JRC TECHNICAL REPORTS

The African Networks of Centres of Excellence on Water Sciences Phase II (ACE WATER 2)

Human Capacity Development activities outcomes

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CONTENTS

EXECUTIVE SUMMARY

The demand for Human Capacity Development (HCD) in the water sector is defined by the role that water plays in Africa's ambitions for socio-economic development. In this regard, the African Union Agenda 2063 *(The Africa We Want)* identifies water security as a key priority area, whereas the Africa Water Vision 2025 highlights the necessity to improve water wisdom in order to overcome capacity constraints in the sector. According to studies from early in the previous decade, Africa had only '*35 scientists and engineers per million inhabitants, compared with 168 for Brazil, 2,457 for Europe and 4,103 for the United States*[1]. This major human resources capacity challenge remains a critical factor in the development, growth and sustainable life for most African countries. In 2014, the International Water Association launched an unusual study, the first of its kind, in an attempt to quantify WASH human resource capacity gaps in 15 developing economies, ten of which were in Africa. The results were telling: 'In ten countries reviewed in the second phase of the study there was a cumulative shortfall of 787,200 trained water and sanitation professionals in order to reach universal coverage' with an average of only 16.7% of the workforce in the 15 countries reported to be female professionals[2]'. Following analyses of numerous country water sectors performed by the West African and Southern African members of the AUDA-NEPAD Network of Water Centres of Excellence (CoEs), it was identified that a critical skills and needs gap existed among professionals, qualified technicians and management in the water sector.

This prompted the African Ministers Council for Water Executive Committee (AMCOW EXCO) in 2013 to direct the AMCOW Secretariat to work with the African Union Commission and AUDA-NEPAD Water Centres of Excellence to develop a Human Capacity Development (HCD) Programme aimed at addressing junior and senior professional and technician level capacity challenges in the water sector. The result was the HCD component of the ACEWATER II project supported by the European Commission DG Joint Research Centre (JRC) and the UNESCO Intergovernmental Hydrological Programme (IHP) to the Centres of Excellence in the implementation of the Project

This review documents the implementation of the Human Capacity Development (HCD) component of the ACEWATER II Project; starting with a sector-wide analysis across a broad spectrum of previous studies and projects, stakeholder and key water sector actors and an ownership process of Government and sector actors in the design and implementation of National HCD Frameworks. National case studies and profiles of project Partner Countries are compiled by the CoEs, supported by detailed data collection from Monitoring and Evaluation and an Impact Study. The results present both a photograph of the current Capacity Skills and Gaps in both the Water Sector and Educational Institutions, as well as the results of piloting the implementation of the National HCD Frameworks in a number of African countries. In the face of the COVID-19 outbreak worldwide, the project partners were able to re-orient the activities of the project to still obtain measurable results; a testimony to both the innovation and flexibility of all Partners and the resilience of the AUDA-NEPAD Centres of Excellence to the unexpected stress test of the COVID-19 pandemic. Conclusions and recommendations are presented from the national level by the CoEs, Regional actors and by the coordination partnership of UNESCO-IHP, the JRC and AUDA-NEPAD Centres of Excellence.

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[1] AfDB (African Development Bank), News and Events Newsletter, July 25, 2013.
[2] IWA (International Water Association) Executive Summary, An Avoidable Crisis WASH Human Resource Capacity Gaps in15 Developing Economies

BACKGROUND

It has been over 20 years, in September 2000, when African countries and the international community adopted the Millennium Development Goals at the United Nations Millennium Summit pledging to 'halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation'. This meant that for a number of years, there was an influx of money for water and sanitation infrastructure, technological innovation, improved management and administration systems and other policy and institutional reforms. However, what did not happen, was a focus for the provision of people to do the actual work. Studies at the time, showed that Africa had only '*35 scientists and engineers per million inhabitants, compared with 168 for Brazil, 2,457 for Europe and 4,103 for the United States*[3]'. This major human resource capacity challenge remains a critical factor in the development, growth and sustainable life for most African countries.

With African students mostly opting to study economics, business, law and social sciences rather than science, engineering and technology, a skills mismatch and concomitant human resources capacity gaps emerge. To the extent that every sector of the economy is influenced by water, the realisation of sustained economic growth and social transformation is dependent on ensuring water security. According to the UN, water security entails '*to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability*[4]'.

The UNESCO-coordinated World Water Development Report of 2016 was one of the first in-depth evaluations of this relationship noting, '*Water and Jobs are inextricably linked on various levels, whether we look at them from an economic, environmental or social perspective. The report estimates that well over one billion jobs, representing more than 40% of the world's total active workforce, are heavily water-dependent. Such jobs are found in agriculture, forestry, inland fisheries, mining and resource extraction, power generation and water supply and sanitation, as well as in several manufacturing and transformation industries including food, pharmaceuticals and textiles*[5]'.

Accompanying this growing awareness of the important role of water in economic development was a number of initiatives to address aspects such as sector finance and infrastructure in order to build up sustainable water sectors in partner countries and developing economies. However, after decades of this approach, another challenge became increasingly evident; gaps in skills and human capacity to implement many of the activities and changes required to run and maintain a healthy water sector, compounded by insufficient training and inappropriate curricula in training and education institutions. In 2014, the International Water Association launched an unusual study, the first of its kind, in an attempt to quantify WASH human resource capacity gaps in 15 developing economies, ten of which were in Africa. The results were telling: 'In ten countries reviewed in the second phase of the study there was a cumulative shortfall of 787,200 trained water and sanitation professionals in order to reach universal coverage' with an average of only 16.7% of the workforce in the 15 countries reported to be female professionals[6]'.

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[3] AfDB (African Development Bank), <u>News and Events Newsletter</u>, July 25, 2013.

[4] UN (2013). What is Water Security? Infographic. Retrieved July 20, 2018, from UN Water
    Publications: http://www.unwater.org/
publications/water-security-infographic/

[5] WWAP (United Nations World Water Assessment Programme). 2016. <u>The United Nations World Water Development Report 2016: Water and Jobs.</u> Paris, UNESCO.

[6] IWA (International Water Association) Executive Summary, An Avoidable Crisis WASH
    Human Resource Capacity Gaps in15 Developing Economies

ACEWATER I

In 2006, AMCOW (African Ministers Council for Water), passed a resolution that initiated a process to support the establishment of African Networks of Water Centres of Excellence, thus the birth of the Africa Centres of Excellence in Water Sciences (ACEWATER I) project. Over the past ten years, the ACEWATER project has been implemented in two phases, with ACEWATER I implemented between 2009 and 2014, and ACEWATER II implemented between 2016 and 2020. It was through the EU funding, that two initial networks of CoEs were established in West Africa (WANWATCE) and Southern Africa (SANWATCE) in 2008. Later, in 2016, an AU/NEPAD Network of CoEs was established in Central/East Africa (CEANWATCE) as part of ACEWATER II.

In the 2013 AMCOW EXCO met in Cairo, and noted the growing human resources shortages to achieve the water and sanitation development goals in Africa. They directed the AMCOW Secretariat to work with the African Union Commission and AU-NEPAD Water Centres of Excellence to develop a Human Capacity Development Programme aimed at addressing junior professional and technician level capacity challenges in the water sector. This set the scene for the design and implementation of the ACEWATER II project and the Human Capacity Development activities.

Following the analyses of numerous country water sectors performed by the West- and Southern African members of the Network of Water Centres of Excellence, it identified as critical, the gap among professionals, qualified technicians and management in the water sector. This included observations that the most experienced professionals are retiring or otherwise leaving the sector and are not being immediately replaced by persons with either the requisite training or a middle range of experience, partly due to the fact that there has not been a constant and consistent maintenance of professional, technical and management capacity within the sector for a number of years. Consequently, the newly-engaged young professionals and technicians who received standard education and entry-level training did not have the required experience or specialist training for them to function effectively in this middle-management and service provision area. With the steady departure of the older experienced professionals, this gap was growing year by year.

While this sector gaps in Africa were identified as being continental in scale, it is clear that its characteristics vary from region to region for reasons which are geographical and demographic as well as human-capacity related. Challenges pertaining to the education and training of water technicians and professionals was clearly exacerbated by both the mismatch of existing curricula in the higher (HEIs) and technical (TVET)[7] education sectors and the practice in many countries of merely supplying skilled labour to the industrial sector without responding effectively to the needs of sustainable development strategies. The links between TVET and the water sector has remained unexploited and unexplored for decades and the human resources gaps on all levels have continued to intensify.

To ensure the buy-in of all stakeholders, the strategies developed would be validated in each country, in relation with the different components of the sector. The set of national strategies, once validated, would serve as a basis for the development of a sub-regional strategy and will concern the different areas of the network of Centres of Excellence (West, Southern and Central-East Africa).

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[7]

https://documentcloud.adobe.com/gsuiteintegration/index.html?state=%7B%22ids%22%3A%5B%2212c0uitUFKu4_n0xmZkZ-tOQmAjtmwdZ8%22%5D%2C%22action%22%3A%22open%22%2C%22userId%22%3A%2210128469344947803270%22%2C%22resourceKeys%22%3A%7B%7D%7D

United Nations Educational, Scientific and Cultural Organization, Status of TVET in the SADC Region, UNESCO, Paris, France, 2013

ACEWATER II

As with ACEWATER I, the ACEWATER II project activities are funded by the European Commission DG DEVCO (Directorate General for Development Cooperation) now under the appellation of DG INTPA (Directorate General for International Partnerships). The ACEWATER II HCD activities are implemented with the HCD expertise of the UNESCO-IHP (Intergovernmental Hydrological Programme) in partnership with the DG JRC (Directorate General Joint Research Centre) and the AU-NEPAD African Network of Water Centres of Excellence.

The project engages with 15 AUDA-NEPAD[8] CoEs within the HCD component of the project. The project partners contributed towards HCDs in Africa's water sector with specific process-oriented activities which are located in regions of Africa corresponding to the Regional Economic Community (RECs) member states[9].

During ACEWATER II, the objectives included, *inter alia,* to support the development of national water-related human resources capacity building strategies. The project focused on fostering sustainable capacity development in the water sector at the scientific, technical and institutional levels, specially addressing the capacity challenges of junior professionals and technicians. It did this through the support and facilitation of data-sharing, technology transfer and human capacity development to ensure that sustainable access to water and sanitation services can be provided throughout the African continent.

The ACEWATER II project partners are:

CEANWATCE (Central and East Africa Water Centres of Excellence)

- University of Khartoum's (U of K) Water Research Centre (WRC) in Sudan - Secretariat
- University of Addis Ababa's Ethiopian Institute of Water Resources (EIWR) in Ethiopia
- IGAD Climate Protection and Application Centre (ICPAC) in Kenya
- Makerere University (Mak) in Uganda

WANWATCE (West Africa Network of Centres of Excellence)

- L'Université Cheikh-Anta-Diop (UCAD) in Senegal - Secretariat -
- Kwame Nkrumah University of Science and Technology (KNUST) in Ghana,
- National Water Resources Institute (NWRI) in Nigeria
- University of Benin (UNIBEN) in Nigeria

SANWATCE (Southern Africa Network of Water Centres of Excellence)

- Stellenbosch University (SU) in South Africa - Secretariat
- University of the Western Cape (UWC) in South Africa
- Council for Scientific and Industrial Research (CSIR) in South Africa
- University of Botswana (UB) in Botswana
- National University of Science and Technology's International Centre for Water Economics and Governance in Africa (IWEGA) in Mozambique,
- University of Malawi (UNIMA) in Malawi,

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[8]African Union - New Partnership for Africa's Development

9 The Regional Economic Communities (RECs) of the African Union - https://www.un.org/en/africa/osaa/peace/recs.shtml

- University of Zambia (UNZA) in Zambia

ACEWATER II hinged on:

1. Facilitating high-end scientific research in the water and related sectors, to provide effective scientific and educational support to governments. This was streamlined through establishing common sector priorities for higher education institutions at regional level, where the CoEs played a key role in supporting the ongoing efforts of the African Ministers' Council on Water (AMCOW) to implement their Human Capacity Development Programme (HCDP).
2. Strengthening human capacity development activities at the regional and local levels by, *inter alia,* maintaining strong links and relationships with relevant policy- and decision makers in the water sector, such as the regional economic communities (RECs), river basin organisations (RBOs), and national technical services.
3. Working through the CoEs that have identified human capacity gaps and priorities in the water sector through a multi-stakeholder participatory approach where all levels of government(s) and a wide range of stakeholders were involved. These stakeholders included technical and managerial level groups, education and training institutions and research bodies.
4. Developing an operational framework and designing and implementing training programmes for a minimum of 1,200 students at post-graduate and technical levels, tailor-made to fill the identified human capacity gaps and ensure increased access to water-sector related training and research at regional levels.
5. Adapting and acknowledging the impact of the COVID-19 pandemic on the implementation of the ACEWATER II project and the concomitant redesigning of the modes of intervention. The full impact of the pandemic was ascertained through a risk analysis of a random sample of the institutions. The redesigned modes of intervention then focused on distance learning, e-learning and webinars.

THE HUMAN CAPACITY DEVELOPMENT PROCESS

The objective of the ACEWATER II project was to develop a national framework to address the human capacity gaps and needs in the water sectors of the participating CoEs, mainly addressing junior and senior professionals at higher education (HE) level and technicians at technical and vocational education and training (TVET) level.

The objectives were achieved within a process of three main steps:

1. A wide-reaching Sector-Wide Analysis with desk studies, questionnaires and interviews;
2. Consultations with key sector institutions (government and educational) and stakeholders and drafting an HCD Framework; and
3. Establishing a priority list of skills gaps and needs for HCD in the form of a National HCD Framework, validated by all stakeholders in a National Workshop, including an implementation plan to focus on agreed-upon HCD priorities.

The phases of implementation of the National HCD Frameworks included the following activities:

4. Design and present Pilot Courses / Training addressing the selected HCD priorities; and
5. Exchanges of staff and students between CoEs.

Results of both the Sector-Wide Analysis and the HCD Framework implementation were followed closely with a specifically designed **Monitoring and Evaluation (M&E) Framework** for tracking the progress of the HCD Frameworks and facilitate analysis. This was supplemented by a separate **Impact Study** which looked at the wider scope of the ACEWATER activities. These steps are described in more detail below.

Sector-Wide Analyses

All the institutional partners followed a process that was systematically implemented in a phased manner, starting with a review of the current status at country level, to establish the existing human capacity gaps and needs. It was consisted of various steps with a mixture of methods:

Desk review of documents and literature

The available literature/documents relevant to the consultancy assignment on the water sector were reviewed including water policy and strategy, institutional set up and human capacity gaps. This also included looking at the education and training institutions at different levels (universities, research centres, technical universities and centres, vocational training institutions, etc.) and the curricula on offer. Other documents covered the general conditions of the water sector, human capacity status and challenges. For the desk study, the participating institutions used all or a combination of the following methods (sources of data) to obtain information.

1. Review relevant Sector-wide government plans, policies and strategies water sector instruments to identify existing provisions on human capacity development.

2. Identify, review and summarise previous water sector studies which address aspects of HCD, or any reports of project which included HCD activities such as needs assessments or capacity building.

3. Conduct a stakeholder analysis to identify key actors and any existing HCD initiatives followed, where possible, with stakeholder interviews.

4. Surveys and questionnaires distributed or shared out to Government and training institutions and sector stakeholders including NGOs and private sector actors.

HCD Framework Development

Consultations

Visits and interviews were organised with senior officials of key water resources institutions, universities, water research centres, training institutions (professional and technicians training), UN organisation representatives, as well as NGOs and stakeholders from the private sector. The questions raised focused on capacity building gaps at junior professionals and technician levels, capacity building programmes and initiatives that exist or are in the pipeline as well as the capacity building challenges facing these institutions.

Following the data collection from desk studies, surveys and questionnaire, priorities were identified and assembled into a draft HCD Framework of technical and professional human capacities skills gaps and needs in the water sector.

Many of the CoEs convened national meetings to discuss the first findings of the desk study and solicited the input of key stakeholders. The inputs were integrated into the desk study results, and the CoEs produced a draft National HCD Framework, proposing an implementation framework to be supported by M&E of the implementation. The draft frameworks were then presented at national validation workshops in which the National HCD Frameworks were validated by all key stakeholders, including government institutions.

National HCD Frameworks

The validation workshops were organised essentially to present the draft National HCD Frameworks of the first findings with the objective to discuss final adjustments to the Framework and obtain validation. More specifically, the workshops aimed to:

1. Review the initial long list of identified HCD needs and define a short list of priorities to be implemented as pilot courses; and

2. Establish buy-in of the validated National HCD Framework by the stakeholders, especially from Government.

Generally, the validation workshops emerged with some key recommendations which included the following:

- Well planned delivery of short-term tailored training courses in various professional areas in the water sector at HE and TVET levels, including water resources assessment and planning, water resources modelling, Computer-aided Design (CAD) in water resources design, water resources development projects management, geo-spatial analysis, irrigation system performance monitoring, water quality management, project management, etc.

- Launching water-related technical training courses in the existing technical, vocational, education and training institutes and expanding more for the same.

Design and presentation of pilot courses/training addressing selected HCD priorities

Following validation, the CoEs commenced with implementation of the National HCD Frameworks. This activity consisted of: dissemination of the Frameworks to stakeholders, donors and training institutions at national level; designing and implementing new courses addressing junior professional and technician level capacity for HCD priorities established in the validation of the Frameworks; and implementing the courses for junior professionals and technicians.

The ACEWATER II project provided funding for CoEs to support Pilot Courses and for the purchasing of materials and equipment for training purposes, including for laboratory and field work and training.

Staff and student exchange programme

An exchange programme between staff and students of the CoEs was intended to strengthen the network with sharing of knowledge and expertise among staff for joint research and even developing joint course curriculum. The exchange programme aimed to enlarge learning opportunities for students at graduate level. Staff exchanges would focus mainly on the staff from the CoEs but could be extended, as appropriate and relevant, to water sector institutions in the network countries, particularly to partner institutions. As a result of COVID-19 this component did not take place.

