



## **Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa (CAWESDEA)**

**IDRC Grant No. 108888-004**

**Country: Tanzania**

### **FINAL TECHNICAL REPORT**

---

Submitted by:

Dr Victor Kongo (Principal Investigator)  
Global Water Partnership Tanzania, Dar es Salaam  
Tanzania

Dr. Job Rotich Kosgei (Co – Principal Investigator)  
Moi University, Eldoret  
Kenya

Dr. Subira Eva Munishi (Co – Principal Investigator)  
University of Dar es Salaam, Dar es Salaam  
Tanzania

Dr. Jotham Sempewo (Co – Principal Investigator)  
Makerere University, Kampala  
Uganda

March 2022

## RESEARCH INSTITUTIONS

Global Water Partnership Tanzania  
196 Rose Garden Road  
P.O Box 32334, Dar es Salaam, Tanzania

Moi University, Eldoret Campus  
School of Engineering  
Department of Civil and Structural Engineering  
P.O Box 3900-30100, Kesses, Eldoret, Kenya

University of Dar es Salaam  
College of Engineering  
Department of Water Resources Engineering  
P.O Box 35131, Dar es Salaam, Tanzania

Makerere University  
College of Engineering, Design, Art and Technology  
Department of Civil and Environmental Engineering  
P.O Box 7062, Kampala, Uganda

## CONTACT INFORMATION

Victor Kongo, Executive Director  
Email: [victor.kongo@gwpsaf.org](mailto:victor.kongo@gwpsaf.org)  
Phone: +255 783 376717

Subira Eva Munishi; Lecturer  
Email: [evasubira@gmail.com](mailto:evasubira@gmail.com)  
Phone: +255 783 627427

Jotham Sempewo; Lecturer  
Email: [jothamsempewo@yahoo.com](mailto:jothamsempewo@yahoo.com)  
Phone: +256 776 568426

**Copyright 2022:** Victor Kongo; Job Rotich Kosgei; Subira Eva Munishi; Jotham Sempewo  
Disseminated under Creative Commons Attribution Licence  
<https://creativecommons.org/licenses/by/4.0/>

## ACKNOWLEDGEMENT

The successful implementation of this project is attributed to contribution from various partners and institutions from the countries that participated in this endeavor i.e Kenya, Uganda and Tanzania. We are grateful to the immense support that our partner institutions i.e Global Water Partnership Tanzania, University of Dar es Salaam, Makerere University, Moi University accorded unto us. We are indebted to the great support we got from the Commission of Science and Technology (COSTECH) in Tanzania as well as Engineering Registration Boards, other Government institutions and engineering professional bodies from all the three countries. The contribution from various consulting teams, partners, stakeholders that were engaged in all countries in the process of implementing this project is highly appreciated. We thank the Management and Board of Directors of Global Water Partnership Tanzania for their continued support and oversight role in steering the project to its desired conclusion. Lastly, we thank IDRC for initiating the great and timely programme on *Strengthening Engineering Ecosystem in sub-Saharan Africa* of which CAWESDEA Project was part of. We are eternally grateful to IDRC for funding our project as well as providing technical guidance and support in implementing the project.

Funded by:



## Table of Contents

<b>List of Figures .....</b>	<b>vi</b>
<b>List of Tables.....</b>	<b>vi</b>
<b>Acronyms and Abbreviations.....</b>	<b>vii</b>
<b>1.0 Introduction .....</b>	<b>1</b>
<b>2.0 Project Management.....</b>	<b>1</b>
<b>3.0 The Burning Issue.....</b>	<b>1</b>
<b>4.0 Objectives .....</b>	<b>2</b>
<b>5.0 Methodology and Project Activities .....</b>	<b>3</b>
5.1 Objective 1: To assess the relevancy of engineering education and training in the water sector to the national and regional development goals .....	4
5.1.1 Activity 1.1: Partners virtual meeting .....	4
5.1.2 Activity 1.2: Situation Analysis .....	4
5.2 Objective 2: To enhance innovative skill delivery approaches in engineering training focusing on graduate students and faculty in the water sector .....	5
5.2.1 Activity 2.1 Intern selection .....	5
5.2.2 Activity 2.2 CAWESDEA Project Inception and Induction workshop .....	7
5.2.3 Activity 2.3 Development of fellows Problem Based Learning (PBL) training modules .....	8
5.2.4 Activity 2.4 Placing selected interns in host institutions .....	8
5.3 Objective 3. To support on-going initiatives such as those undertaken by the Structured Engineers Apprenticeship Program (SEAP) and implemented by the Engineers Registration Boards (ERBs) and gender mainstreaming.....	10
5.3.1 Activity 3.1 Gender analysis .....	10
5.3.2 Activity 3.2 Capacity building.....	11
5.4 Objective 4. To share lessons from the project for scaling up successful strategies in engineering education and training in the water sector and networking with the industry .....	12
5.4.1 Activity 4.1 Training interns on drafting journal manuscripts from project reports. ....	12
5.4.2 Activity 4.2 IWA Special issue and publication of journal articles .....	13
5.4.3 Activity 4.3 Video clips for project.....	15
5.4.4 Activity 4.4 Participation in national conferences and workshops .....	16
5.4.5 Activity 4.5 Culmination workshop.....	16
5.4.6 Activity 4.6 CAWESDEA webpage – a repository for all project materials.....	20
<b>6.0 Project Outputs .....</b>	<b>20</b>

6.1	Special issue – Water Practice and Technology .....	20
6.2	Paper publications.....	20
6.3	Reports .....	20
6.4	Posters .....	21
6.5	Workshop reports .....	21
<b>7.0</b>	<b>Project Outcomes .....</b>	<b>21</b>
7.1	Scaling up.....	21
7.2	Establishment of community of practice .....	23
7.3	Actualization of the Triple Helix Concept.....	23
<b>8.0</b>	<b>Overall Assessment and Recommendations .....</b>	<b>23</b>
<b>Annexes</b>	<b>.....</b>	<b>25</b>
	Annex 1: Special Issue – call for papers .....	25

## List of Figures

Figure 5.1: CAWESDEA Project Inception Workshop .....	8
Figure 5.2: PBL Training session .....	9
Figure 5.3: Interns training session on drafting journal papers.....	12
Figure 5.4: Interns presenting their work in conferences .....	17
Figure 5.5: CAWESDEA Project Culmination Workshop.....	19
Figure 6.1: Examples of CAWESDEA posters.....	22

## List of Tables

Table 2.1: Management Structure of CAWESDEA project.....	1
Table 5.1: Papers submitted to the CAWEDEA special issue .....	13

## Acronyms and Abbreviations

<i>CAWESDEA</i>	Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa
<i>COVID-19</i>	Corona Virus Disease of 2019
<i>GWPO</i>	Global Water Organization
<i>GWPSA</i>	Global Water Partnership South Africa
<i>GWPTZ</i>	Global Water Partnership Tanzania
<i>HEI</i>	Higher Education Institution
<i>MoU</i>	Memorandum of Understanding
<i>STEM</i>	Science, Technology, Engineering and Mathematics
<i>TWP</i>	Tanzania Water Partnership
<i>UDSM</i>	University of Dar Es Salaam

## 1.0 Introduction

Tanzania Water Partnership (TWP) in collaboration with Department of Water Resources Engineering, College of Engineering and Technology (CoET), University of Dar-es-Salaam in Tanzania; Department of Civil Engineering and Environment, Makerere University in Uganda; and Department of Civil Engineering and Structural Engineering, Moi University in Kenya jointly applied and implemented the IDRC funded project titled ***Building Capacity in Water Engineering For Addressing Sustainable Development Goals In East Africa (CAWESDEA)***. The project was conceived out of collaborative efforts between the partnering institutions, starting way back in 2017 when TWP submitted a concept note to IDRC in response to a call for the programme titled *Strengthening Engineering Ecosystem in sub-Saharan Africa*. TWP led the efforts of developing the concept note into a project proposal of which was funded by IDRC after going through due diligence processes. The CAWESDEA project was designed to cover 3 years - starting from October 1<sup>st</sup> 2018 and ending in September 2021. However, due to unprecedented global COVID19 Pandemic, the project was extended by four months up to February 2022. Thus, this report provides an account of the implementation trajectory of the CAWESDEA project.

