gender empowerment.

Besides, the campus already has a sexual harassment officer, campus gender focal person, the Society of Women Engineers, heads of the various women's hostels. At present, these different players are not well-connected. The WRU was established to serve as a focal point to facilitate the implementation of gender equity policy but has been struggling to play a prominent role on campus, and it still lacks any full-time staff beyond interns.

Gender Policy Framework

1. Establishing institutional and policy framework for making MUET a gender-friendly campus, where gender equity is understood to be a top management priority.
2. Adopting and promoting HEC policy guidelines against sexual harassment in institutions of higher learning.
3. Providing an inclusive environment in which everyone irrespective of its gender and socio-ethnic, economical and religious backgrounds can participate and benefit.
4. Strengthening legislative framework to protect women's rights, enhance their empowerment, and eliminate discriminatory practices in all their forms.
5. Moving towards improved gender-parity in students' population, in faculty and non-faculty positions, in decision making bodies, and in access to scholarly benefits.
6. Creating, mentoring and leadership opportunities for empowering women students, staff, and faculty, and strengthening their participation in academic and extra-curricular activities.
7. Promoting partnerships with institutions and networks which encourages advancing gender equity and women empowerment agenda.
8. Identifying good practices in eliminating gender-based stereotypes and public perceptions which prevent women from reaching their full potential in public life.
9. Learning from good practices on gender equality and anti-discrimination laws and policy instruments being implemented elsewhere.
10. Ensuring that on-campus facilities and infrastructure (both teaching and research) is consistent with the needs of both women and men.

The Gender Equity Plan (GEP) provides policy guidance, specific actions to promote equity, and addresses to both employees and students. The plan also contributes for a better gender balance in categories of staffing and study programs, and promotes an organizational culture for working and learning that will give woman and men equal opportunities.

Lessons Learnt

1. **Gender Equity:** In order to mainstream social inclusion including gender participation into all programs and policies, Center organized entry test centers in major cities to attract enrollment, especially of females, from all parts of the country. To this end, the Center organized several outreach activities at other universities of the country to publicize Center's programs and gender equity policy. Free on-campus accommodation and transportation created an enabling environment for the females from different parts of the country and encouraged females to join the program.
2. **Cross Cultural Environment:** Being national center, the center enrolled students from all over the country with 34% female ratio. This helped center create a cross-cultural work environment which provided students an opportunity to improve their communication and interpersonal skills. Moreover, presence and frequent visitation of professors and researchers of UU and other US universities provided a platform to learn from people of different cultural background.

MEDIA, COMMUNICATION AND OUTREACH

TARGET SDG – 6.6(B):

**“BY SUPPORT AND
STRENGTHEN THE
PARTICIPATION OF
LOCAL COMMUNITIES IN
IMPROVING WATER
AND SANITATION
MANAGEMENT”**

Media, Communication and Outreach

Effective communication with internal and external stakeholders was critical to enhance the transparency of actions. Strengthening a communication unit was also crucial for successful marketing of the Center's competencies and services, especially its research products. In this regard, the Center tried to outreach the stakeholders in many ways towards achieving the national level of credibility for its sustainability.

The Center was also guided by the Development Outreach and Communications (DOC) office of the USAID, and the communication plan was executed accordingly. Developing and implementing an effective communication and outreach strategy had always been critical in achieving the desired program outcomes. For effective program outreach, the Center carried out different activities including media coverage, awareness-raising seminars with local stakeholders, writing of news features, creation of website and printing of promotional material etc.

The Center also created following web portals and other material;

- 1) Website of the Center was developed and is updated regularly.
<http://water.muet.edu.pk/>
- 2) USPCAS-W Facebook was created and maintained ([@uspcasw](#))
- 3) Twitter page of the Center was also created ([#uspcasw MUET](#))
- 4) The Center also continued obtaining space in print media. Significant media coverage included the following and can be accessed from the link:
<http://water.muet.edu.pk/about-us/media-coverage/>
 - Daily DAWN
 - Business Recorder
 - The Sindh Times
 - The Kawish
 - Pakistan Point
 - Daily Express
 - The Nation
 - Onlineindus.com
 - Sindh Express
 - Awami Awaz
 - The NEWS
 - The Tribune
- 5) Quarterly Newsletters were published and circulated among stakeholders.
- 6) Flyers on Center's introduction and other achievements were developed and circulated among stakeholders.
- 7) Brochure on Gender Equity Policy was issued.
- 8) Print material produced by the Center can be accessed from the link:
<http://water.muet.edu.pk/resources/publications-reports/>
- 9) Events of the Center were covered by print and electronic media.
- 10) Various promotion material developed by the Center