First Results Summary

From the CoE reporting, during the development of the HCD Frameworks a total of 78 priorities were identified by the Centres of Excellence in countries in Central-East, West and Southern Africa.

The Figure 1 below shows the top three priorities per region and their degree of importance. Some of the priorities identified, such as Water Supply and Water Quality, are common to all regions. Regional trends can be identified: for instance, Water Supply is a higher percentage priority in West Africa and Management and Administration is a main priority only in Central-East Africa.

Central-East Africa
- Water supply - 23%
- Management & Admin - 23%
- Water quality - 16%

West Africa
- Water supply - 26%
- Water quality - 26%
- Groundwater - 16%

Southern Africa
- IWRM - 26%
- Water supply - 22%
- Water quality - 22%
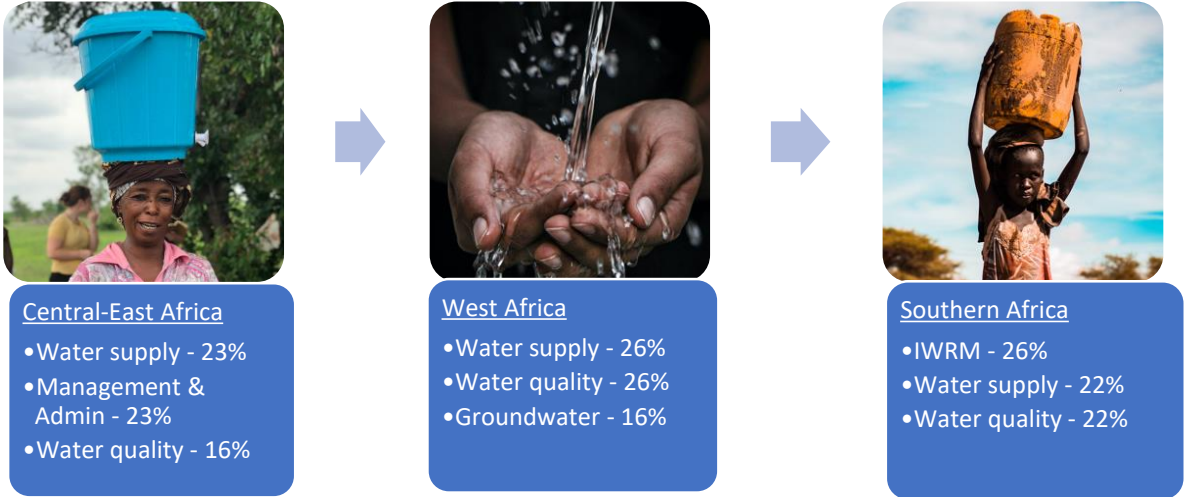
Figure 1: Top three priorities per region

Onset and Impact of COVID-19

The outbreak of COVID in March and April 2020 occurred almost simultaneously with the planned implementation of many of the HCD Frameworks by the CoEs. Due to COVID-19 and lockdown worldwide, it became clear that it would be extremely difficult for the CoEs and UNESCO to implement the HCD Pilot Courses as per the usual modalities of face-to-face, classroom lectures, lab sessions and field work. Lockdowns almost immediately limited the possibilities of staff and students to attend training and/or implement any fieldwork. As lockdown measures became more rigorous, staff from universities and training institutions were required to work from home, meaning that the institution effectively closed for normal training and classes. On a country-by-country basis, these measures were often accompanied by restrictions and complete travel bans between countries, except for returning citizens. This also ensured that staff and student exchanges could not proceed.

Consequently, the ACEWATER II project was confronted with the necessity of re-orienting project activities and explore the possibilities of alternative modalities such as digitalisation

of course materials, on-line, distance and e-learning, with resources such as coaching, training, material and other resources. In order to have a more effective re-orientation, it was necessary to evaluate the size and scope of the challenge. This was achieved with the following actions:

1. Risk mapping
2. E-readiness survey
3. New pilot course designs
4. Adjustment of implementation agreements

Figure 2: Steps adjusting to COVID-19[10]

COVID-19 Context Analysis

Risk Mapping

UNESCO initiated a risk mapping and analysis intervention with all CoE partners concerning their existing and expected future situation (challenges, restrictions) for implementing pilot courses, training and staff and student exchanges. The risk mapping consisted of a questionnaire circulated to all CoEs and was launched in April 2020. The main objective of the questionnaire was to establish:

- Challenges being experienced by CoEs in implementation of HCD activities such as:
    a. Presence/absence of staff and students
    b. Partial or full closure of facilities or institutions
    c. Need to adjust workplans and calendars
- Immediate needs identified to allow for implementation of HCD activities such as:
    a. Improved internet access
    b. Hardware and software
    c. IT and coaching support

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[10] UNESCO Situation Report, June 2020

- Mitigation actions which could facilitate implementation of HCD activities such as:
    a. Distance and on-line learning
    b. Decentralised delivery of courses
    c. Extend project duration

Initial results from the risk mapping indicated that on-line learning and distance activities are seen as options for re-orientation if activity implementation trending to on-line options, but that there are current challenges and needs to be addressed. These are presented in the following graphs which summarise the risk mapping responses from the CoEs. Figure 3 below indicates that on-line learning was the most favoured response to dealing with implementing pilot courses, followed by the possibility of extending the duration of project activities. Concerning the implementation activity of staff and student exchanges, applying a distance or on-line approach was not regarded by many as a viable solution.
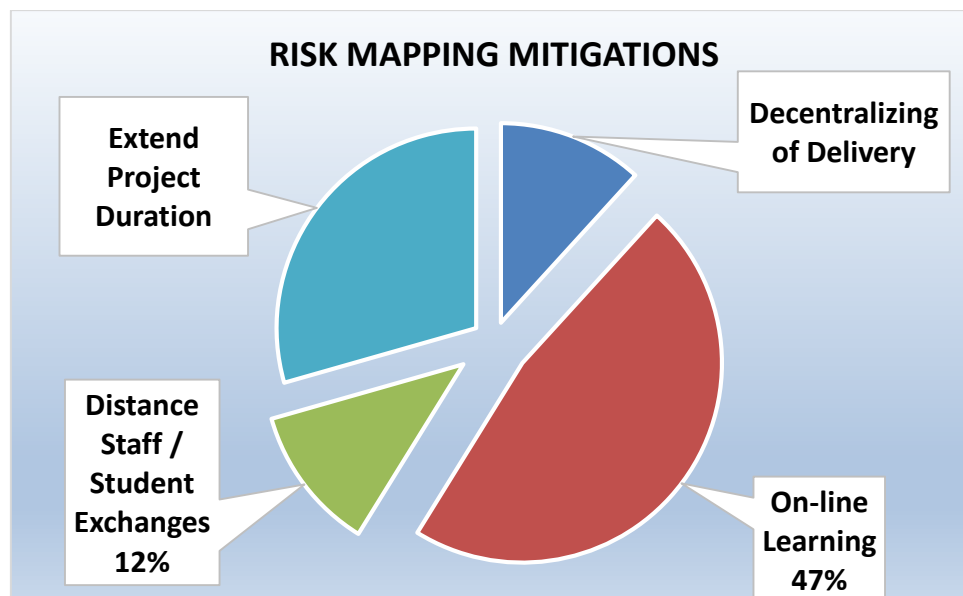
Figure 3: Risk Mapping Mitigation Activities

In terms of the then-current situation early in the pandemic, the main challenges to implementing HCD activities, more specifically the presentation of pilot courses but also including exchanges, are presented below in Figure 4. At the time of the risk mapping, the combination of school shutdowns and/or absence of students and staff due to lockdown regulations and limited mobility were the main problems being experienced.
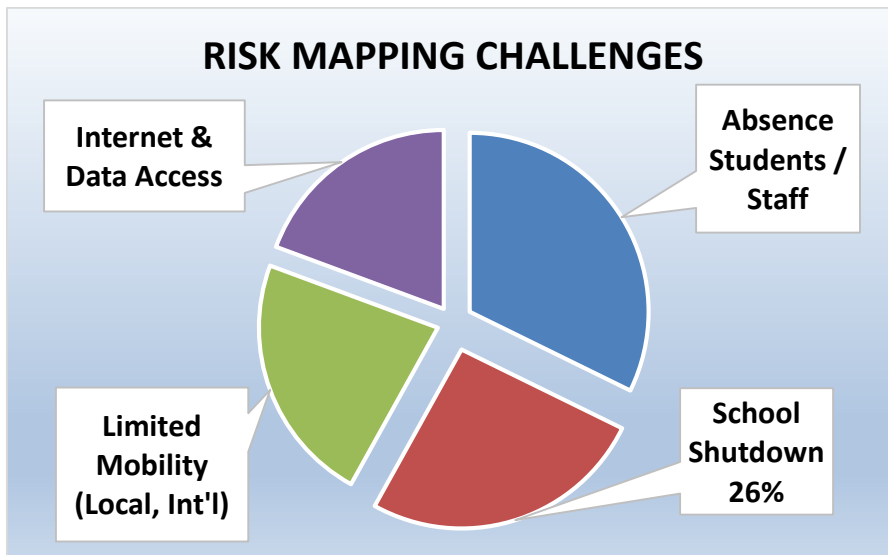
Figure 4: Risk Mapping Challenges to implementing HCD activities

Finally, Figure 5 below presents the perceived needs by the CoEs to address the key activity of presenting pilot courses, under the conditions experienced in early 2020 pandemic context, show that better connectivity, hardware and software were clearly perceived. However, from an education/training perspective, experienced training professionals were keenly aware of the need to not only adapt existing curricula for on-line delivery but that training and coaching would also be necessary in order for a smooth delivery.
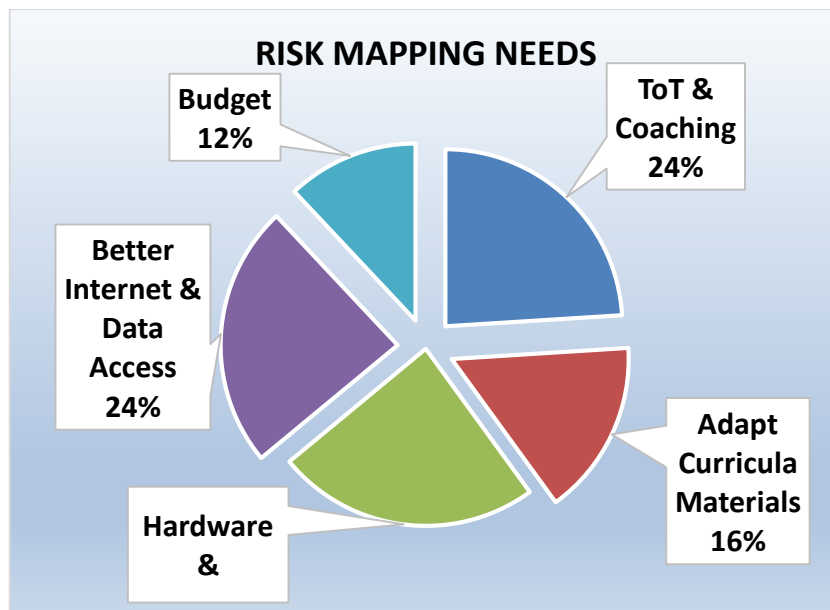
Figure 5: Risk Mapping Needs to overcome challenges to adjusting to on-line learning

E-readiness Survey – Post COVID-19

Following feedback from the risk mapping, it was evident that the key HCD activities of implementing pilot courses would be adapted, where possible, to an on-line format. In order to re-orient the project with the donor and partners it was necessary to establish, as closely as possible, what the capacity of the CoEs was to adapt to an on-line environment. After three months of COVID-19 exposure, a number of the CoEs were able to assess how their individual institutions were planning to move forward with research, education and

training activities. Therefore, an e-readiness evaluation was done to produce an overview of an institution's capacity and willingness to implement training and courses using blended, on-line and e-learning modalities as a response to COVID-19 and the limitations of face-to-face learning. The evaluation was an on-line survey launched in mid-June 2020, addressed to what degree individual CoEs were already engaged, to some extent, in on-line learning activities including blended learning with face-to-face added to training.

The survey also aimed to identify which existing curricula and course(s) could be adjusted for online/e-learning, and what aspects of budget would be affected, such as requirements for extra staff and technical support, materials, hardware/software, licenses and even possible restrictions on funding for loss of student fee revenue. Adapting course curricula was a key concern, especially for some HCD Pilot courses which involved extensive lab and field work unlikely to be implemented within the existing restricted context.

The survey collected information on the institutional online e-learning experience of project partners in the three regions, but should not be taken as a representation (this would require a much larger scale survey). However, the opportunity to reach out to other CoEs not engaged in the ACEWATER II project was taken and included the Zimbabwe National University of Science and Technology, the Namibia University of Science and Technology and the University of Mauritius.

Among a range of information, the survey comprised of the following indicators: when online e-learning offerings were introduced (Figure 6); whether faculty/department has provided any training related to online e-learning (Figure 7) collaboration with other higher education Institutions (HEI); and willingness to collaborate with other CoEs.
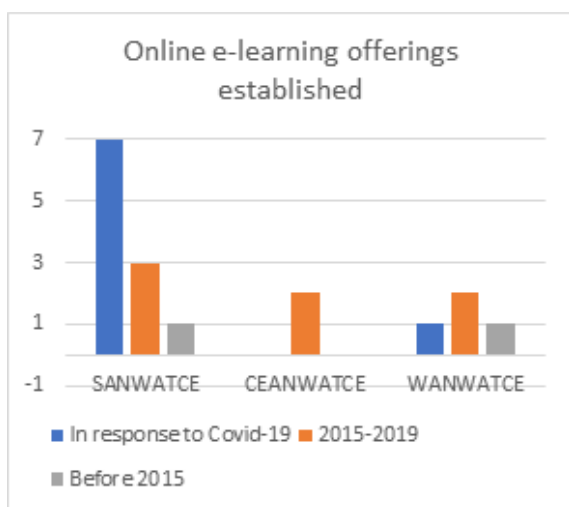
Figure 6: When online e-learning offerings were established
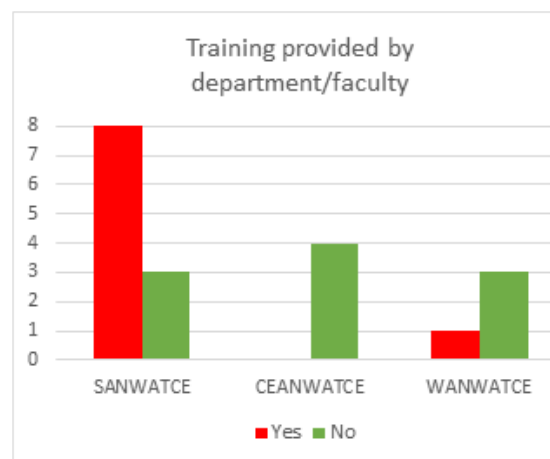
Figure 7: Training provided by department/faculty

E-learning Capacity and E-readiness

Table 1 below illustrates CoEs current capacities, for instance, materials and hardware; software, licenses, fees and data; HR, staff and tech support which ultimately affect their readiness for online e-learning – Low, Medium or High.

How online learning platforms can be integrated with face-to-face learning/or improved (same section as above).

15/07/2020			Capacity			Readiness	
CoE	Region	Country	Material and Equipment Hardware: Low, Medium, High	Software, licenses, fees, data: Low, Medium High	HR Costs, Staff, Tech Support: Low, Medium, High	Ready for online e-learning Yes/No/ Partly	Ready for blended learning: Yes/No/ Partly
National Water Resources Institute	WANWATCE	Nigeria	Medium	Medium	Medium	Partly	Partly
University of Benin			Medium	Medium	Medium	Yes	Yes
Kwame Nkrumah University of Science and Technology		Ghana	Low	Medium	High	Yes	Yes
Cheikh Anta Diop University		Senegal	Low	Low	High	Partly	Partly
Makerere University	CEANWATCE	Uganda	Low	Low	Medium	No	Partly
ICPAC IGAD Climate Prediction and Applications Centre		Kenya	High	Medium	Low	No	No
Water Research Centre, University of Khartoum		Sudan	Low	Low	Low	Partly	Partly
Addis Ababa University- Ethiopian Institute of Water Resources		Ethiopia	Medium	Medium	High	Partly	Partly
The University of Malawi	SANWATCE	Malawi	Medium	Medium	High	Yes	Yes
Namibia University of Science and Technology (NUST)		Namibia	High	High	High	Yes	Yes
University of the Western Cape		South Africa	Medium	Medium	High	Yes	Yes
University of Stellenbosch			Medium	High	High	Yes	Yes
University of KwaZulu-Natal			Medium	High	High	Partly	Partly

		Country					
Council for Scientific and Industrial Research (CSIR)			High	High	High	Partly	Partly
University of Zambia		Zambia	High	High	High	Yes	Yes
International Centre for Water Economics and Governance in Africa (IWEGA) - Eduardo Mondlane		Mozambique	Medium	Medium	High	Partly	Partly
University of Botswana		Botswana	Low	Medium	High	Partly	Partly
University of Mauritius		Mauritius	High	High	High	Yes	Yes
NUST - Zimbabwe		Zimbabwe	Medium	Medium	Low	Partly	Partly

Table 1: E-readiness Survey Results

Guidance Notes: The two columns on the right indicate the CoEs' ultimate readiness for online e-learning – yes, no or partly. The capacities were informed by the following questions in specific questionnaire sections:
- Experience with distance/online teaching (background section)
- Training received to deliver such teaching (background; institutional online e-learning experience sections)
- Extent to which the faculty has integrated ICT with academic offerings (institutional online e-learning experience section)
- Experience with re-packaging face-to-face materials (institutional online e-learning experience section)
- Time distance/mixed and online e- learning academic offerings have been available (institutional online e-learning experience section)
- Access to adequate hardware and software (staff online e-learning experience section)
  - What are the CoEs' current needs (same section as above)
  - The current internet challenges (same section as above)
  - Student challenges (student learning experience section)
- Access to sufficient ICT hardware and software support for online and distance learning in current working situation (institutional level technical and learning support section)
- Access to teaching and learning and / or communications support (same section as above)
  - Types of support partners have access to (same section as above)

E-readiness Needs to Upgrade for e-learning

Table 2 below illustrates the CoEs' **needs** to establish/improve online e-learning. Partners were first asked to specifically indicate their needs related to internet (connectivity, data and power supply), followed by hardware and software capacity and needs.