## 2.0 Project Management

The management structure of the project is as indicated in Table 2.1

**Table 2.1: Management Structure of CAWESDEA project**

	Name	Institution	Portfolio
1	Dr. Victor Kongo	Tanzania Water Partnership	Team Leader & PI
2	Dr. Jotham Sempewo	Makerere University	Coordinator (Uganda) & Co-PI
3	Dr. Eva Subira	University of Dar es Salaam	Coordinator (Tanzania) & Co-PI
4	Dr. Job Rotich Kosgei ( <i>deceased</i> )	Moi University	Coordinator (Kenya) & Co-PI

During the Project lifespan, the external auditor for Tanzania Water Partnership was Kasegenya and Company Ltd who are Certified Public Accountants. As a rule, in Global Water Partnership (GWP), the auditing process for the entire Global Water Partnership family (including regional offices and accredited Country Water Partnerships of which Tanzania is part of) is normally controlled and supervised by a global auditing firm of which by then was PwC based Sweden. In this case, Kasegenya and Company Ltd. was under instructions from PwC in Sweden.

At the beginning, as part of enhancing effectiveness and transparency in managing the project, the PI developed a project prospectus that coherently summarized the core activities of the project and delivery pathway for each collaborating partner. This prospectus was the main reference document for the team of which summarized and provided a simple narrative of project objectives, activities and budget allocation for each activity.

### Lessons learnt:

GWP Tanzania has adopted this approach of generating simple narratives (prospectus) of all projects that are being implemented in the organization. This has the benefit of enhancing effectiveness in delivery of projects especially for those that are being implemented by multiple partners.

## 3.0 The Burning Issue

Skills and knowledge are the key profound requisites for successful realization of steady economic growth and achievement of sustainable development goals in any country. This is very critical in the context of SDG6 on water. In sub-Saharan Africa, there is a critical shortage, including gaps, of skilled



and competent workforce especially in the fields of engineering and especially those that are aligned to water.

One of the challenges in engineering in East Africa is mismatch between skills that engineering education and training is imparting to students and market skills demand. Most training institutions seems unaware of the ever-changing skills domains in society and industry, due to limited structured collaboration with the industry. Notably, the content of engineering curricula delivered to students in universities lacks continuous feedback from industry and hence, the skills acquired by graduate engineers are increasingly becoming irrelevant to societal and industry needs. The result is inadequacy in skill and competency of engineering graduates in the water sector in providing the ever-needed services in the industry and society as well.

It was also realised that, most often, the engineering registration and professional bodies in the three pilot East Africa countries (Kenya, Uganda and Tanzania) are always working independently with minimal structured interaction with private sector and Universities - in spite of having a common goal. A vibrant collaborative partnership between universities, private sector and engineering professional/registration has always been the best breeding ground for technological innovation. It is therefore imperative that this partnership should be supported and enhanced so as to deliver the necessary skills and competencies in engineering education by bringing together key stakeholders in the engineering ecosystem.

Furthermore, the mode of delivery of training in many Universities in East Africa is wanting as it is typified with conventional methods where lectures dictate to students with minimal impact on skill delivery. Such delivery approaches fail to challenge the students to use their imaginative and innovative capabilities. Hence, there is a need to change the mode of delivering engineering training in the Universities to a Problem-Based Learning (PBL) approach.

Lastly, there is a common trend in sub-Saharan Africa of under-representation of women in the engineering discipline. This narrative is well documented in numerous journal articles as well as project reports. The under-representation has its genesis from societal perceptions as well “massive leakage pipeline” phenomenon where few girls in primary and secondary schools end up taking science subjects as well as female graduate engineers opting for other less engaging careers as part of adapting to parental obligations. Each country has tried, in a different way, to address this gender issue in engineering including Tanzania where the Structured Engineers Apprenticeship Program (SEAP) where graduate female engineers have been supported through a mentorship placement programme. The CAWESDEA project appreciated, acknowledged and supported such great efforts to support female engineers.

It is on this premise that the CAWESDEA project was developed in-order to address the above issues through a set of five specific objectives. The main goal was to institute a knowledge and skill transfer platform in the form of an innovative well-structured internship programme for young fresh engineering graduates in the water sector (i.e graduate engineer in any field with interest in the water sector) while addressing the gender issues therein. The internship programme was successfully established as a vehicle for enabling transfer of requisite skill set and knowledge, that the market demands, to the graduate engineers through a hands-on training under the supervision of practicing professional engineers.

## **4.0 Objectives**

The overall objective of the project was to strengthen the capacity of engineers, in the water sector, in East Africa by enhancing their competency and employability in order to effectively meet the societal and developmental needs, focusing on gender parity in the profession. Despite the fact that the project

focused on the water sector, the approach and principles of the project has the potential of being up scaled and replicated in other engineering disciplines in the context of addressing country development priorities as well as Sustainable Development Goals. Efforts were focused on infusing innovative capacity building initiatives to address inadequacies in water related engineering fields in the East Africa region with the view of up-scaling to other regions.

The project specifically aimed to:

- i) Assess the relevancy of water and related engineering education and training to the national and regional development goals
- ii) Enhance innovative skills delivery approaches in water and related engineering training focusing on students and faculty
- iii) Establish a sustainable participatory mechanism for aligning engineering training curricula within the existing engineering ecosystem frameworks
- iv) Support on-going initiatives targeting to increase the number, skills and experience of female engineers
- v) Establish a mechanism for learning, sharing information, scaling up lessons from the project and networking with the industry

However, the project has been designed to follow a particular sequence or pattern of events. These events are basically activities that have been carefully and logically thought so as to facilitate the realization of the project goal and specific objectives within a methodological framework. Below is a summary and brief narration of each objective and specific activities.

## **5.0 Methodology and Project Activities**

In late 2018, the CAWESDEA project started by participating in a programme inception workshop that was convened by IDRC at University of Kumasi in Ghana where the whole programme team met for the first time to share insights on their respective projects. The programme team members discussed the following issues:

- Engineering's role in higher education, economy & society
- There were presentations for each project which focused on problem framing & assumptions; identifying key partners; aligning targeted outcomes; developing possible pathway for scaling up; and developing key activities for 6 to 12 months of the project implementation
- There was a panel discussion which focused on project implementation realities when working with university and industry.
- The participants were also taken through a system mapping of the 'Engineering Ecosystem', which explained the broad 'theory of change' underpinning the ecosystem approach. The participants analyzed their own work (projects, research, etc.) and indicated areas of emphasis on a large, full-scale system map.
- The programme team also discussed challenge assumptions on what is likely to influence change in different type of actors; drawing on practitioner research and academic research to advance collective approach.
- Gender Self-Assessment was done taking stock of current situation through framing gender self-assessment as a vehicle for organizational change; unpacking organizational self-assessments, using focus group discussions to stimulate deeper thinking; connecting with broader initiatives – SDGs, Government of Canada & IDRC strategy; devising preliminary recommendations for GSA for the duration of the projects and giving feedback from project leaders
- Pilots, Scale & Learning was done which focused on introducing some key concepts related to scale – what does it mean, how can we plan for scale from the beginning? There were group brainstorming on the key actors at national, regional, and international levels, and how the programme could

connect with them. The programme team developed a plan to contact key players in their respective context with support from others in the field e.g funding, policy and research.

- On the next steps and working together, the teams discussed on desired modes for discussion, connecting across projects, and sharing resources; they identified key opportunities in the year ahead (in terms of conferences, policy meetings, etc.) and gathered feedback on proposed topics for virtual learning sessions.
- At the end the participants were asked to align their project to key administrative responsibilities for IDRC: i.e. open access, reporting formats, cash flow.
- The teams had opportunity to discuss with the IDRC senior programme officer on next steps based on workshop insights

The inception meeting in Ghana provided a good platform for understanding the programme-wide approach and scope as well as the administrative protocols. Most of the project PIs had not yet had a grant with IDRC and hence it was their first time to explore the admin requirements of which turned out to be very manageable and friendly. It also facilitated interactions among project lead partners of which is always good when managing multiple projects within a programme.