Program Outreach

An outreach program was initiated to provide first-hand information on the degree programs offered at the Center, which involved visits to selected universities across Pakistan. The universities visited included; University of Engineering & Technology- Taxila-Punjab, University

of Engineering & Technology-Lahore-Punjab, University of Agriculture-Faisalabad-Punjab, University of Agriculture-Peshawar-KPK, University of Engineering & Technology-Peshawar KPK, Balochistan UET, Khuzdar, Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMs), Quetta, and Sardar Bahadur Khan Women's University, Quetta, Baluchistan.

As part of its Outreach plan, the Center organized and participated in the following events:

- 1) The Center participated in the meetings of USAID's Communication Working Group, held periodically.
- 2) USAID/Pakistan arranged a radio show on FM 101 on 13th September 2019 in which students and staff, who had recently returned from the exchange program, participated. The participants talked about their feelings on the completion of the exchange program in the USA, their experiences, aspirations, expectations, and challenges.
- 3) Faculty and students of USPCAS-W participated in Energy Research Expo 2018 Islamabad, organized by U.S.-Pakistan Center for Advanced Studies in Energy (USPCAS-E), housed at National University of Sciences & Technology (NUST). The expo aimed at showcasing potential renewable and sustainable green energy solutions to cater to Pakistan's increasing energy needs. The one-day exhibition showcased over 40 research projects, including ten from the faculty and students of USPCAS-W MUET.
- 4) A group of students participated in 1st Sindh Water Expo at Mirpurkhas that was jointly organized by the Center, Research & Development Foundation (RDF), Sindh Agriculture University (SAU) Tandojam, Sindh Irrigation Drainage Authority (SIDA), Mirpurkhas District Administration, and Laar Humanitarian Development Program (LHDP). The Trocaire Pakistan collaborated in the event held at Sindh Horticulture Research Institute, Mirpurkhas. USPCAS-W also set up the stall to display and distribute the promotional material for outreaching the concerned stakeholders. Dr. Mohammad Rizwan, Assistant Professor USPCAS-W MUET, Mr. Sahib Khan Bhand, the CMO Expert and Mr. Faizan Memon facilitated the students during their visit to the expo.
- 5) MS students of Batch 2015, accompanied by Communication, Media and Outreach Expert of the Center, participated in the 3rd Karachi International Water Conference organized by Hisaar Foundation held on November 21-22, 2017 at Karachi. The Center set-up a stall in the exhibition part of the conference, which was visited by students, water experts, and representatives from academia and industry. The organizing team briefed the stall visitors about the objectives and activities of the Center.
- 6) Radio Pakistan Hyderabad aired the interviews of Dr. Bakhshal Khan Lashari, PD and Dr. Rasool Bux Mahar, Professor of the Center. They shared the objectives and scope of the Center, water issues of Pakistan and their remedies.
- 7) Dr. Jameel Ahmed, Assistant Professor of the Center, participated in a radio program recently broadcasted on the occasion of the recently inaugurated Community Health FM Radio of Liaquat University of Medial and Health Sciences (LUMHS) Jamshoro. Dr. Jamil focused the discussion on wastewater – the theme of the day and on water-borne diseases.
- 8) Exchange students Mr. Asim Ali, Mr. Abdul Basit, Ms. Rubab Sahar, Mr. Muhammad Touseef and Assistant Professor Ms. Rakhshinda participated in a USAID sponsored radio program at FM 101 Karachi on 2nd February 2017. The participants shared their

exchange experiences, research opportunities in the water sector of Pakistan and the contribution of USPCAS-W in solving the water-related problems of the country.