CoE	Region	Needs				
		Connectivity	**Data costs**	**Power backup**	**Hardware**	**Software**
National Water Resources Institute – Nigeria	WANWATCE				Medium	Medium
University of Benin City – Nigeria					Medium	Medium
Kwame Nkrumah University of Science and Technology – Ghana		✓	✓		Medium	Medium
Cheikh Anta Diop University – Senegal		✓	✓		Medium (servers, HD camera)	Medium - High
Makerere University – Uganda	CEANWATCE	✓	✓		High - medium	High – medium (course platforms; training)
ICPAC IGAD Climate Prediction and Applications Centre - Kenya					Low	Medium (course platforms)
Water Research Centre, University of Khartoum – Sudan					High	High (training; IT backup support)
Addis Ababa University-Ethiopian Institute of Water Resources – Ethiopia			✓		Medium (laptops for trainees)	Medium (learning platforms)
The University of Malawi	SANWATCE		✓		Medium (LCDs)	Medium (learning platform)
Namibia University of Science and Technology (NUST)					Low	Low
University of the Western Cape – South Africa			✓		Low - medium	Low - medium
University of Stellenbosch – South Africa		✓	✓	✓	High – medium (UPS)	Low
University of KwaZulu-Natal – South Africa		✓		✓	Medium	Low
Council for Scientific and Industrial Research (CSIR) – South Africa		✓	✓		Low	Low
University of Zambia		✓			Low	Low

Institution						
International Center for Water Economics and Governance in Africa (IWEGA) - Eduardo Mondlane – Mozambique					Medium	Medium
University of Botswana		✓			High (PCs)	Medium (learning platform)
University of Mauritius		✓			Low	Low
NUST - Zimbabwe		✓			Medium	Medium

Table 2: E-readiness Needs

Guidance Notes: The needs assessment investigated the indicators within the following questionnaire sections:
- What are the CoEs' current needs (staff distance and online learning experience section)
- The current internet challenges (same section)
- Student challenges (student learning experience section)
- How online learning platforms can be integrated with face-to-face learning/or improved (institutional level technical and learning support section)

Reference notes:
- HD – High definition
- LCD – Liquid Crystal Display
- UPS – Uninterrupted Power Supply
- PC – Personal Computer
- IT – Information Technology

Student (Capacity) Online E-learning Experience

The final section of the e-readiness survey investigates, from the CoE's experience and perspective, their students' capacity to engage with online e-learning, with the following indicators: students' access to and support with using online e-learning platforms (Figure 8); student challenges to access online e-learning platforms (Figure 9). These indicators should also be considered in combination with Table 5, which illustrates a comparison among CoEs.
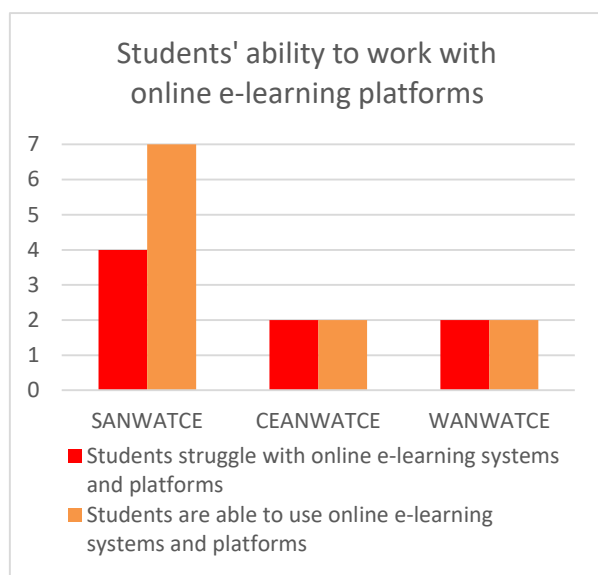
Figure 8: *Students' Ability for Working with E-learning Platforms*
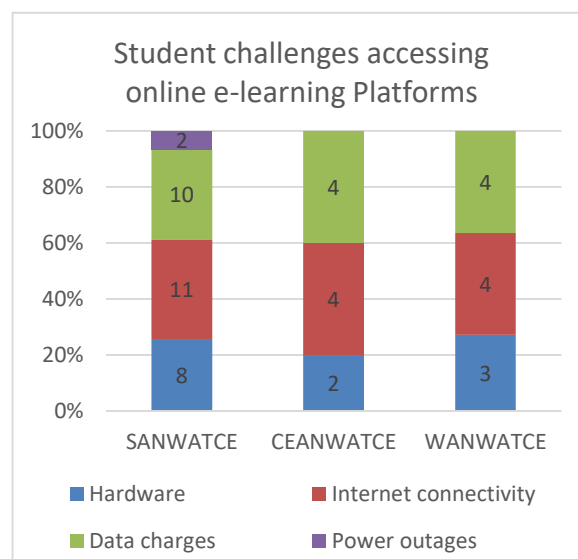
Figure 8: Students' Challenges to Access E-learning Platforms

Figure 8 above shows that for all of the CoEs their students have challenges to work with online e-learning platforms, although in SANWATCE, the number of CoE institutions whose students able to access these platforms is higher. The specific institutions and the ability of students to work with on-line platforms is listed in Table 3 below. The main challenges across the board in all regions for students to have and maintain sufficient access for on-line training purposes are identified in Figure 9 as being internet connectivity and data charges, while in Southern Africa power outages are also included as a challenge.

Country	Institution	Region	Students' ability to use online e-learning systems and platforms	Student challenges	Students' ability to work remotely
Ghana	Kwame Nkrumah University of Science and Technology	WANWATCE	Able	Conn, Data costs	Moderate extent
Nigeria	National Water Resources Institute Kaduna		Struggle	Hard, Conn, Data costs, ICT	To some extent
	University of Benin			Hard, Conn, Data costs	Moderate extent
Senegal	Cheikh Anta Diop University		Able		To some extent
Ethiopia	Addis Ababa University	CEANWATCE	Able	Hard, Conn, Data costs	Moderate extent
Kenya	International Climate Prediction and Applications Centre			Hard, Conn, Data costs	Small extent
Sudan	University of Khartoum		Struggle	Hard, Data costs	Small extent
Uganda	Makerere University			Hard, Conn, Data costs	To some extent
Botswana	University of Botswana	SANWATCE	Struggle	Hard, Conn, Data costs	To some extent
Malawi	University of Malawi			Hard, Conn, Data costs, Power	Small extent
Mauritius	University of Mauritius		Able	Hard, Conn, Data costs	Moderate extent
Mozambique	University Eduardo Mondlane		Struggle		To some extent
Namibia	Namibia University of Science and Technology		Able		Moderate extent
South Africa	Council for Scientific and Industrial Research			Conn, Data costs	
	University of KwaZulu-Natal			Hard, Conn, Data costs, Power	Small extent
	University of Stellenbosch		Struggle	Conn, Data costs	Moderate extent
	University of the Western Cape		Able	Hard, Conn, Data costs	
Zambia	University of Zambia			Hard, Conn	Small extent
Zimbabwe	National University of Science and Technology			Conn, Data costs	To some extent

Table 3: Comparison of Student (capacity) online e-learning experience between CoEs

The pandemic has highlighted the need to develop resilience against natural disasters by developing appropriate online and E-learning materials and distance teaching/learning aids. Preparing for E-learning course / modules with equipment and materials is only part of the challenge; secure internet access and a reliable electricity supply remain major issues.

Exchanges

All CoEs were expected to participate in an exchange programme for students and researchers within and, where feasible, between the regional networks of CoEs. The CoE Secretariats for each region was to coordinate regional exchanges.

The exchange programmes planned to be implemented up to October 2020 were cancelled as a result of the COVID-19 outbreak. With the exception of one exchange student in the SANWATCE network, it was thus not possible to start the programme during this period in the face of the disease outbreak and restrictions that existed then and still prevail at the time of this writing.

Even though the exchange programme of staff and students was cancelled due travel restrictions, one student from the SANWATCE network was able to participate in an exchange program prior to the pandemic. From the selected nine candidates for staff and student exchange within the network, a student from the University of Zambia spent a total of six weeks at the University of Cape Town (UWC) and left prematurely as a result of the national COVID-19 lockdown. The student, whose degree program was in Integrated Water Resources Management, participated in courses and had access to laboratories at UWC for analysis of water quality samples as part of his Masters training. The student was supervised by faculty at UWC.

Monitoring and Evaluation Plan

In order to contribute to the development and then implementation of a Monitoring and Evaluation (M&E) Framework for the HCD activities and to ensure that a homogenous methodology was employed for collecting key and measurable data, an M&E Tool was developed for all CoEs to apply. Initially the M&E Tool was to address both the activities of pilot courses and the mobility and exchange of staff and students; but following the outbreak of COVID-19, this was subsequently limited to the pilot courses.

Impact Study

An Impact Study Framework for the identification, monitoring and reporting of the contribution to impact of a research and HCD programme was designed and implemented. The design was the application of mixed-methods research instruments to develop a methodology to identify and collect documentation pertinent to the project and related to the ACEWATER projects. Given that a number of partners in ACEWATER II were also active in ACEWATER I, this Impact Study presented a unique opportunity to identify impacts emanating from the ACEWATER project activities between 2009 and 2020.

MONITORING AND EVALUATION

Introduction

The objective of the M&E activity was to contribute to the development and implementation of a Monitoring and Evaluation Framework for ACEWATER II HCD activities of Pilot Courses and the Mobility and Exchange of staff and students. An M&E expert developed a draft framework; with an Excel Format and worksheets selected as the most efficient M&E tool allowing for:

- Standardisation of M&E reporting and data collection from all CoEs;
- Robust storage of all M&E data in one file;
- Drop-down menu responses to limit confusing or incomplete narrative reporting; and
- Use of built-in tools for data analysis, graphic presentation and data visualisation

The M&E Tool framework was presented to the CoEs at regional project meetings for consultation in West African and Central and East Africa, which were also attended by SU, the South African CoE Secretariat. The framework was revised and then shared with the CoEs in all three African regions of the project. Online training on the use of the tool was provided region by region.

Course/Module Information

Data collected on Course / Modules included the following:

- The course/modules location, work plans, dates and themes addressed;
- The target groups, participants' profiles, gender and age breakdown;
- The mode of teaching (face-to-face, e-learning or blended); and
- The e-learning platform used where applicable.

The latter two information points were added following the reorientation of the ACEWATER II project activities in response to the COVID-19 outbreak. The collection of M&E data on course / modules was entered into the M&E Tool framework which consisted of a main overview sheet accompanied by three theme worksheets addressing the following sectors of data:

- The dissemination of National HCD Frameworks and the development and implementation of the pilot courses and modules;
- The purchase of equipment, materials and human resources to support training modules;
- Mobility and exchange of staff and students; and
- A quality review of the implemented pilot courses.

Baseline findings

The data collected on priority course/modules and their distribution among the main themes began early in 2020 before the COVID-19 outbreak. Figure 10 below illustrates this distribution, highlighting the importance of Water Quality and Data and Modelling as sector priorities, with IWRM less prevalent as a sector priority in a number of countries.
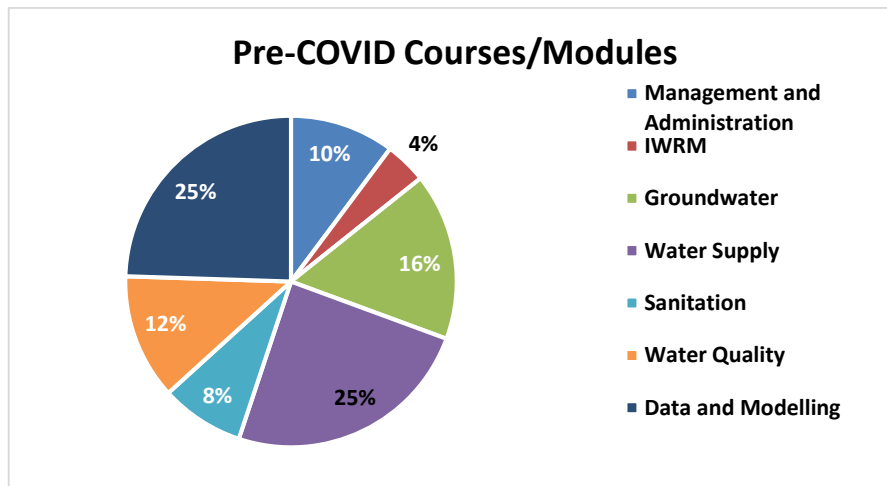
Figure 9: Pre-COVID-19 HCD Priority themes

Impact of COVID-19

Before the outbreak of COVID-19, twelve CoEs in West, Southern and Central East Africa were planning to implement a minimum of four HCD pilot courses: two at HE level for water sector professionals and two at TVET level for water sector technical and management actors. With the COVID-19 outbreak, and following the national COVID-19 lockdowns, a re-orientation of the project HCD activities resulted in the following:

- Extension of the project duration from May to November 2020;
- Where feasible, pilot courses were redesigning in the following manner:
  - Presentation of courses with on-line and blended learning modalities; and
  - Rescheduling course deliveries to take advantage of the project extension.
- Cancellation of staff and students exchanges due to travel limitations.

Four CoEs from the three regions were not able to implement a pilot course/module:

1. WANTWATCE: UNIBEN (Nigeria)
2. CEANWATCE: ICPAC (Kenya)
3. SANWATCE: UNZA (Zambia) and UB (Botswana)

Implementation Trends

The extension of the implementation timeframe of the pilot courses, as well as the reduction of expected Pilot courses from four course/modules *per CoE Partner country* to one *per region*, was a major contribution to the success of the project. Ten CoEs were able to implement at least one pilot course/module. The majority of CoEs reported that staff training was required for *course preparation*, with the NRWI (Nigeria) requiring additional training for *course implementation*. A total of 27 pilot course/modules were implemented across *all of themes*, with a reported 839 participants. The number of courses or modules at TVET level were much lower, with some CoEs reporting that technical level courses required more hands-on training and were therefore more difficult to implement on-line. Figure 11 below depicts the distribution of **implemented** courses within the seven reported themes. The most prevalent course theme was Data and Modelling, followed by Water Supply and Groundwater.
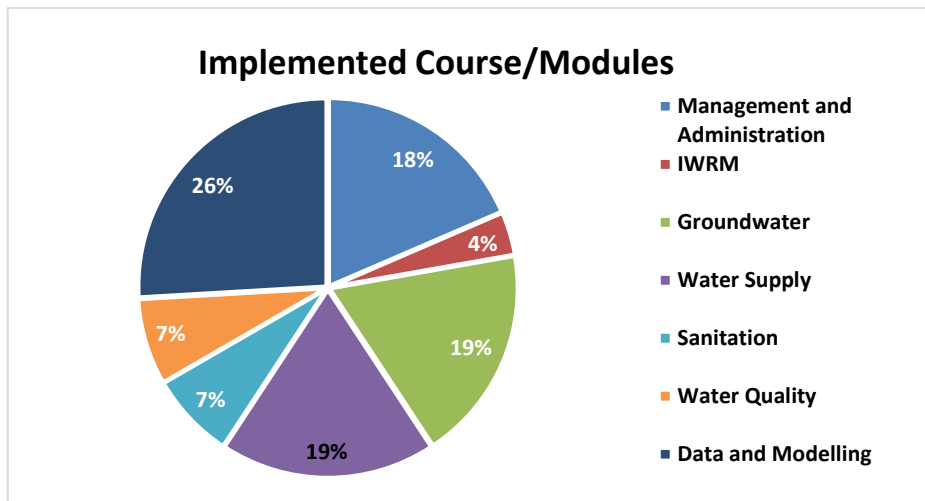
Figure 10: Implemented Courses

The distribution of participants among the themes is presented in Figure 12 below. Compared to course/modules per theme, the most attended was theme Groundwater closely followed by Data and Modelling, then Management and Administration.
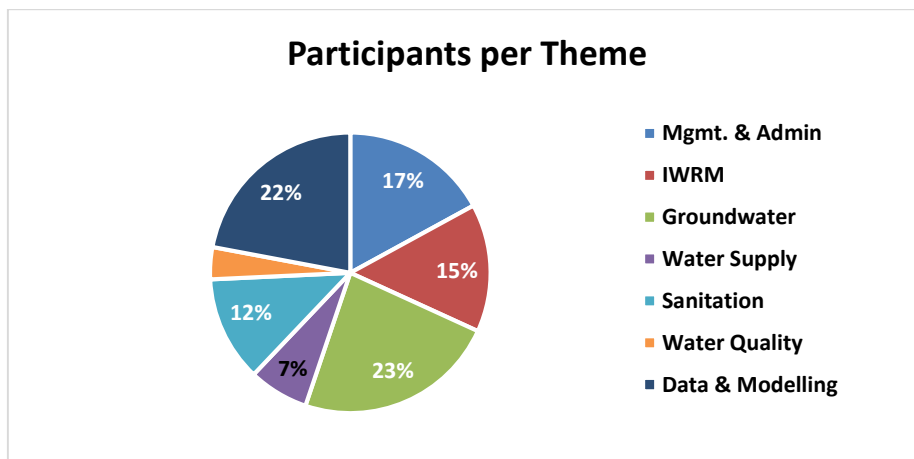
Figure 11: Participants per Theme

When comparing the number of courses implemented with the number of participants in Figure 12, it is interesting to note that while only 4% of courses were for IWRM, 15% of participants attended these course/modules and groundwater, accounting for 16% of courses/modules registered 23% of participants. A similar observation can be made for the theme Water Supply, while Data and Modelling displays the highest priority theme with the highest level of participation.