Subsequent project activities were all aligned to specific objectives as indicated in the original CAWEDEA project proposal. There were a few deviations, especially between 2020 and 2021 mainly due to COVID Pandemic. However, all deviations, and how they were managed, were fully communicated to the Senior Programme Specialist where advice and or permission to deviate was sought as narrated herein.

## 5.1 Objective 1: To assess the relevancy of engineering education and training in the water sector to the national and regional development goals

### 5.1.1 Activity 1.1: Partners virtual meeting

A partner's virtual meeting was arranged for project coordinators from Moi University, Makerere University, University of Dar es salaam and the PI. It was acknowledged that the partners had not had a joint planning meeting before, as a team, and hence the virtual meeting served as a platform for acquainting each other as well as fine tuning project objectives, deliverables, timelines, budgets and relevant protocols for managing the project.

### 5.1.2 Activity 1.2: Situation Analysis

Each collaborating partner, under the leadership of Tanzania Water Partnership (TWP) spearheaded the delivery of a situation analysis exercise in the respective countries. However, TWP lead the situation analysis exercise in Tanzania. In each country, the needs assessment exercise analysed, but not limited to, the following aspects in the water sector:

- Assessment of existing policies as well as national and regional economic development initiatives in the context of engineering education and training in the water sector.
- Assessment of current employment trends and opportunities for engineering graduates in the water sector.
- Assessment of market skills requirements for fresh engineers in the water sector in relation to skill delivery at institution of higher learning
- Identify potential host institutions willing to support the internship programme where the interns will be placed
- Review of existing curriculum of partnering universities with respect to relevancy in addressing the prevailing and emerging engineering challenges in the water sector.
- Participatory identification of skill training needs for fresh graduate engineers in the water

sector

The outcome of the situation analysis exercise in each country was to help inform the design and content of the 6-month internship programme as well as inception workshop (see section 5.22) that was to be held within a year after commencement of the project. Each country drafted and submitted a Situation Analysis Report of which are readily available.

## 5.2 Objective 2: To enhance innovative skill delivery approaches in engineering training focusing on graduate students and faculty in the water sector

This objective was mainly achieved through the graduate fellow's internship programme and development of the Problem Based Learning modules as narrated herein.

### 5.2.1 Activity 2.1 Intern selection

One of the core activities of the project was anchored on a 6-month internship programme for fresh engineering graduates (in any of the engineering disciplines so long as it was inclined to water) at BSc or MSc. The internship programme was envisaged to make attempts to address the existing gaps between curriculum delivery and the skill set that the industry expects from fresh graduate engineers as well as the issues that were identified in the respective situation analysis reports. Some of the skill set that needed to be imparted include competency in job skills and as well as professional training. In addition, key transferable skills that include communication, research and planning, innovation and patents, interpersonal skills and human relation, creative thinking and organization skills, entrepreneurial skills, management, and leadership skills were also found to be limited. Each country had the opportunity to select 7 interns (while reflecting on gender dynamics) who were to be placed in leading firms/institutions with ongoing water projects. The interns were to be exposed to new technological insights in their respective professions under supervision of (i) the national coordinator in respective University and (ii) skilled engineer at the host firm. The whole idea and focus of the internship programme was to impart skills and expertise to the interns with the view to increase their competency in the market.

The national coordinators were responsible for preparing project reports at their institutions (both financial and technical). The respective situation analysis reports helped to inform and design the internship programme in each country after focal thematic areas as well as reputable host institutions were identified.

The selection process of the interns was managed by the respective partner Universities, and it was an open and transparent process with a clear objective function on the selection criteria.

A common CAWESDEA advert call for the internship programme was developed, and each Country coordinator managed to share the same in their respective platforms e.g social media, group emails, websites etc with the view to reach as many potential candidates as possible. The call targeted fresh engineering graduates from across all engineering disciplines. The candidates were asked to express their interest by filling in a Google form and send their CVs accompanied with a short motivation of their area of interest. Three areas were considered viz. (i) Water supply and sanitation (ii) Water Quality, and (iii) Water Resources Engineering. The call was out for just about a week and the following responses were received:

Uganda	92
Tanzania	425
Kenya	48

As indicated in the figures above, there was a great variability in the responses, with Uganda, Tanzania and Kenya accounting for about 16%, 75% and 9% of the total responses, respectively. The lower response for Kenya was attributed to a recent concerted effort by the government and partners to initiate a national internship programme for fresh graduates (from all disciplines) where more than 5,000 fresh graduates were competitively recruited for a 1 year internship programme.

The huge interest from Tanzania was attributed to various factors (i) that the Water Resources Engineering Department of the University of Dar es Salaam has a huge network on alumni through which the advert was shared (ii) Tanzania Water Partnership has an established network of partners through which the adverts were shared. The combined yet independent effort by University of Dar es Salaam and Tanzania Water Partnership led to the advert reaching out to many potential candidates.

Due to limited resources, the CAWESDEA project could only support 7 interns in each country. Some of the criteria considered, in each country, during the selection process are as follows:

- i) Institutional supervisory strengths in the respective partner University department within the three areas of interest (water quality, water supply and sanitation, water resources engineering)
- ii) Candidate not having pursued another internship programme before
- iii) Gender
- iv) A minimum degree qualification of second class (honours) upper division
- v) Geographical and institutional diversity (e.g. from different Universities, geographical spread, engineering disciplines etc)
- vi) Candidates who were pursuing postgraduate studies without prior field experience
- vii) Candidates who were available, full-time, for 6 months starting November 2019
- viii) A well articulated motivation on their area of interest

#### 5.2.1.1 Gender consideration

Each country underwent a rigorous collaborative/inclusive short listing exercise involving the respective University Departments and where necessary through consulting the respective engineering regulatory bodies and potential placement firms. Each partner institution recruited seven interns. What was very encouraging is that there were more female interns than males in each of the three countries. Each country nominated 4 female and 3 male interns.

It was necessary to have a commitment from each of the interns after defining roles for them as well as sharing the project's obligations. The interns were made to sign commitment that:

- i) They were to be available during the six-month internship period
- ii) This placement was a fixed-term engagement and thus not an offer for employment.
- iii) They were entitled to a monthly stipend.
- iv) They are expected to organize for a personal insurance cover while undertaking the internship.
- v) Once attached to a host firm, the interns were expected to develop an innovative project under supervision by a Practising Engineer with periodic visits by the National Coordinator. The CAWEDEA project was to support the interns to develop and implement the innovative project.

All the recruited interns accepted the terms of engagement and thus participated in the Project inception and induction workshop as well as training on Problem Based Learning (PBL) that was held in Dar es Salaam, Tanzania (18th – 20th September 2019) as elaborated in Section 5.2.3.