- 9) Exchange Students namely Mr. Dhanji Mal, Ms. Iram Sifat and Ms. Rubab Sahar participated in a program “Naee Tahee” – the New Generation, one of the most popular programs of Sindh TV News Channel. Around 40-minute program aired from the channel on the next day of the recording. The students shared their experiences of one-semester exchange visit at the University of Utah, United States.
- 10) The Center participated in “Dawn Education Expos” held every year since 2016. A stall of the Center was regularly set-up in these expos. On these occasions, the Dawn group published special supplementary in which the advertisement of USPCAS-W was also published according to the given branding policy of USAID.
- 11) A delegation headed by the Vice Chancellor, Senior Dean and staff of USPCAS-W participated in the Launching Ceremony of Centers for Advanced Studies held in NUST on 3rd June 2015. This event provided a lot of opportunities to interact with many people from USAID, all the four Centers, experts and students.

SUSTAINABILITY

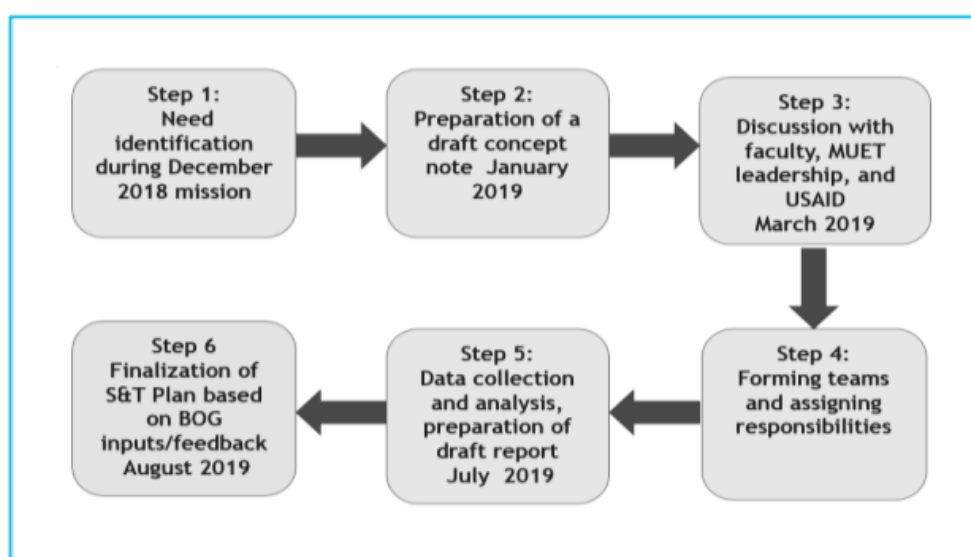
**“BY HELPING
GOVERNMENTS AND
STAKEHOLDERS MAKE
THE SDGS A REALITY”**

SUSTAINABILITY

The center is committed towards its sustainability for which a comprehensive sustainability plan has also been developed based on an assessment of internal and external needs, including the experiences gained with reference to feasibility of various initiatives launched during the project life, and new ideas evolved from ongoing discussions with many stakeholders. The complete sustainability plan is given at annex-9, however, salient features of plan are given as under.

SALIENT FEATURES OF THE SUSTAINABILITY PLAN

The sustainability plan focus on sustaining the current level of activities to the extent possible. This entails addressing the following four major objectives: (i) development of an operational plan and resource requirements for the next five years, (ii) analysis of various operational scenarios and assessment of funding requirements under the most plausible scenario, (iii) elaboration of key elements of the sustainability strategy, and (iv) forming research and training partnerships for transfer of innovative practices, and supporting evidence-based policy formulation. This plan is prepared while following the six self-explanatory steps as shown below figure.



The monitoring framework designed for this project was primarily steered by a set of quantitative targets stipulated in the Cooperative Agreement. The achievement of these targets was regularly monitored throughout the project life and, as and when required, necessary actions were implemented to ensure that progress stays on track. It is, however, not assessed that how the achievement of these targets has contributed towards solving the water challenges of the country on the ground or has impacted the performance of the water sector through policy change. The sustainability plan emphasizes addressing this limitation through future monitoring framework. This will help in creating an understanding about the role this Center is playing or can play in advancing the implementation of the sustainable-development agenda, which, in turn, can positively impact the Center's resource mobilization efforts.