Target Groups for Course/Modules

Figure 13 below shows that the majority of pilot course/modules were designed for junior or senior professional levels at HE level with the majority of technical course/modules targeting senior staff or actors.
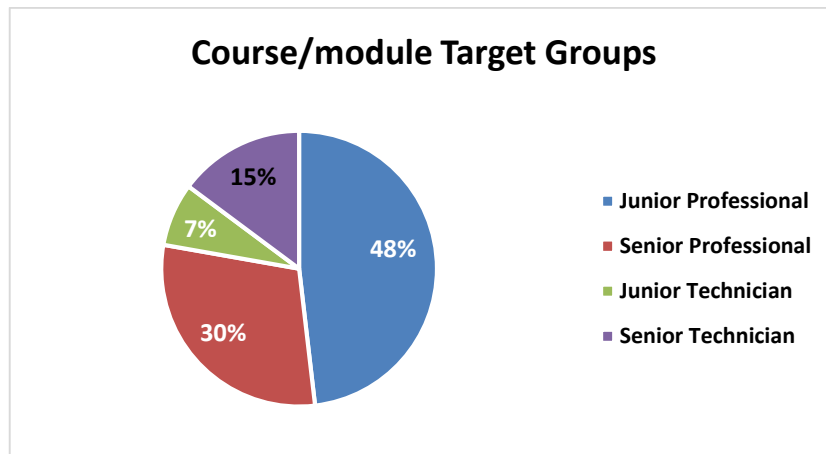
Figure 12: Target Groups for Course/modules

Mode of Teaching Delivery

The mode of teaching was fairly evenly spread as shown in Figure 14 below with the three options recording face-to-face 26%, blended 37% and e-learning 37% respectively. This was partly as a result of the constraints faced by the CoEs which forced them to adapt their teaching strategies and consider blended and e-learning as modes of teaching. The most common platform utilised for e-learning components of trainings was ZOOM (Figure 15). The only face-to-face course/modules were undertaken by U of K (Sudan), EIWR (Ethiopia) prior to COVID-19 restrictions.
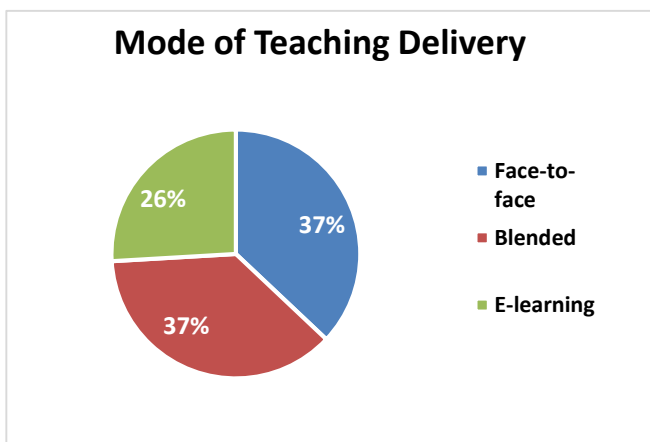
Figure 13: Mode of Teaching Delivery
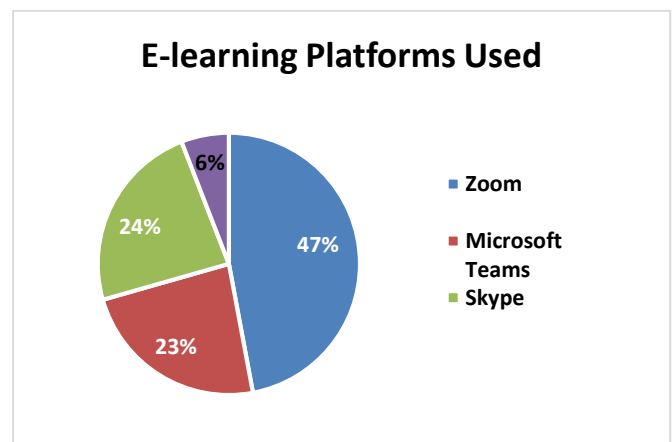
Figure 14: E-learning Platforms utilised

Participant Profiles

Gender

Figure 16 below shows that of the 791 reported participants by gender, 61% of participants were male while 39% were female.
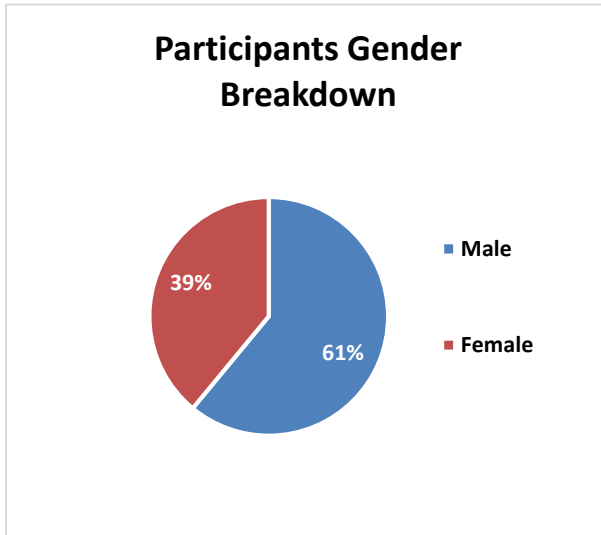
Figure 15: Gender breakdown of Participants
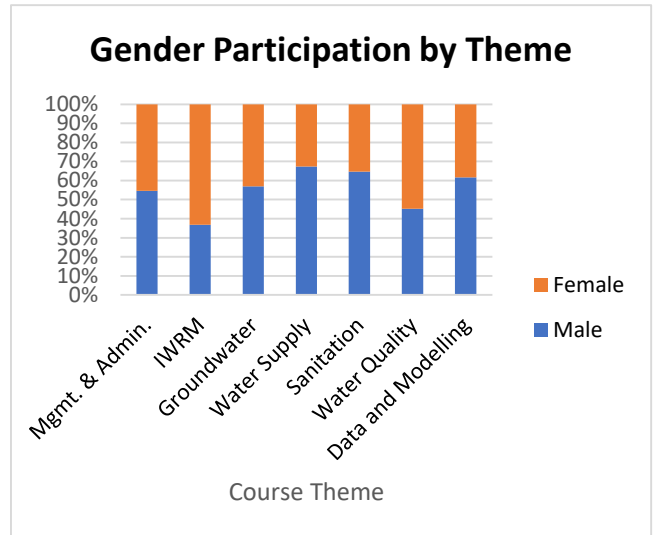
Figure 16: Gender Participation by Theme

Figure 17 above represents the percentage as a breakdown of gender by theme and data indicates that IWRM and Water Quality had majority female participants. Water Supply and Sanitation were the two themes with the highest percentage of male participants.

Age Groups

Four Age groups were identified using the following rational:

- 18 – 25 Students, undergraduate or graduate, or young professionals and technicians entering into the sector
- 26 – 35 post-graduate / researchers and junior sector professionals and technicians,
- 36 – 45 middle management, project coordination
- 46 – 60 senior management, programme coordination
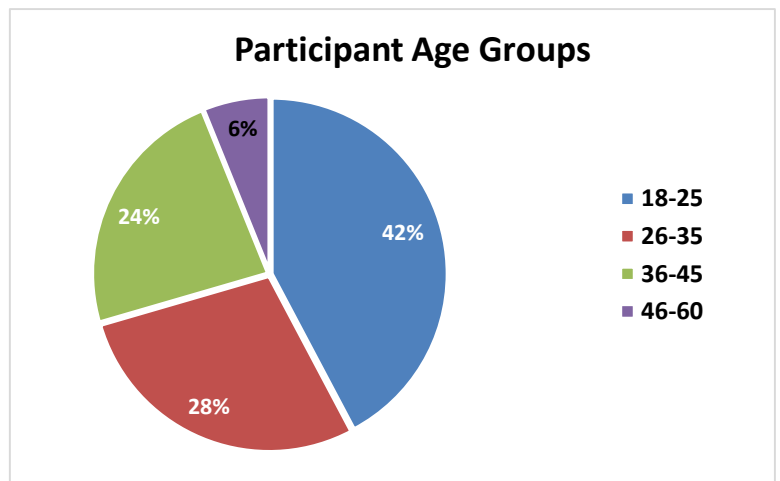
Figure 17: Participant Age Groups Distribution

Figure 18 above shows that the age group 18-25 had the highest percentage of participation while the participants aged 46 and over were the least number of participants.

Background and Source of Participants

The participants came from a range of backgrounds including HE (Higher Education) TVET (Technical and Vocational Education), Private sector and Government. For this exercise, the private sector was defined as including small medium enterprises and artisanal businesses. As can be seen in Figure 19 below, participants from government institutions were highest, followed those from HE institutions. The low presence of TVET and Private Sector is likely reflecting the difficulty in Technical or Vocational courses to be designed and presented by on-line or blended learning modalities.

Source of Participants

- Higher Education 33%
- TVET 6%
- Private 8%
- Government 53%
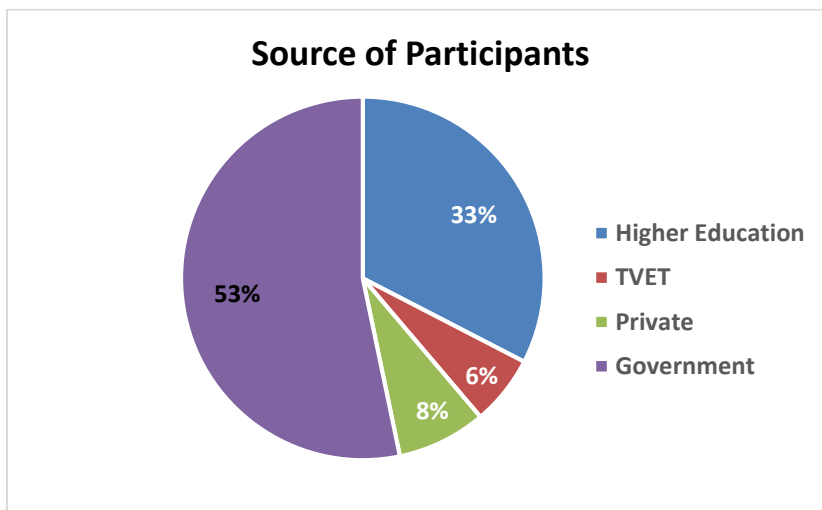
Figure 18: Background and Source of Participants

Costs of Preparation and Delivery of Course / Modules

Costs: Equipment & Materials
- Preparation 14%
- Delivery 86%

Costs: Human Resources
- Preparation 40%
- Delivery 60%
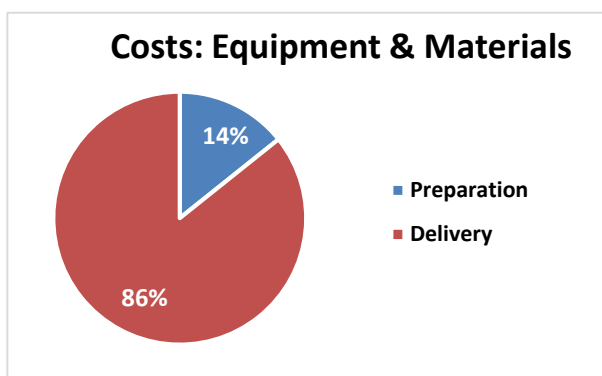
Figure 19: Equipment and Material Costs of Course/modules
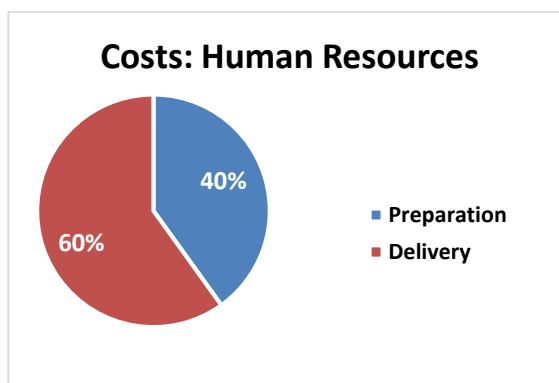
Figure 20: Human Resource Costs of Course/modules

Figures 20 and 21 provide a breakdown of costs for both preparation and delivery of course/modules. It shows that the delivery of course/modules entrains considerable costs in comparison to preparing trainings, with highest costs allocated to equipment and materials used for delivery.

Comparative Analysis between the Regions

The data collected by the individual CoEs on specific course/modules was also assembled for comparison between Regions.

Participants and Themes in Regions
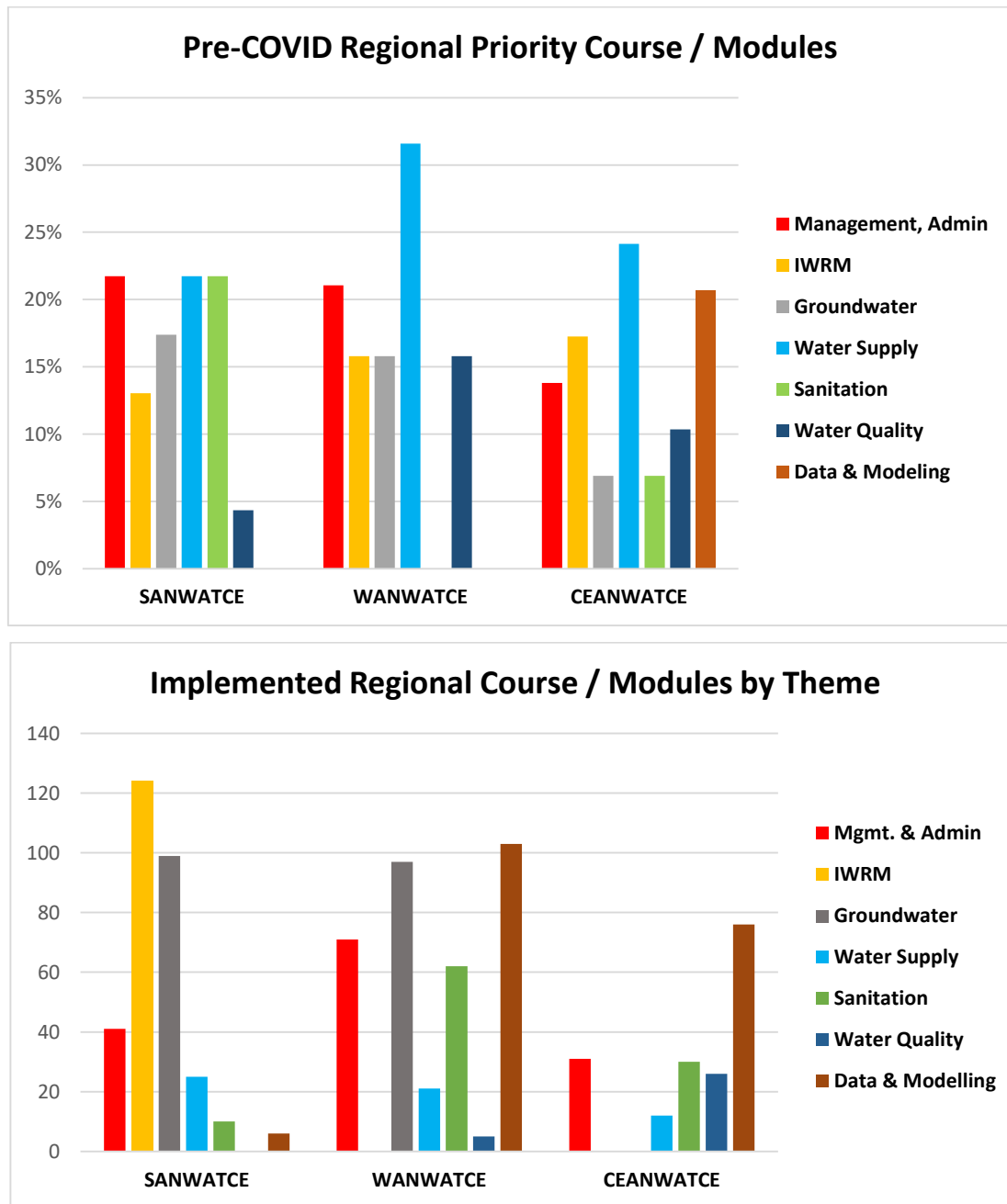
Figure 21: Distribution of Course/module Themes among the Regions

Figure 22 above compares, in regional breakdown, the number of participants per theme of the implemented courses to the original distribution of planned courses per theme. With re-orientation of activities in the COVID-19 context that the statistics of implemented course / modules represent both the priorities identified by the CoEs *and then* what individual CoEs were able to offer. When compared to the pre-COVID list of full course / modules on offer, we clearly see the impact of the challenges to implement blended, on-line or even face to face modalities due to restrictions on movement or gathering.