#### 5.2.1.2 Threats, concerns and uncertainties

Although the process of recruiting the right interns was successful, and necessary measures for realizing the desired goals were put in place, there was a need to be cognizant of the following:

- i) Tendency of interns viewing the internship as a normal Field Practical Training (FPT) – a compulsory practical session for all final year engineers where they are usually attached to the industry. It was emphasized during the inception workshop that the main difference between the FPT and the CAWESDEA internship programme is that the latter focuses on impartation of skills and enhancement of employability rather than completion of a programme/curriculum where the students basically focuses on attainment of marks. This orientation and mindset change had to be inculcated in all stages of the internship programme.
- ii) Possibility of interns decamping from the internship programme before time.  
A number of approaches were suggested to address this concern as highlighted below:
  - Riding on the high motivation that the interns demonstrated during the workshop and training
  - Attaching the interns to reputable host institutions
  - Engaging the interns through a formal contract clearly spelling out the Terms of Reference
  - Devised a plan to follow-up on intern's progress or instituting a mechanism to monitor their progress on a continuous basis
  - Attaching each intern to a mentor, a professional engineer, who was to be responsible for the progress of the intern
- iii) The risk of interns not accepted in the host institutions.  
The following are some means that were used to address this threat:
  - Utilize organizations that the respective University Departments already have good working relationships
  - Develop Memorandum of Understanding with the potential institutions
  - Clearly spell out ToR for the interns and design some agreed terms
- iv) Inadequate delivery with outputs not sufficing project objectives
  - Supervisors were required to develop a mechanism to monitor the progress of the Interns by having weekly feedback
  - Coordinators were required visits the interns at their host institutions as was practical
  - Coordinators were required to institute a mechanism for exchanging notes and experiences with the host supervisor

### 5.2.2 Activity 2.2 CAWESDEA Project Inception and Induction workshop

A three-day convening (18-20 September 2019) was organized in Tanzania, after the situation analysis exercise and selection of interns. The convening brought together project partners, interns and stakeholders in water and related engineering disciplines from each country as seen in Figure 5.1.

The three-day convening had the objective to grant an opportunity for the collaborating partners to jointly reflect on the outcome of the situation analysis exercise with the view to:

- Undertake closer appraisal of project objectives, planned activities, responsibilities, milestones
- Fine tune procedures and implementation pathways in each country.
- Finalise schedules, reporting protocols, deliverables and project calendar

The convening also served as a launch pad for the CAWESDEA internship programme. It was acknowledged that the interns were not in the same phase with other project partners and hence there was a need for an induction process - to help the interns understand the bigger picture of the CAWESDEA project within the context of the IDRC funded programme - *Strengthening Engineering Ecosystem*. The induction workshop was a useful platform for introducing the interns to project expectations, processes and deliverables.





**Figure 5.1: CAWESDEA Project Inception Workshop**

#### 5.2.3 Activity 2.3 Development of fellows Problem Based Learning (PBL) training modules

A consultant was engaged to support, in a participatory manner, the project partners in each country in drafting respective PBL training modules for the internship programme. The process of developing the modules was informed, among others, by the outcome of the situation analysis reports in each country. The draft modules were present, shared and discussed during the PBL training workshop that was held back-back with the CAWESDEA inception workshop. Figure 5.2 shows one of the PBL training sessions. The PBL practical training was one of the preparatory sessions for the interns before they were deployed to their host institutions. The training was of great importance given the fact that each intern was supposed to develop an innovative project at his or her host institution with an express motive to solve an existing challenge using the PBL approach. The three-day convening was attended by Engineering Professional Associations and Regulatory bodies and experts from the three countries. In order to rationalize the available project budgets, the three sessions i.e project inception, induction workshop and PBL training were held back-to-back.

#### 5.2.4 Activity 2.4 Placing selected interns in host institutions

Partner Universities and National Engineering institutions were to identify host firms in the respective countries. A number of factors were used to determine the efficacy of a firm before being nominated to be a host institution e.g. being a leading engineering enterprise in the water sector etc. The main thrust for the internship programme was two-fold:

- To inspire and support the interns/fellows to develop skills relevant to the market in the water sector
- To promote interaction with practicing engineers in the water sector and expose the interns to real-world case studies



**Figure 5.2: PBL Training session**

The host institution provided a conducive working and learning environment. The supervisory team, i.e. registered engineer at the host institution together with the national coordinator from partner University, guided and mentored the interns to apply innovative approaches in solving practical challenges, using PBL, in any engineering field in the water sector. Each intern developed a detailed project design and its implementation pathway and was supported by CAWESDEA project to implement their pilot project.

Unfortunately, the COVID-19 pandemic came at a time when the interns had just been deployed to their respective host institutions. The unprecedented lock-downs that came into force in many countries led to most institutions closing their activities and hence the interns had to work from home. This was a Force Majeure to the project and hence innovative ways were instituted by the project leadership (the PI and National Coordinators) to facilitate direct communication with the interns on a weekly basis. Such unprecedented moments also forced some interns to change the orientation of their innovative projects – to align with prevailing situation given the fact that access to data or engaging in field activities was more of a challenge.



### 5.3 Objective 3. To support on-going initiatives such as those undertaken by the Structured Engineers Apprenticeship Program (SEAP) and implemented by the Engineers Registration Boards (ERBs) and gender mainstreaming

All activities under this objective were geared towards promoting gender equality and developing and implementing activities, which, specifically targeted priorities for female engineer's in the water sector. Targeted interventions for female engineers has the potential of creating an empowering space and act as an important incubator for ideas and strategies than can be transferred to mainstream interventions. There were two main activities that were undertaken in this specific objective.

#### 5.3.1 Activity 3.1 Gender analysis

A comprehensive gender analysis, on the current situation and position of female engineers in the water sector, was undertaken in each country (Kenya, Uganda and Tanzania) in the context of assessing the potential impact of Problem Based Learning approach (PBL) on the situation and position of women. A consultant was hired in each country to undertake the exercise. A detailed online tool was developed, with support from Feminist Data & Research - FDR Inc. where their Gender Based Analysis (GBA+) Tool was adapted. Multiple consultative partner meetings were convened to restructure and adapt the tool to local settings while maintaining the thrust and purpose of the tool.

The core objectives of the gender analysis were to: (i) analyze the root causes of gender inequality in the context of STEM careers at individual, institutional, and policy levels and (ii) identify programming opportunities, strengths, gaps, lessons learnt and recommended strategies for designing a gender-responsive strategy that addresses the needs and interests of women, men, boys and girls to enhance program effectiveness.

In all countries, the selection of participating institutions in the gender analysis was based on their role in Engineering Training and Education through either (i) implementing programmes leading to the award of at least Bachelor's Degrees (ii) were beneficiaries of Engineering graduates or (iii) were professional or accreditation body.

Unfortunately, the gender analysis exercise came at a time when the COVID-19 pandemic was at its peak. In this case, most of the initial interactions with the participating institutions was mainly through online tools. By then most countries were under lock-down of which severely limited movements. However, the project leadership implored on the consultants to use their inherent networks in the respective countries to access the relevant information from participating institutions. The consultants went an extra mile to have phone interviews with heads of the various institutions – something which the leadership of the project really appreciated. In this case, the gender analysis took relatively long compared to the initial schedule.

Since all countries used the same GBA+ tool, they also used more or less the same approaches in data collection. The main approaches that were used include survey questionnaires (both online and posting hardcopies), interviews and focus group discussions – when an opportunity arose and within COVID-19 guidelines. Another approach that was used is the feminist methodology, which positions the advancement and empowerment of women as central to the research process. The intention of this approach is to bring to the surface the voices that are often excluded from knowledge production and policy making, and critically reflect upon what and or how it can be done better.

The fourth framework that was adopted was an intersectional approach that recognizes diversity of female engineers in the water sector in terms of level of education, age, specialization and employment (Private, government or academia) etc. In so doing, it identified where experiences were consistent across women engineers in the water sector, and where and why some experiences varied. The data collection process also utilized a mixed method design that combined both qualitative and quantitative

approaches. This process offered an in-depth insight into the research problem rather than a generic solution.

The data collected was disaggregated by sex to provide an understanding of the social construction of gender roles and how labour is divided and valued. The gender analysis provided the evidence based on which concerns that arise in and through project design can be effectively addressed. It will also promote better informed gender-responsive and effective interventions. The GBA+ framework of gender analysis, recommended by IDRC was adopted because it examines how various intersecting factors impact the effectiveness of contextual initiatives. It involves examining disaggregated data and research considering social, economic and cultural conditions and norms. It also ensures inclusion of women, men and gender diverse people leading to an intersectional analysis which attempts to examine the consequences of interacting inequalities on people occupying different social locations as well as address the way specific acts and policies address the inequalities experienced by various groups.