After the USAID funding is ceased at the end of 2019, MUET will have to prepare for sustaining Center's operations without external financial and technical support. This is going to bring in several changes in the current institutional set up, incentive structures, management culture, and working methods. The challenge is to manage and adapt to these changes, minimize their impact on employees' performance while simultaneously maximizing the effectiveness of the

change effort. The sustainability plan proposes a new organizational structure of the Center as presented in Figure 2.1 reflecting similarities to that of a hierarchical organization. It strongly proposes to retain the BOG of the center to continue with the autonomous status of the center and also renames the position of project director as an Executive Director. Maintaining the Center's operational autonomy is critical for its sustainability and for enabling it to effectively deliver on its mandates. While the experience during the project period has been positive, so the operational autonomy will help in: (i) mobilizing resources and building partnerships to expand research opportunities, (ii) implementing a performance-based system, and (iii) providing the necessary freedom to the Center's management in implementing quality control standards introduced during the project life.

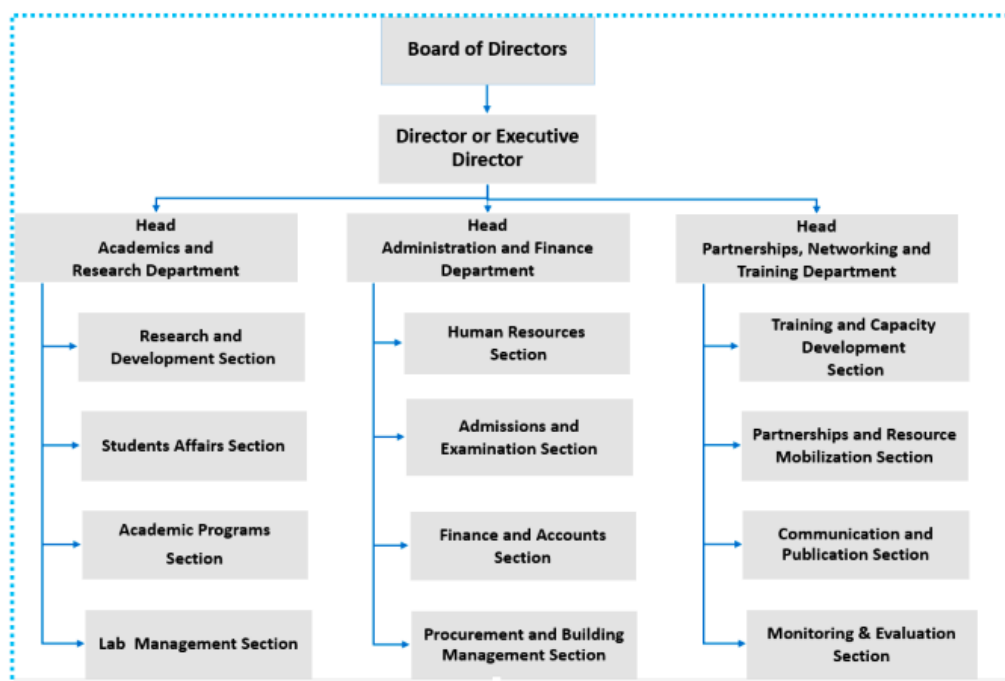


Figure 2.1: Proposed Organizational Structure

The sustainability plan describes mechanisms and drivers that will enable the Center to sustain its momentum and quality after the external the USAID funding is ceased. This is organized around three sustainability pillars – financial, technical and social. The financial pillar defines the expenditure and income streams for different operational (or funding) scenarios, including the potential funding sources to meet the budget deficit. Assumptions employed to estimate different expenditure and revenue items are discussed and their feasibility analyzed. Technical and social sustainability pillars examine conditions necessary for maintaining the quality of the programs launched during the project life in such a way that they continue to respond to market needs, based on sustained inputs of stakeholders.