Regional Presentation of Target Groups

The four target groups for the pilot projects were junior and senior professionals and technicians.
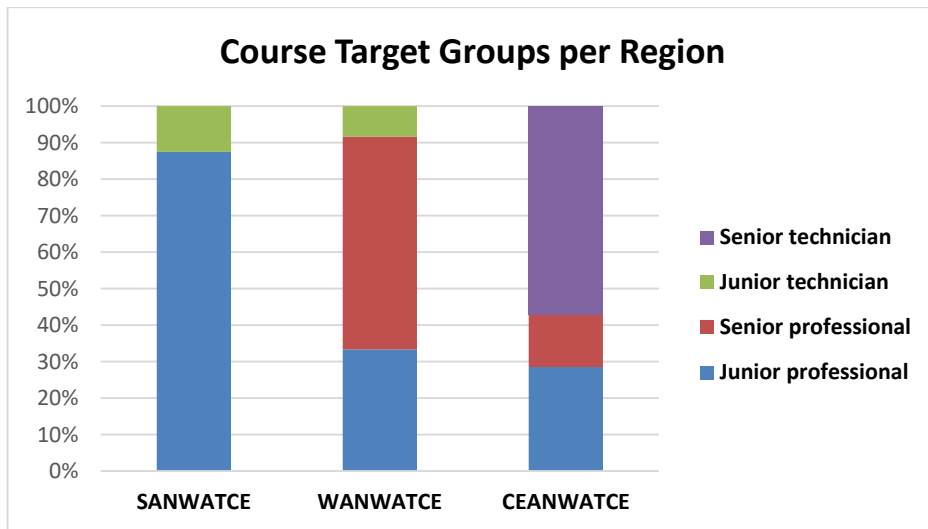
Figure 22: Regional Orientation towards Target Groups

The regional breakdown of course/modules by target group with SANWATCE providing the most courses targeted towards junior professionals. WANWATCE targeted the majority of their course/modules targeted towards senior professionals, SANWATCE course/modules were heavily oriented towards junior professionals (including young students) and CEANWATCE was the only region to provide course/modules designed for senior technicians.

Gender Analysis

Regional gender analysis was applied to Course/Module participation, distribution among themes and target groups.
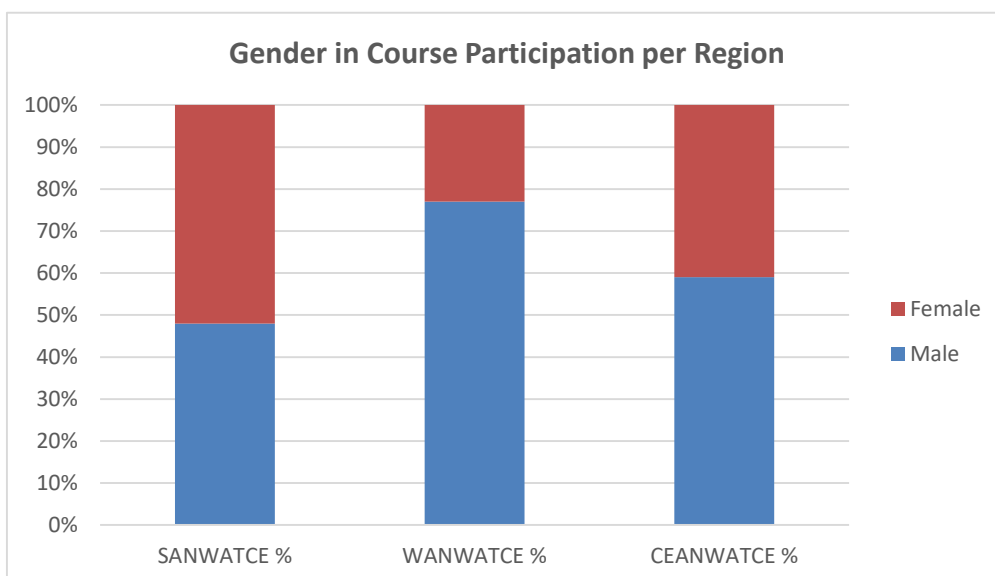
Figure 23: Gender Breakdown of Course/module participants

Figure 24 above shows the regional percentage breakdown by male/female gender. SANWATCE had most female participants with 52% female and 48% male. CEANWATCE had a larger percentage in favour of males with a 58% male and 42% female breakdown. WANWATCE had by far the most disparity by gender with 77% male and 23% female.

In Figure 25 below, there is a percentage comparison by Gender versus Target Group. When comparing gender versus target groups, there is a fairly even split with regards junior professionals between male and female participants. However, with senior professionals this shifts to predominantly a male oriented group size. The number of participants for both junior and senior technician is too small to draw much of a conclusion but does show a slight bias towards male versus female participants.

Gender Participation by Target Group
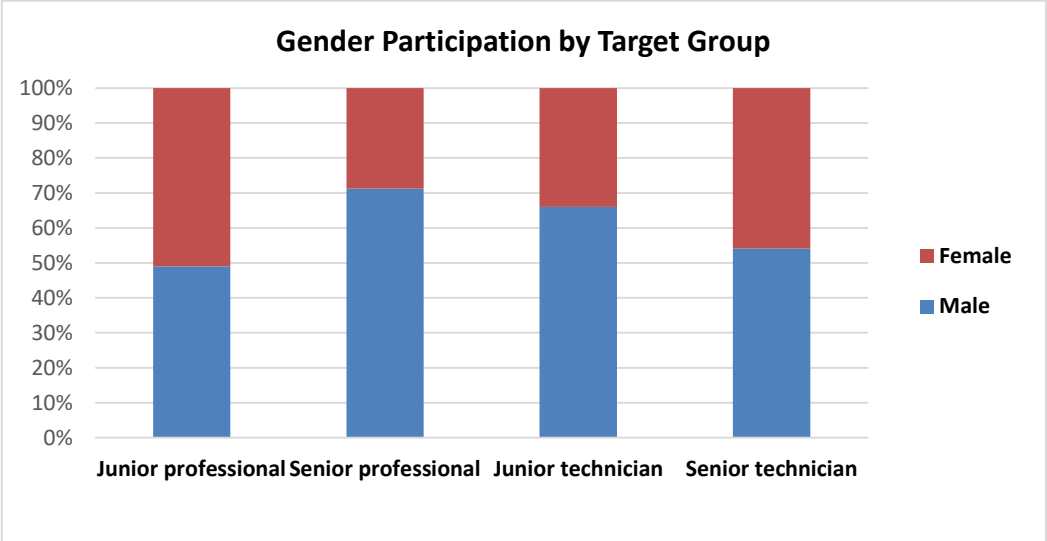
Figure 24: Gender Breakdown in Target Groups

Regional Breakdown of Participants by Age
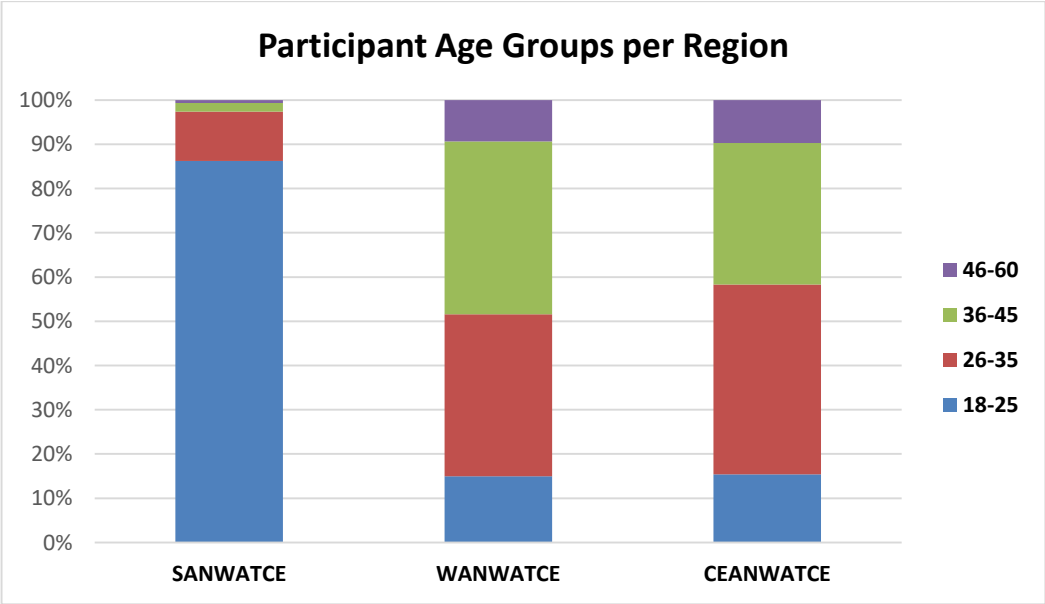
Figure 25: Participants' Age Group Regional Comparison

As already mentioned, the distribution of age groups, especially among the youngest, is linked closely to the Target Group and thus what was on offer for course/modules while still addressing sector HCD priorities. While all ages of the defined age groups are represented in Figure 26, all regions had limited participation from the older target group 46 to 60 years of age with only 49 of the 839 reported participants.

Regional Comparison of Modes of Teaching
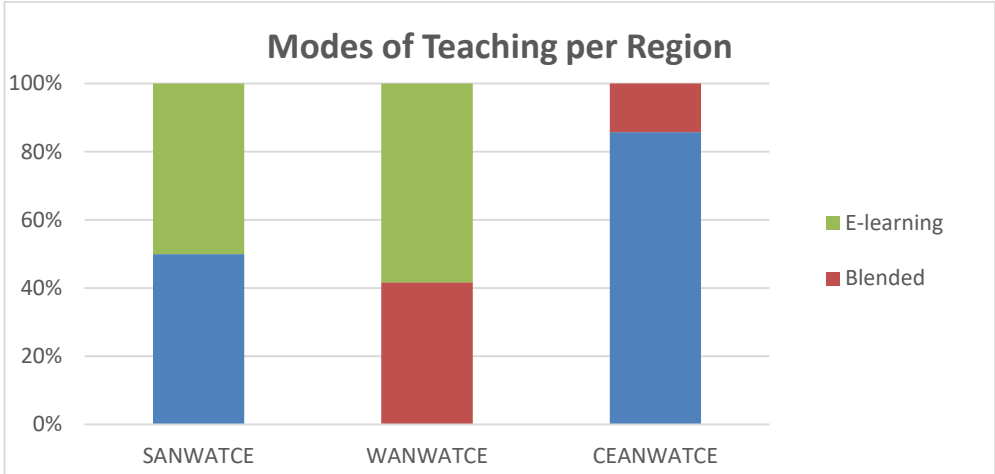
Figure 26: Regional Comparison of Modes of Teaching

Figure 27 above compares the modes of teaching employed in the regions. In SANWATCE, some pilot courses/modules were still able to be implemented face-to-face teaching (under restrictions) but were adapted to also include 50% e-learning teaching. In WANWATCE CoEs were forced to adapt their pedagogical methods and only used blended and e-learning strategies. CEANWATCE predominantly used face-to-face with one course as blended learning.

Pilot Course Platforms
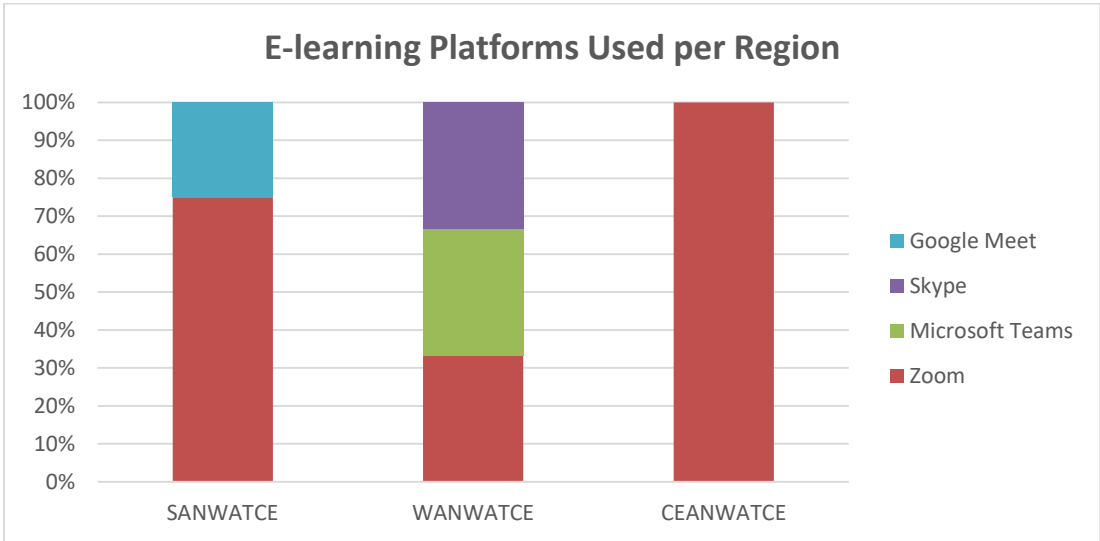
Figure 27: E-learning Platforms Used per Region

Seventeen courses/modules were implemented using a software tool as highlighted in Figure 28 above, to implement the courses/modules across the three regions. WANWATCE accounted for 12 of the 17 platforms and used predominantly Zoom as the method of delivering the course/module. SANWATCE delivered four courses/modules of which three used Zoom and one Google Meet. Mak (Uganda) used Zoom for the one course/module they implemented.

Conclusions

M&E Process

The M&E process was a stop-start process with a six-month pause while a project extension was negotiated and Risk Mapping and E-readiness surveys were conducted. The final M&E process was restarted with a revised format of the Tool framework to include blended and e-learning in October 2020. It can be concluded that the flexibility by the different stakeholders including UNESCO, JRC, the Regional Secretariats and the CoEs have helped to mitigate the impact of the pandemic on the project implementation. The extension of the timeframe for implementation of the pilot courses as well as reducing the number of courses/modules from four to one had a positive impact on the success of the project. The flexibility to reorientate the mode of teaching also contributed to some of the CoE being able to implement their courses/modules.

Recommendations

1. It would be advisable to create a central reporting environment which each CoE can access and complete the M&E information. This does not need to be a complicated database, but a shared document stored centrally where follow up and version control is easy to manage.
2. It would be advisable to request the CoEs to conduct a further quality review of the pilot courses/modules six months to 12 months after their completion to assess the impact of the trainings. This would help guide the development and implementation of the any further phases of the ACEWATER II project.

IMPACT ASSESSMENT

The OECD-DAC definition of impact is deliberately comprehensive: 'positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended'. This definition is widely accepted and quoted by development agencies and government departments, but current evaluation practice often falls short, instead looking only at relatively short-term, intended direct effects. Research interventions, be they scientific or social, evolve through a series of phases from inputs and activities toward outputs and outcomes. Most research, in its conception and design, aims for a desired impact but there can be as many as four impact dimensions which can be measured; the scientific or *knowledge benefits* derived from research, benefits to *policy* formulation, benefits to the *economy* and *social* benefits from research. While outputs and outcomes can be easily measurable, identifying impact requires a more hands-on approach such as open-ended feedback from participants and key stakeholders, as well as observation.

There are challenges when the impact of research is identified and reported on: if the evaluation of the impact of research is undertaken too early after the conclusion of the research, the impact of the research might not have occurred yet, or if the evaluation is undertaken too late, some impacts might have occurred without a lasting effect. The challenge lies in capturing the duration of the research impact[11].

Methodology and Objectives

An Impact Study on the ACEWATER II HCD activities was implemented by an expert during 2020. A mixed-methods approach was used, which include surveys and interviews between the expert, CoE members and other project partners. The study also took advantage of gatherings of researchers and stakeholders such as the annual ACEWATER II consultative workshops held in February 2020 in Senegal and Ethiopia were used as opportunities to introduce sessions to build impact cases for this study.

In this study, a framework was developed to demonstrate various aspects of impact, including knowledge, policy, social, economic and ecological impact. This study was undertaken in the final stages of ACEWATER II, thus, taking an *ex-post* view on most of the ACEWATER project's duration. It does, however, provide an opportunity to set a basis and framework for the continued identification, monitoring and reporting outcomes and eventual impact, when certain outputs can be measured. With further ACEWATER project activities envisaged, results of this study can be carried forward and integrated into any and all future ACEWATER activities, thus providing an opportunity for the *ex-ante* framework on the significance of such a project.

In essence, the study aimed to identify and report the contribution or influence (or impact) the HCD activities of the ACEWATER project has made towards policy development, knowledge production, contributions to higher education in the African water sector, socio-economic impact and ecological impacts. In addition, pathways to impact were identified, from which impact frameworks can be designed into future phases of the ACEWATER project. From the case studies related to joint learning and cooperation with continental and regional agencies, the continuous involvement of all members of the AUDA-NEPAD Networks of Water CoEs in project activities and the governance of the networks, translated into the continuous learning whereby best-practices were shared and which impact on the general knowledge production amongst AUDA-NEPAD Water CoEs. Moreover, the cooperation with continental and regional agencies since the inception of the ACEWATER project in the mid-2000s, further contributed towards the participation of key stakeholders in consultative-, validation and regional workshops of the HCD component of the

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11 Bell, S., Shaw, B. & Boaz, A. Real-world approaches to assessing the impact of environmental research on policy. *Res. Eval.* **20**, 227–237 (2011).

ACEWATER II project. This participation impacted positively on the eventual valorisation of the pilot courses.

General Impacts

- It is a fact that, in general, academics are not often involved in driving policy-making processes. In developing inputs into a National HCD Framework within the ACEWATER II project, some academics confirmed during the SANWATCE regional meetings that they initially felt 'out of their comfort zones' while engaging with policy-makers. However, it was found that the activity had a positive impact because through the processes, individual and organisational growth took place, especially when the outputs were valorised, and academics experienced that their inputs were accepted.

- At an institutional level, the development of National HCD Frameworks and HCD pilot courses contributed towards knowledge production within the CoEs, and the courses will be an asset in future for the institution. Also, at an institutional level, the reputation of the CoEs as active knowledge producers and skills developers in the water sector is strengthened by the HCD activities in the ACEWATER II project.

- With the involvement of the relevant Ministries in the various countries from the outset of the project, and the alignment of training priorities to national priorities, the uptake of training programmes is increased, leading to an increase in the impact of training and capacity development activities.