Based on the outcome of the gender analysis and desk top review, a framework for improving women participation in engineering in the water sector was developed. Training and capacity building initiatives were developed to create an empowering space for women engineers in the water sector and act as an important incubator for ideas and strategies that can be transferred to mainstream interventions.

From onset, due to COVID-19 pandemic, the level of participation by invited institutions in responding to the questionnaires was expected to be below average. For example, in Kenya, 51 institutions were invited to participate and only 21 responded. In Uganda, 15 institutions responded while in Tanzania 10. The institutions were from different orientation including government departments, academic/research, consulting firms, private companies and accreditation/professional bodies. The responses were analysed using Macro tools written in VBA. The results were presented in percentages (institutional) to establish the status and per gender (of the respondents) to establish the root causes of disparity and the likely intersectionality which was guided by IDRC's Gender Based Analysis plus (GBA+).

Each country produced a Gender Analysis report of which are readily available. The reports were the foundational base upon which the gender capacity building (training) phase built upon. The training was a sequel to the gender analysis phase.

### 5.3.2 Activity 3.2 Capacity building

It useful to note that, the capacity building workshops came at time when most countries had eased out COVID-19 protocols. In this case, physical meetings were allowed and hence the consultants were advised to use the training sessions to fill in the data gaps that they had observed during the gender analysis phase. For example, in Uganda, the consultant took advantage of a national women's convening to slot in the training session from where she managed to get very valuable information of which she used to firm up her gender analysis report.

In each country, the gender analysis phase was followed by training sessions where participants had an opportunity to reflect upon the findings and outcome of the gender analysis. The gender analysis reports formed one of the inputs in the capacity building process. The Consultants were the main facilitators of these training sessions, with the main aim of the training session being to highlight gender knowledge and awareness of issues facing female engineers in a male dominated workplace and suggesting some solutions to these problems. The training workshop was also a good platform and opportunity to interact and network with stakeholders and seek partnerships with engineers in the water sector.

## 5.4 Objective 4. To share lessons from the project for scaling up successful strategies in engineering education and training in the water sector and networking with the industry

All partners of CAWESDEA project were to share lessons learnt and experience with respective stakeholders at different levels in each country. It is acknowledged that, in each country, there existed ongoing initiatives on sharing knowledge and capacity building. In this regard, CAWESDEA project proactively engaged such initiatives with the view of sharing lessons, experience, building partnerships and synergies.

### 5.4.1 Activity 4.1 Training interns on drafting journal manuscripts from project reports

One of the profound observations that was made by all national coordinators was the high quality of projects that the interns had designed and were implementing. Of course, this was as a result of effective supervision especially by the national facilitators who monitored very closely the progress of each intern. It is useful to note that, most of the interns had just graduated with BSc degrees and had not gone through the conventional vagaries of research to enable them draft meaningful journal manuscripts for potential publication in peer reviewed journals. However, the output of the projects prompted a change of plan where dedicated efforts were made to train the interns on how to write scientific papers so that they could generate the same from their reports. Nevertheless, it was realized that there was no budget allocation for the training session to enable the interns draft manuscripts from their project reports. In this case, a consultative process with the IDRC Senior Programme Specialists on reallocation of funds from other budget lines to augment the existing meager budget for publications was well received. Each country was allocated some supplemental resources, to host training session for the interns as seen in Figure 5.3.



**Figure 5.3: Interns training session on drafting journal papers**

The beauty of the whole set up is that the trainers were seasoned authors of journal papers and also part of the CAWESDEA project hence did not charge time compensation fees. They used the resources to hire venues as well as support the travel and incidental costs for the interns. In this way, the training workshops achieved their goals with minimum costs. Most of the write shop training covered two sessions e.g initial part where the interns were taken through the theoretical art of writing journal papers and the second being hands on training where the interns used their respective project reports to generate journal manuscripts. The interns were trained in a systematic way – starting with drafting an abstract, then introduction before dwelling on methodology and finally results, discussion and conclusion.

Through this training, all interns drafted a manuscript, some even two. Some interns even went further to submit their manuscripts to peer reviewed journals and two have already been published as indicated in subsequent sections of this report.

#### 5.4.2 Activity 4.2 IWA Special issue and publication of journal articles

It is on the realization that the manuscripts were of good quality that the project leadership thought it wise to come up with a special issue for the CAWESDEA project. On this note, the team contacted the IWA Water Practice and Technology, an open access journal, for an opportunity to publish the special issue. A call for papers was made (see Annex 1) where contributions from developing countries were allowed to contribute to the special issue; on and above the eighteen (18) manuscripts from the interns.

A total of 26 papers were submitted to the IWA special issue. Out of these, 18 papers were from the CAWESDEA project. The titles for the CAWESDEA papers and authors is as indicated in the Table 5.1. It interesting to note that a few of the interns managed to draft more than one papers – of which was very encouraging.

**Table 5.1: Papers submitted to the CAWESDEA special issue**

No.	Title of Paper	Authors	Status (published or in the process)
1	2D Flood Mapping of Msimbazi River Catchment, Dar es Salaam-TANZANIA.	1. Agnes Fataki 2. Subira Munishi 3. Victor Kongo	In the process
2	Development of an Operational Satellite Based Flood Monitoring Model for Tanzania.	1. Andrew Kimati 2. Subira Munishi 3. Victor Kongo	In the process
3	Determination of logistic deterioration models and rehabilitation strategy for urban water pipe distribution system in the developing world.	1. Rose Auma 2. Jotham Ivan Sempewo	In the process
4	Assessing water demand and availability under climate change by application of SWAT-WEAP in Mitano Catchment, South Western Uganda.	1. Trust Brenda 2. David Kataratambia 3. Martin D. Tumutungire 4. Jotham Ivan Sempewo	In the process

No.	Title of Paper	Authors	Status (published or in the process)
5	A multi-criteria approach to risk assessment of a cascade dam-break on the Victoria Nile.	1. Eyiiga Joel Martin 2. Jotham Ivan Sempewo	In the process
6	Design of hydraulic ram pumping system for small scale farmers: A case study of West Pokot County, Kenya.	1. O. J. Kisia 2. J. R. Kosgei 3. G. Nyandwaro 4. E. C. Kipkorir	In the process
7	Application of soil and water assessment tool (SWAT) to evaluate the impact of land use and climate variability on Kaptagat catchment river discharge.	1. J.Kibii 2. E. Kipkorir 3. J. Kosgei	Published
8	An Application for Guiding Operation, Maintenance, and Troubleshooting Water Pump Problems in Water Supply Projects in Tanzania.	1. Leah Marwa 2. Subira Munishi 3. Tulinave B. Mwamila	In the process
9	Landuse and climate change impact on drainage systems. A case study: Bwaise catchment.	i. Liliane Nampijja ii. Jotham Ivan Sempewo	In the process
10	Performance evaluation of CFSR, MERRA-2, and TRMM3B42 data sets in hydrological modeling of data scarce tropical catchments: a case of Manafwa, Uganda.	i. Nakkazi Maria Theresa ii. Jotham Ivan Sempewo iii. Martin Dahlin Tumutungire	Published
11	Impact of Climate Change on Flood Flow frequencies of Upper Mpanga River, Uganda.	i. Maviiri Balikuddembe ii. Abraham Ogenrwoth iii. Jimmy Byakatonda iv. Martin. D. Tumutungire v. Jotham Ivan Sempewo	In the process
12	Impacts of Climate and Land use/cover change on Mini-hydropower generation in River Kyambura watershed in South Western part of Uganda	i. Musa Aruho Tusingwiire ii. Martin D. T iii. Jotham I. S.	In the process
13	Estimation and Mapping of Water Quality Parameters using Satellite Images: a case study of Two Rivers Dam, Kenya	i. Alice Nureen Adhiambo Omondi ii. Job Rotich Kosgei iii. Victor Kongo iv. Ednah Jelagat Kembo v. Simon Mburu Njoroge	In the process



No.	Title of Paper	Authors	Status (published or in the process)
		vi. Achisa Cleophas vii. Emmanuel Chessum Kipkorir	
14	Purification of Waste Water from Septic Tanks using Slow Sand Filters for Reuse and Recycling	i. Paschal Leonard ii. Subira Munishi iii. Deus Masige	In the process
15	Real-time management of pressure in water distribution networks.	i. Dossaji, Aliasger ii. Munishi, Subira iii. Shagega Frank	In the process
16	Application of hydrogeological and landscape indices in mapping groundwater potential using geospatial techniques in Baringo County	i. Dolphine Teyo Ombasa ii. Job Rotich Kosgei	In the process
17	Application of the SWAT and WEAP Models for Integrated Water Resources Management of Kaptagat Catchment	i. Denis Mailu Kiamba ii. Job Rotich Kosgei	In the process
18	Impacts of land use and land cover change caused by urbanisation on the flood regime of msimbazi catchment.	i. Chrisogonous Kibugu ii. Subira Munishi iii. Victor Kongo	In the process

Before the idea of having a special issue materialized, some interns had already taken the initiative to publish their work with the support of country coordinators. A good example is the case of two interns from Kenya and Uganda who have already published their papers in different peer reviewed journals as indicated in Table 5.1 and narrated in Section 6.2.