Way Forward towards Sustainability

The challenge facing the Center is to maintain the quality and habits of success after December 2019. The sustainability plan precisely describes that financial resources are clearly part of the recipe for sustainability, but also indicates that it is not the only ingredient but implementation of actions listed below can make notable contributions in achieving the sustainability objective.

Developing a Shared Vision: The new management, together with the faculty and stakeholders, should develop a shared vision – where would they like to see the Center five years in the future and how can they realize this vision? What should they do differently than

the approach followed during the past five years? While elaborating on the vision, it is important to define “what is success”, and actions must be defined to promote ownership of the Center and its vision.

Mobilizing Resources: No doubt, this is going to be a major challenge in view of the limited resource mobilization capacities of the existing staff. Setting up a dedicated resource mobilization unit and resourcing it with one or two competent staff may help in steering efforts in the right direction.

Embracing a New Organizational Structure: The proposed organizational structure should be finalized and rolled-out as early as possible. Delays in decision-making could create uncertainties, which might be detrimental to the institutional development process.

Recruiting New Leadership: New leadership should be recruited immediately in line with the approved organizational structure. Among other things, the new leadership should assume the responsibility of discussing and agreeing on the scope of technical assistance framework with the U and its partner institutions beyond 2019.

Maintaining the Center’s Operational Autonomy: Maintaining the Center’s operational autonomy will be critical for its sustainability and enabling it to effectively deliver on its mandates.

Improving Governance: This entails many facets. The most important one is continued implementation of best management practices initiated during the project life (for example FAR, creation of research teams, stakeholder dialogues and training workshops for faculty and students etc.).

Improving Communication and Transparency of Actions: Effective communication with internal and external stakeholders is critical for supporting the social and technical sustainability pillars. Hence, strengthening a communication unit is extremely important for successful marketing of the Center’s competencies and services, especially its research products.

Extending Technical Assistance to Others: The Center’s faculty has benefitted considerably from the capacity building efforts implemented in the form of exchange program and technical workshops. It is now time that the trained faculty should develop similar training for other institutions in the country, including different departments of MUET, in improving their teaching skills, preparing high-quality research proposals, and mentoring graduate students.

Implementing Diploma Programs: There seems to be a reasonable demand for the short-term diploma (1-3 months) courses for the working executives, who cannot attend regular degree programs because of their preoccupation with the official responsibilities. Starting an evening program can help these executives improve their professional credentials. Such diploma courses could be developed and organized for the staff of the health department, water utilities, civil society, and others.

Budget Estimates

The sustainability plan also provides the assumptions used to estimate costs and revenues. This information is used together with cost and revenue assumptions to estimate annual budget requirements for 2020 (the first year after termination of the USAID funding). The total annual budget requirements and revenues estimated under the proposed scenario are summarized in below table.

Budget Items	Estimates (PKR)	%age Share
Salaries and benefits	82,659,600	59.8
Program costs	11,360,000	8.2
Training and workshops	4,300,000	3.1
Research budget	18,000,000	13.0
Travel & transport	2,675,000	1.9
O&M costs	18,800,000	13.6
Technical and financial audit	500,000	0.4
Total costs	138,294,600	100.0
Total revenues	27,515,000	
Budget deficit	110,779,600	
Net budget deficit	25,517,880	

Estimates presented in above table shows a total budget deficit of about 110.8 million PKR and the plan also discusses the scenarios that how center can reduce this budget deficit and enhance its revenues.

Actions taken towards Sustainability

- 1) The BoG and the MUET Syndicate has already approved the sustainability plan of the center. With this approval the basic institutional arrangements of center including its autonomous status and regularization of the faculty as per national pay scale is ensured.
- 2) Center's admin staff has also been awarded one-year extension in the contracts except a few exceptions.
- 3) The proposed annual budget estimates for year 2020 have also been approved by syndicate and senate of the MUET.
- 4) The center has been notified as a National Water Center – post USAID funding.
- 5) Recruitment process of the new leadership positions, as per new organizational structure, has also been initiated and would be completed soon.
- 6) Fall 2020 batch of students has been enrolled by the center outside USAID funding and the MUET continues providing scholarship to all students and free on-campus accommodation to female students.