- The continuous support of the ACEWATER Project of AUDA-NEPAD Networks of Water CoEs in continental and regional bodies and River Basin Authorities have further resulted in regular water-related dialogues on continental, regional and national water issues. Examples included the participation of network members in the annual WaterNet/WARFSA/GWP-SA Symposium in Southern Africa and the involvement of the Université Cheikh Anta Diop de Dakar (UCAD) as the secretariat of the AUDA-NEPAD WANWATCE, participating in the Priority Pilot Groups and Priority Action Groups related to water security, sanitation and cooperation of the 2021 World Water Forum. The participation of AUDA-NEPAD Water CoEs in such dialogues have strengthened the reputation of the network members as water-sector knowledge and skills providers at continental, regional at respective national levels.

- Laying the foundation for future capacity development, the activities in the ACEWATER project supported formal Memoranda of Understanding concluded between the various organisations. In the case of West Africa, an MoU exists between ECOWAS and members of the AUDA-NEPAD WANWATCE. In Southern Africa, the AUDA-NEPAD SANWACTE secretariat has MoUs with key regional role-players such as the Southern African Development Community (SADC) Water Desk, WaterNet, the SADC Groundwater Management Institute (SADC-GMI) and the Zambezi Watercourse Commission (ZAMCOM).

- The stakeholder engagement activities such as the consultative-, validation and regional stakeholder workshops *purposefully* involved key stakeholders from the regional and national government, private industry, society and NGOs – this a clear example of 'productive interactions' [6], *specifically designed* for the project. At the very least, these workshops had the benefit of bringing a broad range of stakeholders from the national water sectors together, which resulted in a broader and more representative contribution to the national discourse, and again contributed towards knowledge production. By taking a leading role in organising the workshops, the reputation of AUDA-NEPAD Water CoEs as water sector knowledge and skills developers was further strengthened. In the case of SANWATCE where regional stakeholders from WaterNet and SADC Water Desk were

present in regional meetings, the role of SANWATCE as a regional knowledge and skills developer were strengthened.

Specific Impacts

Following are two examples of specific impacts identified by the CoEs within the study of ACEWATER activities, especially those linked to the ACEWATER II HCD component and the key role played by the CoEs in developing National HCD Frameworks.

NWRI (National Water Resource Institute), Nigeria

The close involvement of government agencies in the national water sector assessment led to the decision whereby government agencies were directed to sponsor their staff for further training specifically at the NWRI, thus building the reputation of this institution as a water sector skills provider in Nigeria. There is further evidence that the HCD activities in the ACEWATER II project have contributed to policy contributions and stimulated the National Technical Committee on Water Resources (NTCWR) to approve mandatory courses in the Nigerian water sector. In addition, NTCWR directed relevant government agencies to sponsor their staff for further training especially at the NWRI. The benefits of other training at the NWRI have been noted whereby follow-up assessments three months after the training indicated that some of the trainees that attended the NWRI training courses have benefited by way of promotion and financial socio-economic benefit through increased salaries. *Although it is still too early to identify benefits from the ACEWATER II pilot courses implemented by the other CoEs, it is anticipated that similar assessments would reflect similar results.*

WRC, University of Khartoum, Sudan

The involvement of ministry officials during the opening of one of the HCD workshops, support from decision-makers was demonstrated, and was an affirmation of government buy-in that the courses are strongly relevant to the needs of the Sudanese water sector. In terms of impact, the training courses contributed to knowledge production in the Sudanese water sector, with 96 young professionals participated in the training. The training courses further contribute towards the reputation of the WRC as a knowledge producer and skills developer in the Sudanese water sector. As a contribution to a social impact, there was a clear gender balance with 54% of the attendees being female. From the interviews and questionnaires with the stakeholders' institutions after the pilot courses, indications are that the training was useful in enhancing the abilities of their professionals and hence the role of the institution in the development of the water sector. The WRC further reported that the project created a good relationship with the stakeholder institutions which will enable the WRC to provide policy advice and also successfully carry out project activities in the future that serve the needs of these institutions.

Impacts and pathways to impact

Further evidence can be found where HCD activities in the ACEWATER II project actually contributed to policy interventions where, for example in Nigeria, the HCD activities in the ACEWATER II project contributed to policy interventions and stimulated the NTCWR to request and approve mandatory courses for the local water sector. In addition, Nigerian government agencies were directed to sponsor their staff for further training especially at the NWRI.

In Mozambique, the Ministry of Science and Technology actively took ownership of the HCD process initiated by IWEGA at Universidade Eduardo Mondlane to identify skills needs for the water sector, and which resulted in key proposals to skills development in the country. These are some examples of evidence of policy interventions and impacts.

In all activities, the specific (and budgeted for) activity in the ACEWATER II project to organise in-country consultation and validation workshops and the series of regional stakeholder workshops created pathways to impact and contributed to building wider

ownership of the process with and within key-stakeholder institutions such as ministries and relevant government institutions, and the Centres of Excellence. Concerning the element of additionality, relationships with key-stakeholders were developed over time, which contributed towards the success of the activity. However, the ACEWATER II project leveraged these relationships to new levels during the validation and regional workshops and meetings, thus having a beneficial impact on the role the AUDA-NEPAD Water CoEs have to play in research and capacity development.

General Recommendations

Based on the results of this study, the following section presents both general recommendations and specific recommendations.

- Even though it can be regarded as standard practice, the case related to joint learning confirmed that during the *development stages* of a project proposal, even before the project was commissioned, key stakeholders needed to be engaged in designing activities. This required time and effort, but as demonstrated by the AUDA-NEPAD Water CoEs, such engagement can be built over time, and existing relationships can be leveraged to provide input into project development. This study confirms the value of well-designed workshops that span multiple days that should not be underestimated, as they need to provide ample inputs for researchers, key stakeholders and decision-makers to make presentations, deliberate and provide input into eventual deliverables.

- Even if key stakeholders were not involved in the early design stages of the project proposal, activities such as workshops and validation workshops needed to be undertaken during the *research process* itself, where key stakeholders could contribute, as it contributed towards the uptake of the outputs – in this case, the pilot courses.

- Where decision-maker support is required in a project, this study confirms that specific actions such as the HCD Framework *validation workshops* added value to a project. Such ownership of decision-makers in the validation workshops significantly contributed to the support of deliverables.

- The *timing* of the sector-wide impact assessment was important. Initial actions related to impact assessments should preferably be undertaken as early as the project design stages of a project.

- In future projects, impact assessments should be designed in such a way that they support and feed into and benefit from results of an M&E activity, from the outset of the project. The symbiosis should be established where the M&E activity identifies project outputs, and the impact assessment activities would focus on project outcome and impact pathways.

Specific Recommendations

- To measure longer-term impacts of this support which will materialise over time, it is recommended that the participation in courses is monitored, evaluated and analysed over the longer term. This must include continuous and/or follow-up monitoring of outputs and reported benefits.

- This impact assessment focused on the HCD activities of the ACEWATER II project which were undertaken between 2016 and 2020. There is evidence in this study that the impacts that were realised in this project could not have been realised in isolation from the other project's science and research-oriented activities, and that, for example, research and capacity development activities from ACEWATER I (2009 to 2015) and possibly other projects in WASSCAL, SASSCAL and the Pan African University contributed towards impacts. The evidence of such additionality of activities should be investigated to capture a wider range of impacts of the ACEWATER project.

- The impact of the implementation of the pilot courses is being affected by the redesign of the HCD activities in the ACEWATER II project towards online teaching and learning, due to the impact of COVID-19. An initiation of an impact assessment in the early stages of this re-alignment of activities, can contribute greatly to potential pathways to impacts being identified and monitored early in the adapted activities, and contribute to future design of activities.

WANWATCE – West African Network of Centres of Excellence on Water Sciences and Technology of NEPAD

Introduction

As outlined in Chapter 1, the CoE Partners in the West African Region participating in the ACEWATER II HCD activities are:

WANWATCE (West Africa Network of Centres of Excellence)

- L'Université Cheikh-Anta-Diop (UCAD) in Senegal - Secretariat
- Kwame Nkrumah University of Science and Technology (KNUST) in Ghana
- National Water Resources Institute (NWRI) in Nigeria
- University of Benin (UNIBEN) in Nigeria

The WANWATCE network undertook sector-wide analyses in their countries to identify HCD skills gaps and needs, supported by surveys, interviews and followed by consultations at national level to develop and validate National HCD Frameworks for each country. In all countries, many HCD gaps and needs were identified, with a short list prioritized for piloting. UCAD as the WANWATCE Secretariat coordinated the HCD activities of the CoEs in the region and centralized the reports back for individual countries.

Regional Perspective on HCD Priorities

The results of the individual sector-wide assessments were for all countries were combined to present a picture of what the region's top HCD priorities were for their water sectors. Figure 29 below shows the distribution of the HCD Priority themes for the West African Region.
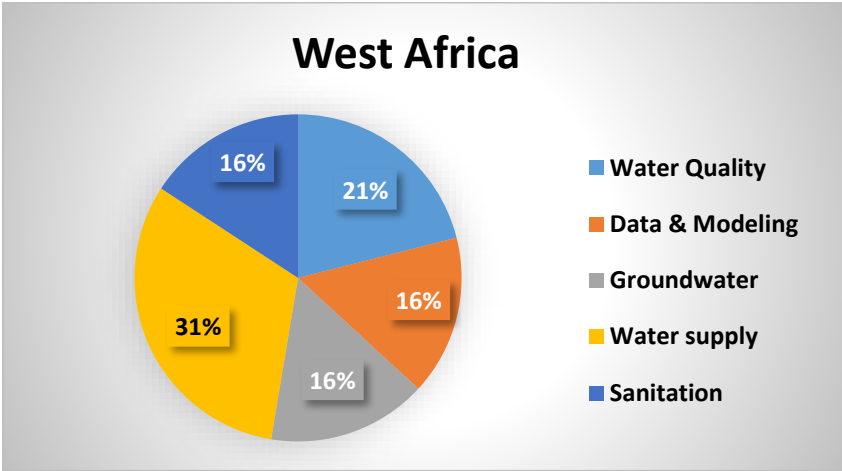
Figure 28: West Africa Human Capacity Development priorities

Water Supply and Water Quality are the themes in which the highest number of priorities are found, while Management and Administration are not identified as being one of the top priorities to be addressed by the ACEWATER II project. On a regional level HCD gaps are significant for all three countries in operational and technician work areas such as data collection and measuring, water supply infrastructure operation or drinking water treatment plants. In the following Country Sections for West Africa, the results of for each country's sector-wide assessment will be presented. However, for a comparative analysis, the following observations can be made on priorities within themes:

1. Water supply: high number of priorities in all countries (especially Nigeria), but none in Senegal

2. Sanitation: only a key priority theme in Ghana
3. Data and modelling: a main priority theme for Senegal, while few in other countries
4. Groundwater: high priority theme in Nigeria, while no priority in the other countries

In consultations with the Regional Economic Community ECOWAS during regional and annual ACEWATER II meetings, their main priority has been consistently the promotion and development of IWRM. What is interesting in this strategy is that IWRM is not the highest HCD sector priority for most of the CoE partner countries in West Africa. This does demonstrate the difference in perspective from regional actors and national level actors and national priorities, and the need to first focus on national level sector-wide analysis. That said, a more active dialogue between ECOWAS and WANWATCE can contribute to bringing the two perspectives closer together and build a stronger foundation for regional HCD priorities.

Adapting to COVID-19

Because of the COVID-19 pandemic, the CoEs were subjected to restrictive access measures to abide to social distancing and to reduce the risk for the students. Most of them were able to adapt to a certain extent, and have been using online tools for the lectures, discussions and assignments. Most of the WANWATCE institutions were not prepared for a rapid switch to online learning, and academics had were confronted with increased workloads to prepare online materials for E-learning. General observations from the CoEs indicate that it was easier to mount E-learning course / modules for theoretical training, usually at HE Level, whereas a number of planned-for technical trainings at TVET level, which required laboratory or field work, had limited implementation or were not implemented at all. In the following Country Profile sections it is shown that in some cases courses falling within the theme of Management and Administration were introduced (see also Figure 22 in M&E section).

Country Results and Analyses

Senegal

University Cheikh Anta Diop (UCAD) Dakar

Sector-wide Analysis

National priorities in the water and sanitation sector in Senegal are defined by the Sectoral Development Policy Letter (SPSD), covering the period 2016 to 2025. In line with the ACEWATER II focus, and the drafting of a National HCD Framework, a sector-wide analysis was conducted to supplement quantify the existing focus.

The results of this sector-wide analysis indicated that there are various academic and polytechnic institutions with professional and private institutions supporting research and human capacity development in Senegal.

An important component of this analysis included consultations and the validation of the results and to ensure the buy in of all stakeholders. The sector needs and skills gaps were broadly discussed and culminated in the development of a National HCD Frameworks.

In Senegal, the situation is slightly different from Ghana and Nigeria, with a unified water sector and central coordination, legislation and clearly defined policies in line with the African and global agenda. Access to water and sanitation has been one of the national priorities defined by the various governments for several decades. However, since 2012 the situation seems to be more complex with the implementation of the Senegal Emerging Plan (PSE), which aims to achieve self-sufficiency and food security in the country by 2035.

One of the major limitations of the sector since 2013 is the lack of qualified technicians and senior technicians for the implementation of operational work in the water sector. While top management is well-staffed, the operational sector is struggling to find skilled workers. There is a need of implementing a water capacity development strategy targeting sector staff, while strengthening and deepening their knowledge on water resources.

The results of the sector-wide analysis showed that various training courses needed to be developed to fill the human resources capacity gaps and support the development of junior and senior technicians and professionals.

Priorities

National priorities in the water and sanitation sector in Senegal are defined by the Sectoral Development Policy Letter (SPSD), the latest dates from November 2017 and covers the period 2016 to 2025.

Longlist of priorities

From the sector-wide analysis and consultations, a long list of human resources capacity gaps was identified as particularly important as priority needs in the country's water sector:

1. Wastewater treatment
2. Management of sludge
3. Knowledge of ERs
4. Modern drilling techniques
5. Groundwater quality
6. Groundwater protection and pollution management
7. Project Management
8. Negotiations and financing of the water sector
9. Water security and sustainability of AEP systems
10. Standardisation and application of charters
11. Modern irrigation techniques
12. Water saving and protection of resources
13. Drainage water management
14. Management of pollutants and pollution of agricultural origin
15. Technological innovations
16. Modelling
17. Geomatics applied to the management of water resources

Shortlist of priorities

Following a final national consultation and a validation workshop, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps:
1. Water and waste water treatment;
2. Groundwater management;
3. Water for agriculture;
4. Water technology and innovations.

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:
1. Water Quality
2. Water modelling
3. GIS

The proposed course / module contents fall within the following two main themes shown in Figure 30:
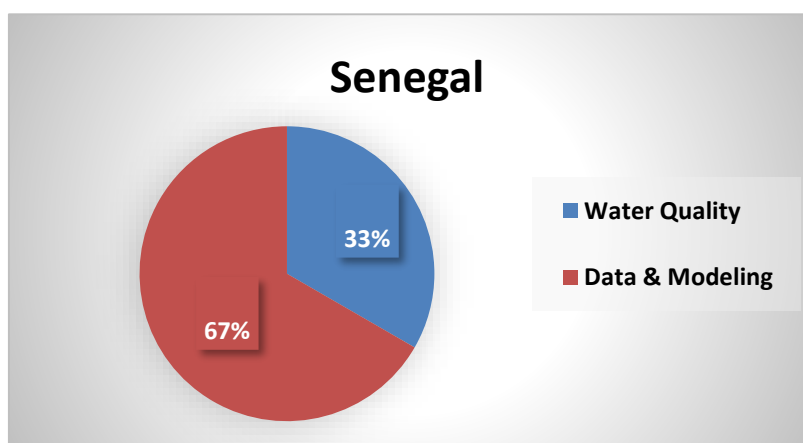
Figure 29 Distribution of course / module content within themes for UCAD

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, UCAD identified which additional resources were needed for them to continue. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Human Resources (Teaching Assistants, Technicians, Instructors)	Partially	Yes	Partially	Yes
Training Materials (Data, information, presentation graphics, video, other)	Partially	Yes	Partially	Yes

Table 4: Existing resources available and additional resources needed for e-learning

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	**Prepare HCD Courses**		**Deliver HCD Courses**	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Partially	Yes	Scanner A3	Scanner A0 Plotter
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	Partially	Yes	MS Teams (UCAD) Video conference equipment (UCAD2)	Licence Zoom &/or Video conference equipment

Software, or software updates for earth science or social science modelling	Partially	Yes	Arc GIS Erdas Imagine Surfer	Licences Arc GIS, Mike 01 year
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables	Partially	Yes	Drone Mavic 2 GPS	Drone Mavic2 Pro Differential GPS

Table 5: Hardware, software and consumables for digitalisation, online and e-learning

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended). Figure 31 below shows that adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes:
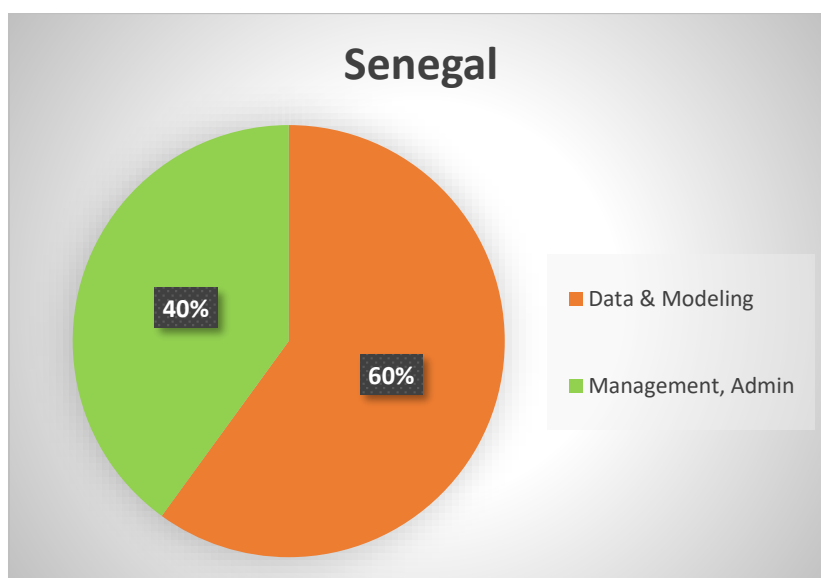
Figure 30 Distribution of adapted planned and implemented course / modules for UCAD

Data & Modelling remain predominant as a theme, but training addressing a Management-related theme replaced the originally planned trainings addressing Water Quality. After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended), the following course/modules in Table 6 were adapted and planned for implementation:

Course title	Target group	Status	Type	Number of participants
Project Management in the Water Sector	Senior Professional	implemented	E-Learning	63
GIS and Remote Sensing technologies applied to Water and Sanitation Management	Junior Professional	implemented	Blended	39
Hydrological Modelling using SWAT	Junior Technician	implemented	Blended	30
Introduction to UAV photogrammetry	Junior Professional	implemented	Blended	28
Development of institutional and regulatory frameworks	Senior Professional	Not Implemented	E-Learning	

Table 6 List of adapted planned and implemented course / modules for UCAD

The pilot course / module on Development of institutional and regulatory frameworks was not implemented due to time constraints at end of project.