Apart from drafting manuscripts, each intern prepared a Poster for his or her project of which were presented during the Project culmination workshop. The posters are publicly and readily available in the CAWEDSDEA project webpage i.e. ([www.gwptz.org/projects/cawesdea/](http://www.gwptz.org/projects/cawesdea/))

#### 5.4.3 Activity 4.3 Video clips for project

At the onset of the project, during pre-COVID era, mechanisms were already set to create a unique documentary for the whole project – mainly covering the experiences of interns when designing and or implementing their innovative projects. The idea was to document how each intern had internalized the Problem Based Learning (PBL) concept in their innovative projects.

With the new realm of COVID-19, the project leadership though of innovative ways of capturing the interns' experiences, in a different way, but still being able to showcase the impact of the internship programme to the individual interns.

Two approaches were used (i) an infographics video highlighting the objective and outcome of the project was prepared (ii) a video clip for each intern, as well as the respective national coordinators. All these video clips are available to the public through the CAWESDEA project webpage ([www.gwptz.org/projects/cawesdea/](http://www.gwptz.org/projects/cawesdea/))

Through the video clips, the interns gave testimonials on how the project had transformed their lives. For example, several interns managed to secure jobs after the internship programme, others managed to secure scholarships to undertake MSc degrees after programme. The most interesting part of the testimonials is where all of them appreciated the training they received on writing journal papers. Some of the interns narrated that they used to hear about scientific papers and were not even thinking that they could even submit a paper in a journal. These were humbling statements from the interns of which made the coordinators to appreciate even more the work they did in supporting the interns. As mentioned in previous sections, the interns had just graduated with BSc. in various engineering fields and hence, as is often the case at this level, were not exposed to the ingenious ways of writing scientific papers.

#### 5.4.4 Activity 4.4 Participation in national conferences and workshops

The tail end of the internship programme came at a time when most countries had relaxed COVID-19 protocols and hence the national coordinators managed to identify national forums that the interns could participate by presenting their work. In each country, there were different opportunities that the interns took advantage of. For example, the interns in Tanzania were facilitated to participate in more than 3 forums i.e (i) the Annual National Water Conference and (ii) University of Dar es Salaam Annual Research Week; 2020 and 2021. In Kenya and Uganda, similar opportunities were identified by the coordinators where the interns presented their work as well. Figure 5.4 shows some of the interns participating in national conferences.

During the 2020 Annual National Water Week in Tanzania, two of the CAWESDEA interns were funded by the convenors of the conference after a competitive process on assessing the quality of their work. During the conference, the two interns participated in a national competition of which one took the second position. Such an impressive performance by the interns showcased the quality of supervision by the national coordinator and commitment by the interns.

#### 5.4.5 Activity 4.5 Culmination workshop

The culmination workshop was the last activity in the project calendar. All the project activities of CAWESDEA were accomplished, in all countries, despite some delays that was caused by COVID 19 pandemic. Therefore, the culmination conference marked the completion of the main activities that were planned for CAWESDEA project. The culmination conference brought together all interns, national coordinators, and stakeholders (policy makers, development partners, CSO's, government departments and agencies, Engineering Registration Boards and Professional organizations) to share project results, outcomes, experience, lessons learnt etc in the process of implementing the project. Additionally, the workshop was meant to gather stakeholders' views on the project results, outcome and impact as one of the foundational steps for preparing Phase II of the project.

The project leadership also took advantage of the convening and arranged a special session for internal review for all journal manuscripts that were drafted by the interns. During one of the preparatory meetings prior to the conference, it was noted that there was a need for a dedicated internal review of all manuscripts by the national coordinators of CAWESDEA to improve their quality before submission to the special issue.



**Figure 5.4: Interns presenting their work in conferences**



The culmination conference took place 18-19 November 2021 in Dar es Salaam. The first day of the conference (18<sup>th</sup>) was dedicated for the internal review while 19<sup>th</sup> was earmarked for the high-profile stakeholder convening. During the internal review on the first day, the three national coordinators were supported by other four professionals to iteratively help each intern polish their respective manuscripts to have them in the required standards before submission to the journal.

The second day of the culmination conference was a high-profile event that was officiated by the Canadian High Commissioner in Tanzania, H.E Pamela O'Donnel. All interns from Kenya, Uganda and Tanzania had an opportunity to present their work to the Chief Guest and other dignitaries through a well-coordinated poster session. The posters are freely available in the project webpage ([www.gwptz.org/projects/cawesdea/](http://www.gwptz.org/projects/cawesdea/)) The PI also made a presentation on the trajectory pathway of the CAWESDEA project, impact, lessons learnt and experience thereof. The presentations by the interns showcased the depth of understanding and above all how they had internalized their work in the context of PBL. As part of appreciating the commitment and hard work by the interns, the project leadership organized for Certificates of Appreciation for each intern of which were presented by the Chief Guest. Figure 5.5 shows a glimpse of the activities that took place during the culmination conference.

Some of the key lessons that were shared during the conference by the project PI especially on managing internship programmes include:

- i) There is a need to establish a multi-disciplinary approach in implementing future internship programmes where teams of interns, of different engineering disciplines, join hands to deliver a life transforming project. Such an approach mimics a real-life situation on solving a real challenge on the ground where different teams join hands to undertake a common project.
- ii) There is a need to clearly disconnect internship programmes from academic programmes. This was evident due to the fact that the prime motivation of students under academic programme is always achieving high marks and grades while those who pursue internship programs are driven by need to access skills and knowledge. From CAWESDEA experience, the two programmes cannot be undertaken at the same time but can run in sequence.
- iii) It was also noted that Universities have realized the importance of incorporating input from the private sector in their teaching and delivery. Through the CAWESDEA project, the partner Universities managed to enhance their partnership with the private sector of which has continued to thrive.
- iv) The internship part of the CAWESDEA project came at the onset of COVID-19 pandemic. This affected the delivery of the internship program after most of the host institutions closed their activities. This prompted the project coordination team to align and adapt innovative ways of supporting the interns. Virtual communication platforms were established, with a weekly reporting schedule where all interns were required to submit a simple one-page update report, through a Project WhatsApp group, on their well-being as well as progress made. In this case, the project coordination team had to be innovative in adapting to prevailing conditions. This calls for the need to have plan “B” at any time



**Figure 5.5: CAWESDEA Project Culmination Workshop**

#### 5.4.6 Activity 4.6 CAWESDEA webpage – a repository for all project materials

The project leadership decided to create a dedicated webpage for CAWESDEA project for two main reasons (i) as a repository for all project materials that can easily be accessed by the project team (ii) as platform for sharing project outputs and narratives to the world.