Conclusions and recommendations

Conclusions

The inadequacy of human resources in Senegal is a huge constraint to good governance of the water and sanitation sector in Africa in general. While there are highly qualified professional human resources, according to the sector-wide analysis, one of the major limitation s of the sector is the lack of qualified junior and senior technicians for the implementation of operational work in the water sector. While top management is well staffed, the operational sector is struggling to find sufficient skill staff.

Recommendations

The following actions are recommended:

- The establishment of a single consultation framework for the water sector, based on the observation of the lethargy of bodies such as the Superior Council of Water or the non-involvement of structures such as the Economic and Social Council and Environment.
- The implementation of a water capacity development strategy for upgrading water sector staff, based on a regular assessment of real human resource needs.
- The annual organisation of 'information water days' extended to all stakeholders, communities and research and training institutions,
- Strengthening and deepening knowledge on water resources (surface and groundwater), including the publication of a national water atlas of Senegal and regular hydrological bulletins.

- Initiate a deep reflection on seawater desalination techniques and technologies, extended to all stakeholders concerned and / or impacted in order to consider benefits as well as risks.

Ghana

Kwame Nkrumah University of Science and Technology (KNUST), Ghana

Sector-wide Analysis

The HCD sector-wide analysis of the Ghana water sector showed that there are knowledge and skill gaps for newly employed staff for design, operation and maintenance of water supply systems. The lack of engineering Professionals in sanitation was due to the unattractive salary and benefits in the Metropolitan/Municipal/District Assembly (MMDAs). There are a number of technical professionals or degree holders with technical skills in the sanitation subsector. Even though there are over 3,000 Environmental Health Workers with diploma and degrees in Environmental Health, most of them lack the technical skills in design, operation and maintenance of sanitation installations and facilities. No specific training programme for technicians in design, construction and maintenance of water and environmental sanitation infrastructure exists.

Priorities

The sector-wide analysis and consultations identified training needs related to water resources, water supply, environmental sanitation and environmental health and hygiene. A total of long list of 25 needs and skills gaps, some general and some very specific, were identified as follows:

1. Sanitary Engineers
2. Dam Safety officers (with Civil, Structural, hydrology, geology)
3. Hydro-geologists
4. Sediment/costal engineering specialists
5. Remote sensing and GIS specialists
6. Fish Genetics specialists
7. Macro Invertebrate specialists
8. Phycologist (algae) specialists
9. Cartographers
10. Agronomists
11. Water resources modelling (surface and sub-surface)
12. Eco-toxicology
13. Ecological assessment and modelling
14. Water and sanitation engineering
15. Sustainable infrastructure management
16. Water asset management and financial management
17. Water treatment technology
18. Information, communication technology for water management
19. Integrated water resources management
20. Policy and planning for water infrastructure
21. Operations and utility management
22. Operations and Plant maintenance
23. Environmental law
24. Climate change and development
25. Disaster and risk management

Shortlist of priorities

Following a final national consultation and a validation workshop, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps:
1. Water Resources management and development
2. Water Supply

3. Environmental Sanitation
4. Environmental Health and Hygiene

Pilot HCD training courses / modules at HE and TVET levels adapted to e-learning

Following a final national consultation, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps:

Higher Education level:

1. Waste resource recovery and entrepreneurship
2. Onsite sanitation and faecal sludge management
3. Water safety management

Technical Vocational Education level:

1. Waste and water laboratory instrumentation skills for technicians
2. Electro-mechanic instrumentation skills for technicians
3. Sanitation technology construction for technicians

The proposed course / modules to address the priorities fall into the following main themes as shown in Figure 32 below:
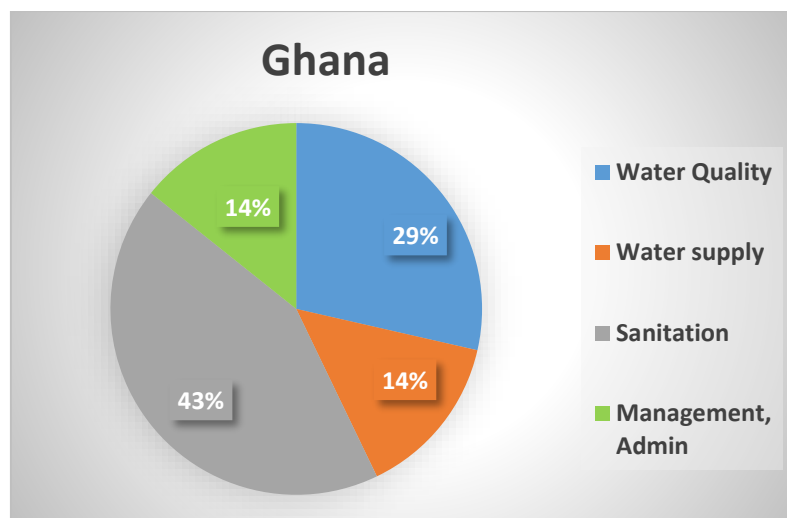
Figure 31 Distribution of course / module content within themes for KNUST

The Regional Water and Environmental Sanitation Centre (RWESCK) of KNUST aims to further develop these courses into a postgraduate diploma, which will make the programmes attractive to WASH sector employees and for future participants. The National Board for Professional and Technician Examinations (NABPTEX) is ready to provide accredited certificates for the three training courses to be run for the non-tertiary technicians. These courses will be further developed and run as Higher National Diploma (HND) Programmes for future career seekers in the WASH sector.

Impact of Covid-19

The ACEWATER II project performed preliminary analysis on both the capacity and the potential needs for each CoE to implement online e-learning courses. The tables below illustrate KNUST's current capacities such as materials and hardware; software, licenses, fees and data; HR, staff and tech support that ultimately affect their readiness for online e-learning.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Human Resources (Teaching Assistants, Technicians, Instructors)	Six resource persons		Yes	
Training Materials (Data, information, presentation graphics, video, other)	Presentation slides for one course	Course handouts, video, presentation slides to be developed for courses	No	yes

Table 7: Existing resources available and additional resources needed for e-learning for KNUST

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	No	Yes	No	Yes
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	No	Yes, dedicated online/ e-learning studio needed. Cameras,	No	Yes, dedicated online/e-learning studio needed

Table 8: Hardware, software and consumables required for digitalisation, online and e-learning for KNUST

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended). Adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes as shown in Figure 33 below:
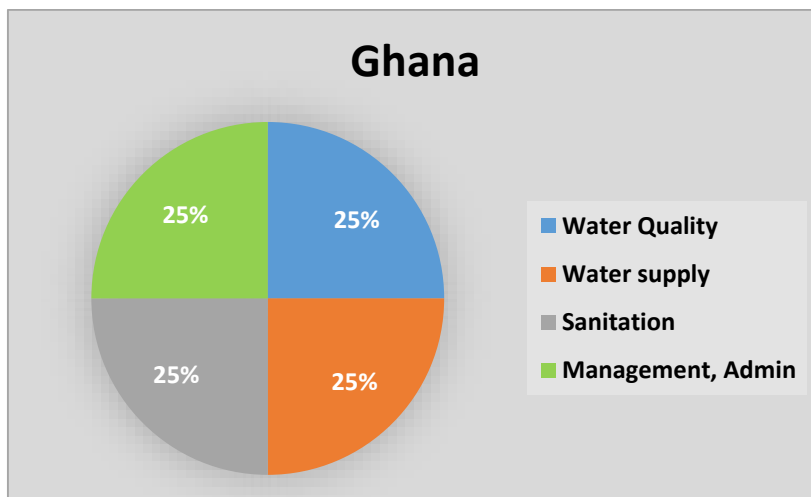
Figure 32 Distribution of adapted planned and implemented course / modules for KNUST

Table 9 shows the list of course/modules which were adapted for implementation. However, due to restrictions linked to COVID-19, blended courses could not be implemented, with only the on-line E-learning modality presented.

Course title	Target group	Status	Type	Number of participants
Sustainable Onsite-Sanitation and Fecal Sludge Management	Junior Professional	implemented	E-Learning	62
Water laboratory instrumentation	Senior Technician	Not delivered	Blended	-
Water systems instrumentation	Junior Technician	Not delivered	Blended	-
Waste resource recovery innovations and entrepreneurship	Senior Professional	Not delivered	Blended	-

Table 9 List of adapted planned and implemented course / modules in KNUST

Conclusions and Recommendations

Conclusions

To build capacity in the WASH Sector, the HCD strategies in terms of the roles, responsibilities and resources of Government Ministries, Agencies, WASH Sector Organisations, individuals and Training Institutions were identified. The National Water Policy and environmental sanitation policy support the human capacity development for the water resources management, urban water supply and community water and environmental sanitation. The water sector Organisations, Ministries, Agencies and Departments are tasked to build capacity for service delivery. They have various forms of human capacity development strategies and service delivery goals. The current service levels and access to services show there is the need for capacity building at all the three levels. The capacity development of the individuals alone is not effort without organisational or institutional capacity development.

Recommendations

A wide range of actions can be recommended to further address the HCD skills gaps and needs for Ghana's water and sanitation (including environmental sanitation and environmental health and hygiene) sectors:

1. Certified short-term courses are equally, if not more, important than long-term training for both quick response to HCD gaps and to allow for in-service training.
2. Training institutions should attract funding from industry, lead in curriculum development with inputs from, and constant interaction with, industry to bridge the gap between academia and industry.
3. While there is a need to address larger shortfall for technicians, there is also a need for short courses to include young professionals to be trained in environmental laws and policies; behaviour change communication in WASH; and entrepreneurial skills in WASH.
4. Government should provide funding through budget allocations and specialized projects; training institutions may attract funding through proposal development, marketing, partnerships and other innovative fundraising strategies.

Nigeria

National Water Resource Institute (NWRI), Nigeria

Sector-wide Analysis

The National Water Resource Institute (NWRI) implemented a sector-wide analysis for the water sector from the Kaduna State Region, identifying the scale and scope of the water sector HCD gaps and needs, and identifying a spectrum of training needs to address these gaps. Training needs were identified at federal, state, and local government agency (LGA) levels. The sector-wide analysis showed that there are three major types of *training service providers* in Nigeria; accredited service providers, further education training and higher education training.

Priorities

The sector-wide analysis and consultations identified training needs related to water resources, water supply, environmental sanitation and environmental health and hygiene. A total of long list of 25 needs and skills gaps, some general and some very specific, were identified as follows:

1. Plant/maintenance & operation,
2. Field Assistant / Drivers
3. Mechanical Engineering
4. Animal Science / Livestock
5. Water Resources Engineering
6. Microbiology
7. Agronomy
8. Computer / System Analyst
9. Hydraulic Engineers
10. Office Assistant / Clerical
11. Artisans and technicians (e.g. boiler makers, welders, plumbers, drillers)
12. Water Analyst
13. Administrative Officers
14. Mining Engineering
15. Agriculture/Agricultural Engineering
16. Geography
17. Policy
18. Environmental Health / Sanitation

Shortlist of priorities

After validation, it was decided that eleven courses will be delivered by NWRI in the years to come. Trainees' feedback will be integrated to further optimise the different courses. In addition, the training strategy and plan includes equipment, tools and materials required for their implementation and methods for monitoring and evaluation. The courses are listed below:

Higher Education level (young professionals and technicians):

1. Short course in Borehole Drilling
2. Short Course in Plumbing

Higher Education level (senior professionals):

1. Short Course in Borehole Supervision and Management
2. Induction course for Fresh Engineers and Scientists

The proposed course / modules to address the short list of priorities fall into the following main themes as shown in Figure 34 below:

NWRI

- Management, Admin — 40%
- Groundwater — 40%
- Water supply — 20%
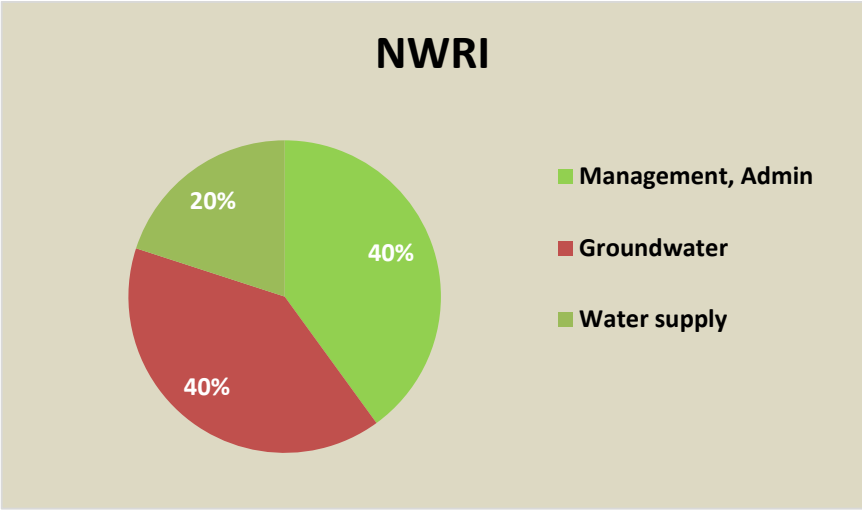
Figure 33 Distribution of course / module content within themes for NWRI

Groundwater is a major source of water supply for parts of Nigeria, which struggles to apply the necessary and extensive regulation and control in order for this resource to be managed sustainably. Thus the high importance in order of priority for not only the technical aspects of groundwater supply but also for supervision and management. The induction course for new engineers and scientists also contains a management component.

Impact of Covid-19

In response to the Covid-19 outbreak, the NWRI participated in the ACEWATER II Risk Mapping and E-readiness to identify their capacity and needs in order to implement adapted training interventions from face-to-face to e-learning platforms. Additional resources were needed. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Human Resources (Teaching Assistants, Technicians, Instructors)	Yes	No	Yes	No
Training Materials (Data, information, presentation graphics, video, other)	No	Yes	No	Yes

Table 10: Existing resources available and additional resources needed for e-learning for NWRI

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	**Prepare HCD Courses**		**Deliver HCD Courses**	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	No	Yes	No	Yes
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	No	Yes	No	Yes
Software, or software updates for earth science or social science modelling	N/A	N/A	N/A	N/A
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables	No	Portable field equipment, water lab facilities	No	Portable field equipment, water lab facilities

Table 11: Hardware, software and consumables for digitalisation, online and e-learning for NWRI

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended), adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes as shown in Figure 35 below:
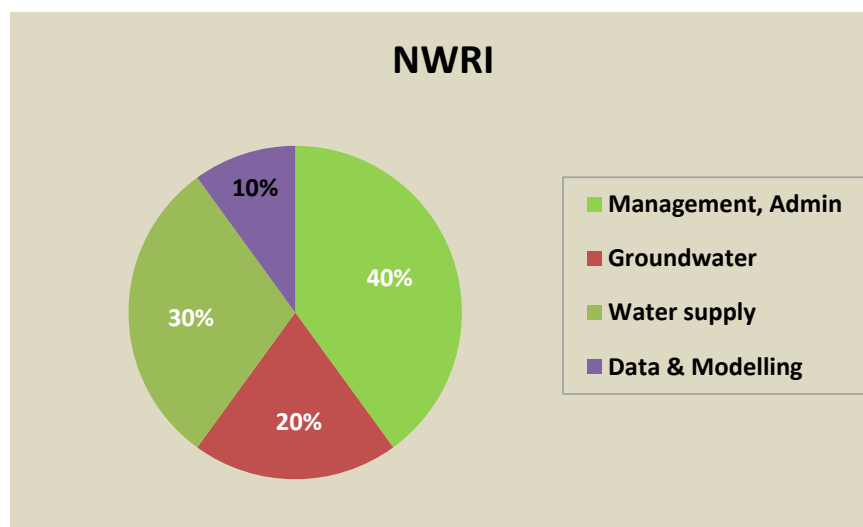
Figure 34 Distribution of adapted planned and implemented course / modules for NWRI

Extra course content now included components of Data & Modelling, and there were more short course / modules developed with an increased orientation to Management, Admin. Table 12 shows the list of course/modules which were adapted for implementation. One course was fully implemented on-line with E-learning modality, while 6 short course / modules could be presented with some face to face sessions in blended learning modality. Additional course /modules have been designed but were not able to be implemented within the project duration.