The webpage has a detailed narrative of the project, starting with a video clip on the project, background information on CAWESDEA, contacts of all interns, video testimonials from coordinators and interns, project summaries and posters as well as uploads of all published articles including journal papers. The URL for project webpage is [www.gwptz.org/projects/cawesdea/](http://www.gwptz.org/projects/cawesdea/)

## 6.0 Project Outputs

### 6.1 Special issue – Water Practice and Technology

As alluded in Section 5.4.2, the CAWESDEA project managed to establish a Special Issue in one of the open access International Water Association (IWA) journals; the Water Practice and Technology. The Guest Editors of the Special Issue were the CAWESDEA PI and national project coordinators. A total of 26 manuscripts were submitted to the special issue, out of which 18 were from CAWESDEA project.

The special issue was scheduled to be ready by end of February 2022, but the review process took rather long than expected. So far, 8 manuscripts have gone through the full cycle of review and the authors are at the final stage of addressing the reviewers' comments. The main challenge was on getting reviewers to review the manuscripts on time. However, this has been addressed through a concerted efforts by the Guest Editors to bring enlist more reviewers. It is expected that the Special Issue will be published by end of 2<sup>nd</sup> Quarter of 2022.

### 6.2 Paper publications

As of end of February 2022, two journal papers were already published through CAWESDEA project. These papers are derivatives of innovative projects by some of the interns i.e:

*Kibii, J.K.; Kipkorir, E.C.; Kosgei, J.R. 2021. Application of Soil and Water Assessment Tool (SWAT) to Evaluate the Impact of Land Use and Climate Variability on the Kaptagat Catchment River Discharge. Sustainability 2021, 13, 1802. <https://doi.org/10.3390/su13041802>*

*Nakkazi M.T.; Sempewo J. I.; Tumutungire M.D.; Byakatonda J. 2022. Performance evaluation of CFSR, MERRA-2 and TRMM3B42 data sets in simulating river discharge of data-scarce tropical catchments: a case study of Manafwa, Uganda. Journal of Water and Climate Change Vol 13 No 2, 522 doi: 10.2166/wcc.2021.174.*

As a norm, all papers duly acknowledged the respective contribution and support from different sources notably CAWESDEA project, the host institutions as well as IDRC.

### 6.3 Reports

While implementing the CAWESDEA project, the following reports were generated:

Situation analysis

- i) Country Situation Analysis Report for Kenya- Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa (CAWESDEA)
- ii) Tanzania Situation Analysis Report - Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa (CAWESDEA)



- iii) Situation Analysis Report for Uganda - Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa (CAWESDEA)

#### Gender Analysis

- i) Gender Analysis on the Current Situation and Position of Female Engineers in the Water Sector in Kenya.
- ii) Gender Analysis Report – Positioning of Women Engineers in the Water Sector in Uganda
- iii) Gender Analysis on the Current Situation and Position of Female Engineers in the Water Sector and Potential Impact of Problem Based Learning Approach (PBL) on the Situation in Tanzania

### 6.4 Posters

Apart from drafting journal manuscripts, each intern prepared a poster for his or her project. A total of 18 posters were prepared and are freely accessible in the project webpage. Figure 6.1 shows a sample of some of the posters that were prepared.

### 6.5 Workshop reports

The following workshop reports are available:

- i) Inception and induction workshop report
- ii) Project culmination report

All the above reports are readily available in the project webpage.

## 7.0 Project Outcomes

### 7.1 Scaling up

There are different opportunities that the project supported or aligned with in the process of scaling up. These opportunities varied but they all added up to adding value to the wider impact of the project.

- **Kenya** - The government of Kenya has 'picked up' the internship issue with new national programs targeting fresh graduates from all disciplines. This is an excellent alignment for project lessons to be taken up.
  - Moi University - the CAWESDEA project added impetus to the establishment of an Incubation Centre that hosts different disciplines. The Centre has since developed partnership with other projects, at the University level, as well as other partners.
- **Tanzania** – The Engineers Registration Board (ERB) has always required supervised work experience to increase chances for graduate engineers to get registered as professional engineers. ERB has a similar placement programme but has had limited resources and internship spaces. In this case, the CAWESDEA internship programme provided an opportunity for increasing the domain for more interns to have supervised experience.
  - University of Dar es Salaam is rethinking its curriculum and considering using the last 6 months of student's academic calendar as attachment to Industry using their current university stipends. However, there could be challenges with this model - as it is still within the examination framework and the students might just focus on marks rather than acquiring experience and hence reverting back to box-ticking. As alluded in previous sections, the best framework for an effective internship programme is when the motive and focus of the interns is anchored on acquiring skills rather than marks.

Global Water Partnership Tanzania has made an affirmative decision that all its future projects, starting from 2022 onwards, will be designed in such a way to have an internship and mentorship component so as to provide opportunities for fresh graduates to learn from senior peers. This decision has already been implemented in two of its

ongoing projects. This is a policy decision that has its roots on the lessons learnt as well as reflection on the cumulative impact of the CAWESDEA project.

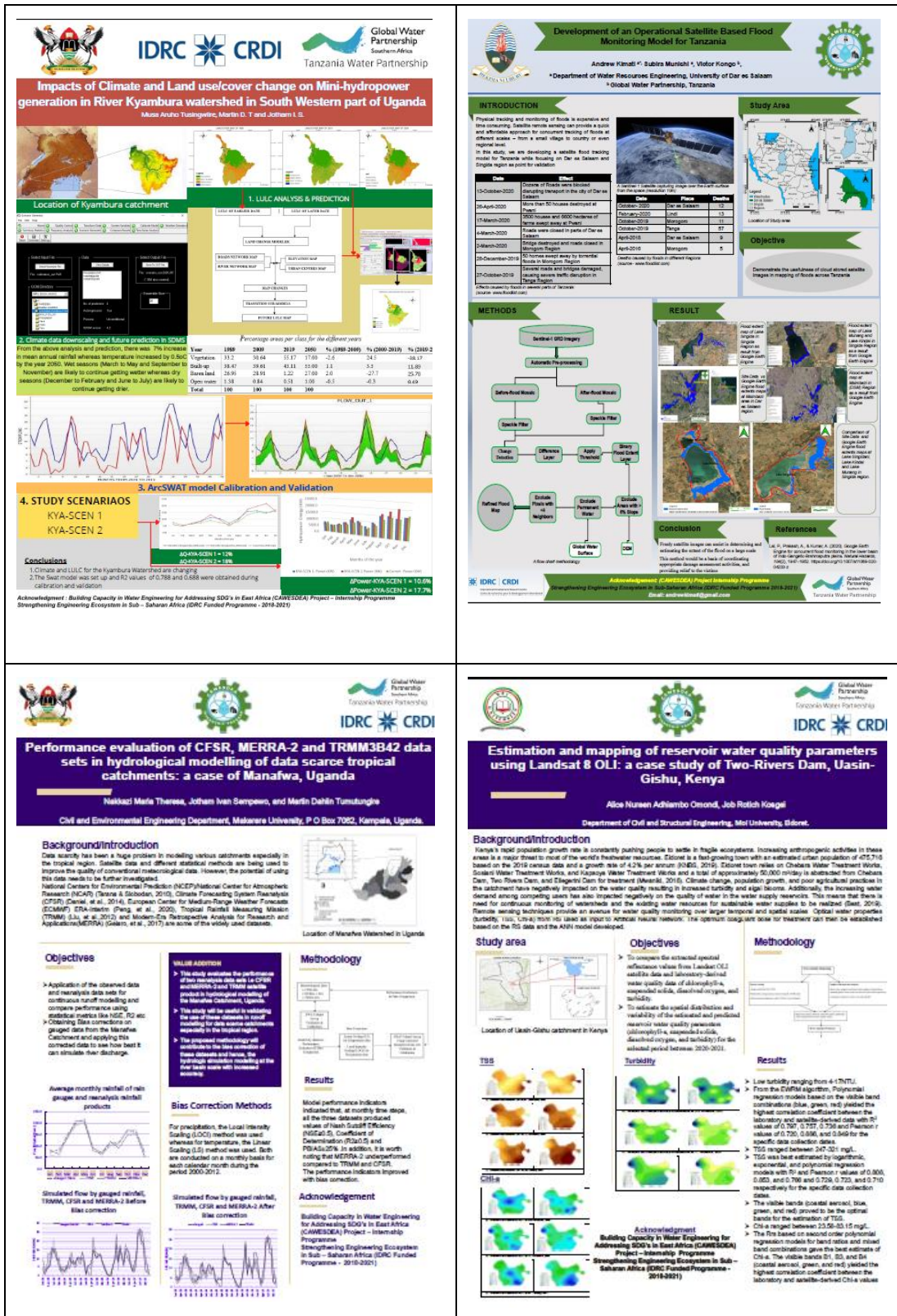


Figure 7.1: Examples of CAWESDEA posters

- **Uganda** – great partnership between the University and Private sector has ensued. Many of the interns who participated in the CAWESDEA are now employed in the private sector and even some have started their own business initiatives in form of companies.

## 7.2 Establishment of community of practice

The CAWESDEA project managed to bring together engineering professionals and fresh graduates in different levels and spheres where mutual learning and interaction took place. At the onset, the interns had minimal confidence and to some extent lacked interaction skills with peers and or senior professional. However, as the project progressed, various avenues for interaction among the interns emerged as well as between the interns and their supervisors.

During the peak of COVID pandemic (2020-2021), the leadership of the project instituted an effective communication framework within the team using online tools as well as social media platforms. It made it easier to reach out to all project team members at the same time in all countries. This enhanced communication amongst the interns of which has continued to date.

The interaction between the interns and supervisors was more intense during the process of drafting journal manuscripts. It became evident that the interns needed the attention and input of their coordinators and supervisors even more while the later were inspired by the desire to publish papers. This created a conducive platform for intensive engagement of which enhanced the confidence of the interns as well imparted the sense of being peers or colleagues with the supervisors. The net effect of this process was the establishment of a peer mechanism through which a community of practice was intuitively established.

## 7.3 Actualization of the Triple Helix Concept

Most often, internship programmes have been managed through single institutional set up where only one organization takes full ownership in their implementation. It is appreciated that inherent institutional challenges may necessitate such an approach. However, such frameworks does not provide for a wider spectrum of learning to the interns due to the fact that they lack cross-fertilization from other organizations in the form of sharing experience, working culture as well as exposure to different skill and mindsets.

The CAWESDEA project was founded on the precincts of Triple Helix concept where three key partners played a key role in nurturing and shaping the project – especially the interns. The partners were (i) Global Water Partnership Tanzania, of which can be categorized as a Think-Tank Civil Society Organization with proven working culture that is focused on delivery (ii) Universities that are known for offering academic programmes and (iii) Private firms with a leading role in highlighting market requirements. The Triple Helix approach made it easier for cross learning among partners while appreciating the strengths of each partner. It was evident that the interns appreciated being in such an environment where multiple forms of strengths were available for them to leverage and scale into their destiny. It is through the Triple Helix approach that fresh engineering graduates were able to undertake a detailed analytical project and had the opportunity to be motivated to write a scientific paper – something that is often reserved for those who scale to postgraduate level.

## 8.0 Overall Assessment and Recommendations

Despite the obvious disruptions that were brought about by the COVID pandemic, the CAWESDEA project managed to pull through the turbulence and delivered as per expectations. During one of internal team reflection sessions, it was evident that there were two main components in the project i.e (i) research and (ii) outreach. The project delivered beyond expectations on the research front – already with two publications and a special issue (IWA Water Practice and Technology) being on the pipeline.

On the outreach front, the project managed to reach out and bring together different stakeholders, at different levels. The project managed to impact both the project partners, leading to policy decisions, as well as boundary partners - commonly referred to as stakeholders. A good example is the blending of the CAWESDEA project with the national internship programme in Kenya as well as the SEAP programme in Tanzania. These were great opportunities of which the project built upon from the beginning with the objective share lessons learnt with similar capacity building endeavors at national scale.

Case studies on capacity building endeavours especially internship programmes have highlighted the need for concerted efforts and input by different partners. This was also established in CAWESDEA where the Triple Helix framework provided a good platform for delivering above expectations. It is on this note that we recommend that future internship programmes be founded on the Triple Helix concept where multiple partners bring together their inherent strengths in designing and delivery of such endeavours.

It was evident that Universities have realized the need to change and deliver their academic programmes differently. This is a result of growing interaction with the market; with the latter being always ahead of as far technological innovation is concerned. The main challenge that has always hindered Universities from catching up with market needs is the curriculum. During the project cycle, it was acknowledged that the institutional structures at universities does not provide for desired flexibility in changing curriculums to align with market demands. This has led to some academic programmes lagging the technological advancements in the market. However, to circumvent the rather rigid curriculum issue, the universities were applying different Pedagogy approaches including PBL where students were being aligned to learning as they addressed real life problems. Through the CAWESDEA project, it was evident that the PBL approach can be more effective if implemented in the context of Triple Helix concept as discussed in previous sections.



## Annexes

### Annex 1: Special Issue – call for papers

#### Water Practice and Technology Special Issue

on

Water and environmental solutions for adaptation to global change pressures in developing countries.

#### CALL FOR PAPERS

Sustainable Development Goal (SDG) 6, 7, 11, and 13 of the United Nations aim to increase access to safe water and sanitation, affordable and sustainable energy, mitigating impacts to climate change, and making cities sustainable. However, the little progress made particularly in developing countries is being outstripped by increasing global change pressures such as urbanisation, climate change, and anthropogenic changes. This has brought into focus the urgent need for innovative approaches, analyses, models, and solutions that are tailored to the unique conditions that often exist in developing countries as a way of understanding and accelerating progress towards the achievement of the aforementioned SDG targets. In addition to this capacity building and training should be an essential part of the innovations and solution development process. To deal with some of the aforementioned challenges, the IDRC funded project titled *Building Capacity in Water Engineering for Addressing Sustainable Development Goals in East Africa (CAWESDEA)* has contributed towards finding practical solutions to the Water Resources Engineering and management in collaboration with the industry to accelerate progress towards achieving SDGs.

Accordingly, the CAWESDEA project would like to promote a Special Issue of the journal of **Water Practice and Technology**, by inviting all participants of the CAWASDEA Project as well as other Water and Environmental Practitioners globally to present research output on innovative water and environmental approaches, analyses, models, and solutions that are tailored to the adaptation to global change pressures as well as the unique challenges that often exist in developing countries. All these are aimed at improved quantification and subsequent holistic management for accelerating progress towards achieving SDG targets 6, 7, 11, and 13.

#### Relevant topics include:

- Water Infrastructure and Asset Management
- Impact of global change pressures and prediction of hydrologic processes and water resources
- Water technologies
- Catchment and surface Hydrology
- Hydrological Extremes-Prediction , Impact Assessments, and Monitoring
- Flood Hazard Modeling and vulnerability mapping
- Water quality modeling monitoring and relationships with global change pressures
- Groundwater, Irrigation and Drainage management
- Integrated Water Resources Management
- Hydropower Dam and Reservoir Sedimentation
- Water and Environmental sustainability
- Socio-economic impacts, Gender mainstreaming , Capacity Building, Institutions and Governance



**Key dates:**

- Deadline for manuscript submission: 30 October, 2021
- Expected publication: February, 2022.

**Editors:**

- Dr. Victor Kongo, Global Water Partnership, Dar-es-Salaam Tanzania
- Dr. Eng. Jotham Ivan Sempewo, Makerere University , Kampala, Uganda
- Dr. Job Kosgei, Moi University , Eldoret, Kenya
- Dr. Subira Munishi, University of Dar-es-Salaam, Dar-es-Salaam, Tanzania

**How to submit:**

Please make sure that your paper follows the [Instructions to Authors](#), before submitting your paper directly to Water Practice and Technology's peer review system: <http://www.editorialmanager.com/wpt/default.aspx> choosing the article type – 'Special Issue Article OA' and the submission category – 'Special Issue: CAWESDEA 2021'. This will send your paper to one of the Guest Editors.