Course title	Target group	Type	Participants
Borehole Supervision and Management	Senior Professional	E-Learning	68
Borehole Drilling	Senior Professional	Blended	29
Induction course for Fresh Engineers and Scientists in the Water Sector	Senior Professional	Blended	15
Billing and Revenue Generation Management	Senior Professional	Blended	8
Plant and Equipment Maintenance	Junior Professional	Blended	6
Water Network Modelling, Network O&M, Non-Revenue Water Management and Leak Detection	Senior Professional	Blended	6
Water Treatment, Production Processes and Optimization, WTP Operation and Maintenance	Senior Professional	Blended	5

Table 12 List of adapted planned and implemented course / modules in NWRI

Conclusions and Recommendations

Conclusions

Manpower development and training for institutional strengthening and capacity development are critical requirements for improved service delivery in the water sector in Nigeria. Capacity and skills assessment assist in providing insights and guide to the development of manpower and trainings to address identified capacity gaps. The training needs presented covered a wide range of areas for the water supply and sanitation as well as irrigation sub-sector at Federal, State and LGA levels.

Recommendations

Decision-makers in education, health and water- and sanitation sectors should be sensitised to embed human resource development in their sectors. Succession planning for the existing sector staff is needed to develop and maintain mentoring policy. Short-term training such as refresher training for people who need to upgrade their knowledge and skills in the identified areas of need, in-house on-the-job training for those whose job schedule may not allow them to leave their organisation, and long-term training not available in the country, such as IWRM, should be introduced by capacity building institutions, such as the NWRI. The development of an induction training package for fresh engineers or scientists entering the sector and follow-up after training is recommended to ensure that skills and knowledge acquired during training are put more effectively into practice.

Nigeria

University of Benin City (UNIBEN)

Sector-wide Analysis

The University of Benin City contributed to the sector-wide survey of Nigeria, identifying the HCD skills gaps and training needs in the water sector with a range of activities including surveys, consultations and workshops. UNIBEN's survey was particularly wide-reaching and included up to 95 participants across the following sectors:

- Universities
- Polytechnics
- Monotechnics
- Research Centres/Institutes
- Government Ministries, Agencies and Parastatals responsible for WASH matters (State and Federal)
- Local Government Councils
- Non-Governmental Organizations (NGOs)
- Private Organizations
- Consultancy companies and Professional Bodies

Results from the various respondents and from various reports reviewed indicate generally a downwards trend in the availability of skilled manpower in water and water-related sectors at all levels (financial systems capacity, public institutions, local government staff capacity, private operator and civil society). The respondents were also asked to provide information on their awareness of any capacity development strategies in Nigeria and the responses indicate that as many as 65% were unaware of any HCD actions or services. That said, the remaining respondents identified a wide range of approaches skills development including:

- Further Education Training (FET)
- Higher Education Training (HET)
- Technical Vocational Education Training (TVET)
- In-service Training
- Internships
- Mentoring
- Recognition of Prior Learning (RPL) short courses

Aside the HET and TVET educational institution offerings, it is clear that the private and public sectors can play a strong role in HCD for Nigeria's water sector.

Priorities

Longlist of priorities

1. Water Treatment,
2. Research and Development,
3. Construction Project Managers,
4. Environmental Health
5. Chemical Engineering
6. Water Conservation
7. Agriculture and Agricultural Engineering
8. Coastal Engineering
9. Waste Disposal
10. Financial Management

11. Waste Handling
12. Climatology
13. Occupational Health and Safety Skills
14. Sanitation
15. Conflict Resolution/Mediation
16. Institutional Management
17. Plant Maintenance and Operation
18. Rainwater Harvesting Technologies
19. Freshwater Systems
20. Marketing and Communications
21. Cultural and Social Science
22. Environmental Law
23. Hydrochemistry
24. Geochemistry
25. Industrial Ecology

Shortlist of priorities

The training needs that were identified pertained to junior professionals (fifteen) and technical training (eight). After the validation workshop, three courses were shortlisted on both junior professional and technician/artisan professional levels.

Higher Education level:

1. Water supply/ environmental engineering
2. Remote sensing and Geographic Information System (GIS)
3. Water treatment techniques

Technical Vocational Education level:

1. Operation and maintenance of pumps
2. Operation and Maintenance of water distribution systems
3. Borehole Drilling and Construction

The proposed course / modules to address the short list of priorities fall into the following main themes as shown in Figure 36 below:
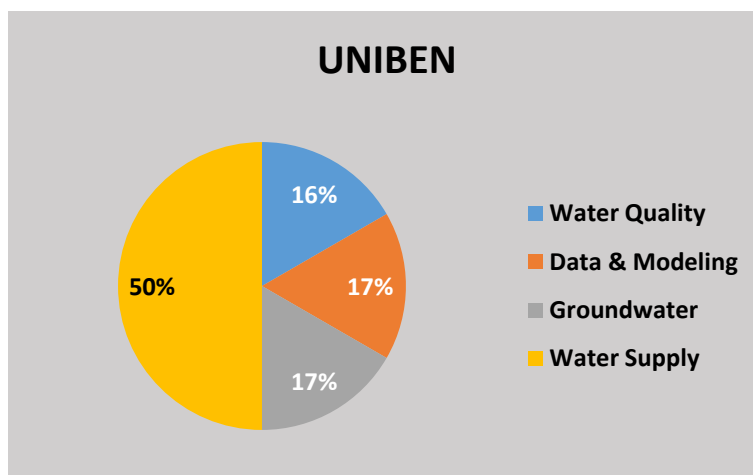
Figure 35 Distribution of course / module content within themes for UNIBEN

Impact of Covid-19

With the COVID-19 outbreak in Nigeria, no travel or face-to-face interactions could take place, which directly affected the implementation of the HCD pilot course / modules. In response the UNIBEN implemented an initial risk assessment which was later followed the

E-readiness survey of its institution to apply on-line and e-learning modalities. In order to implement the adapted training interventions from face-to-face to e-learning platforms, additional resources are needed. The table below, list what existing resources are available and what additional resources are needed by UNIBEN.

The ACEWATER II project performed preliminary analysis on both the capacity and the potential needs for each CoE to implement online e-learning courses. It is clear from the table that materials and equipment would be needed to switch from face-to-face tuition to e-learning.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Human Resources (Teaching Assistants, Technicians, Instructors)	Yes	No	YES	No
Training Materials (Data, information, presentation graphics, video, other)	No	Yes		Yes

Table 13: Existing resources available and additional resources needed for e-learning

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	No	Yes	No	Yes
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	No	Yes	No	Yes
Where relevant, for online or e-learning course implementation: 1. GIS, related software 2. Portable field equipment for survey, water quality/quantity measurement 3. Water laboratory facility materials or consumables		Portable field equipment, water lab facilities		Portable field equipment, water lab facilities

Table 14: Hardware, software and consumables for digitalisation, online and e-learning

Final courses / modules designed

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended), adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes as shown in Figure 37 below:
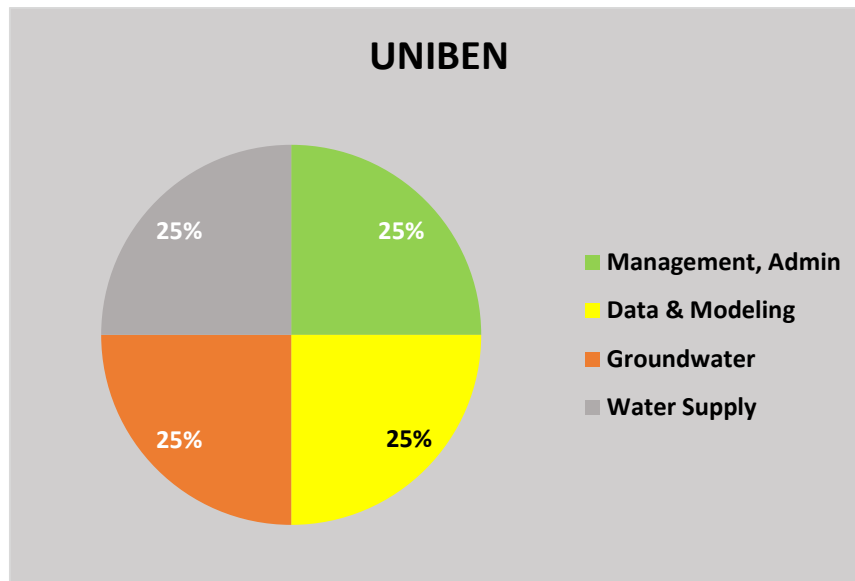
Figure 36 Distribution of adapted planned course / modules for UNIBEN

The Water Quality theme course / module was replaced by Water supply and Environmental Engineering, a course which is aimed at Management and Administration of water resources. Table 9 shows the list of course/modules which were adapted for implementation.

List of training courses planned by UNIBEN

Course title	Target group	Status
Operation and Maintenance of Water Distribution System	**Technicians / Seniors Professional**	Not Implemented
Borehole Drilling and Construction	**Technicians / Seniors Professional**	Not Implemented
Water supply and Environmental Engineering	**Young professionals**	Not Implemented
Remote Sensing and Geographic Information System	**Young professionals**	Not Implemented

Table 15 List of adapted planned course / modules for UNIBEN

Unfortunately, since June 2020 in addition to the particular constraints from the COVID-19 pandemic, Federal Universities in the country remained closed as a result of strike action and security concerns. This situation was not resolved by the end of the project and courses were not implemented.

Conclusions and Recommendations

Conclusions

An overview of the overall analysis shows that there exists a serious shortage of skilled manpower in most water sector organisations in Nigeria, hence the need for an effective

capacity building initiative and programmes that will help upgrade the level of knowledge and awareness in the Water sector. The need for a West Africa wide knowledge must also be encouraged and well-funded since it will help promote research and development especially in the area of capacity building. On the distribution of skills among respondent's organisations, it was seen that the majority of the skills are in civil engineering and hydrology, and that there exist very limited skills in the area of sector governance, cultural and social sciences, forestry, geochemistry, industrial ecology and environmental law.

It is clear that serious human resources shortages exist for skilled workers in most of the water-sector organisations in Nigeria. This illustrated the need for an effective human resources capacity building initiative and programmes exists, which would be funded by the government and help upgrade the level of knowledge and awareness in the water sector.

Recommendations

The universities in the region should focus more on research that will add values to the living conditions of the people of the region. The West African Centres of Excellence should work more closely together to foster much-needed integrated regional development.

1. Research driven capacity building should and must become a major focus in Nigeria in order to address the challenges relating to the non-availability of skilled manpower and also bridge the gap created due to the limited number of skills in the Nigerian water sector.
2. There is the need for public-private partnership especially in the provision of in-service training, internships and mentoring. More also adequate funding must be provided by the government at all levels.
3. The West African Centres of excellence should work more closely together in order to foster the much-needed integrated regional development.
4. The West African Centres of excellence should work more closely together in order to foster the much-needed integrated regional development.

SANWATCE – Southern African Network of NEPAD Water Centres of Excellence on Water Sciences and Technology of NEPAD

Introduction

As outlined in Chapter 1, the CoE Partners in the Southern African Region participating in the ACEWATER II HCD activities are:

SANWATCE (Southern African Network of Water Centres of Excellence)

- Council for the Scientific and Industrial Research (CSIR) in South Africa
- University of the Western Cape (UWC) South Africa
- Stellenbosch (Secretariat) – (SU) in South Africa
- University of Botswana, (UB) Botswana
- International Centre for Water Economics and Governance in Africa (IWEGA at Universidade Eduardo Mondlane) in Mozambique
- University of Malawi (UNIMA) in Malawi
- University of Zambia (UNZA) in Zambia

The SANWATCE network undertook sector-wide analyses in their countries to identify HCD skills gaps and needs, supported by surveys, interviews and followed by consultations at national level to develop and validate National HCD Frameworks for each country. In all countries, many HCD gaps and needs were identified, with a short list prioritized for piloting. SU as the SANWATCE Secretariat coordinated the HCD activities of the CoEs in the region and centralized the reports back for individual countries. National policy and legislative frameworks in the 5 countries acknowledge the importance of human capacity development in the water sector. In Malawi and Zambia for instance, legislation (Water Resources Act of 2013 and Water Resources Acts of 2011 respectively) state that funding for HCD in the water sector is to be financed from water abstraction levies through relevant water authorities. Yet, this is currently not in effect as relevant institutions to implement said provision have either not been formed as yet or are not fully functional. Overall, the challenges lie in the implementation of the policy or strategy.

National HCD initiatives – HCD capacity analyses - previously undertaken in the countries were not necessarily demand-responsive. Courses were developed and undertaken as part of donor-led/driven activities and not always in response to sector needs. As such, results and outcomes have, generally, not institutionalised and therefore not sustained. Most tertiary institutions often only offer academic programmes that do not address the skills required by industry. Thus, university graduates were felt to not possess requisite technical skills to accompany academic qualifications hence not job-ready, and while a host of Technical and Vocational Education and Training (TVET) institutions exist, the programmes offered do not adequately cater for the skills needed in the water sector

Regional Perspectives on HCD Priorities

The results of the individual sector-wide assessments were for all countries were combined to present a picture of what the region's top HCD priorities were for their water sectors.

Figure 38 below shows the distribution of the HCD Priority themes for the Southern African Region.
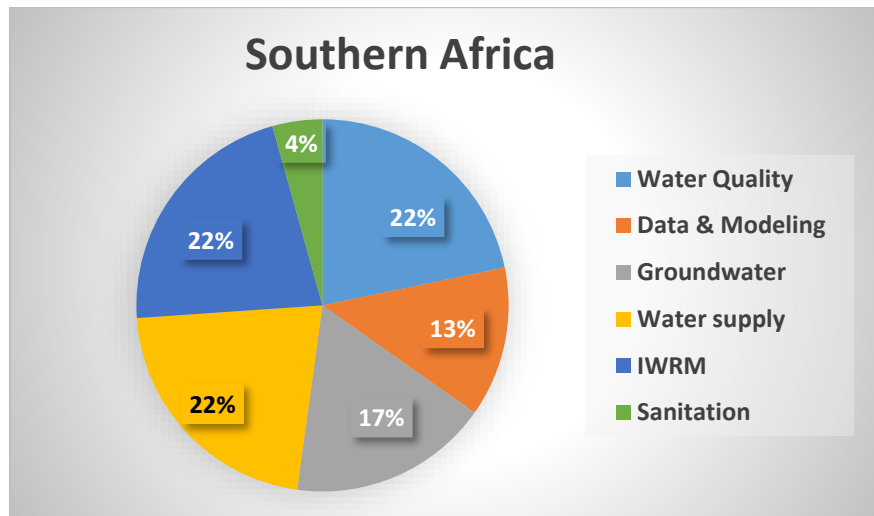
Figure 37: Human Resources Capacity gap priorities

Water Supply, Water Quality and IWRM are the themes in which the highest number of priorities are found, followed closely by Groundwater, while Management and Administration are not identified as being one of the top priorities to be addressed. On a regional level it was found that in all countries the water sector needs to produce more water technicians and acknowledged that training offered in the region was pegged at too high a level for certificate and diploma level trainees. In the following Country Sections for Southern Africa, the results of for each country's sector-wide assessment will be presented. However, for a comparative analysis, the following observations can be made on priorities within themes:

1. Water supply: a priority theme for all countries except for Botswana
2. Water Quality: a priority theme for all countries except for Zambia
3. IWRM: a priority theme for all countries except for Malawi
4. Sanitation: only a priority theme for Malawi
5. Groundwater: high priority theme for Botswana and Zambia, not in the other countries

The Regional Economic Community SADC has identified regional HCD priorities that correspond to their future strategy of industrial development for the region and the role of the water sector. While some priorities such as Climate and Economic Accounting diverge from those of the national water sector priorities, those such as Groundwater, Data and Monitoring & Evaluation are common. That said, SADC was very clear on the importance of national level sector-wide surveys on HCD gaps and needs, stating that the national-level surveys feed valuable information into the regional strategies and that it will be, at the end of the day, at the national level with SADC Member States that a regional strategy will be implemented.

Adapting to COVID-19

Because of the COVID-19 pandemic, the CoEs were subjected to restrictive access measures to abide to social distancing and to reduce the risk for the students. Most of them were able to adapt to a certain extent, and have been using online tools for the lectures, discussions and assignments. Most of the SANWATCE institutions were not prepared for a rapid switch to online learning, and academics were confronted with increased workloads to prepare online materials for E-learning. General observations from the CoEs indicate that it was easier to mount E-learning course / modules for theoretical

training, usually at HE Level, whereas a number of planned-for technical trainings at TVET level, which required laboratory or field work, had limited implementation or were not implemented at all. In the following Country Profile sections, it is shown that in some cases courses falling within the theme of Management and Administration were introduced (see also Figure 22 in M&E section).

Country Results and Analyses

Zambia

The University of Zambia (UNZA), Lusaka

Sector-wide Analysis

The sector-wide analysis for Zambia was implemented to identify HCD skills gaps and needs for their water sector. This involved a consultative process of meetings and discussions held with management and key officials from the Ministry of Water, Sanitation and Environmental Protection organisational structures, systems, policies and processes delegated to the Department of Water Resources Development (DWRD), the Water Resources Management Authority (WARMA) and the Water Supply and Sanitation Council (NWASCO). The process culminated in a national dialogue developed a priority list to inform the development of an HCD framework for junior professionals and technicians as well as an inform an implementation framework and M&E framework

Based on the findings from the dialogues, stakeholders reaffirmed that the implementation of HCD must address national planning aspirations.

Long list of Priorities

During the consultative process, the following priorities were identified by the stakeholders:

1. Operational hydrology
2. Dam safety
3. Hydrological modelling
4. Unmanned aerial surveying
5. Information Management
6. Regulation of Water Supply and Sanitation tools
7. Tariff setting processes and economic regulation
8. Water Resources Monitoring
9. Integrated Water Resources Management
10. Environmental Quality
11. Groundwater
12. Drilling Methods and Well completion
13. Field Hydrogeology
14. Pump Testing and Analysis

Shortlist of Priorities

Following a national validation workshop, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps with the following pilot course / modules:

1. Water resources monitoring
2. Environmental quality modelling
3. Field hydrogeology
4. Drilling methods and well completion

In Zambia, the proposed course / module contents fall within the following themes:
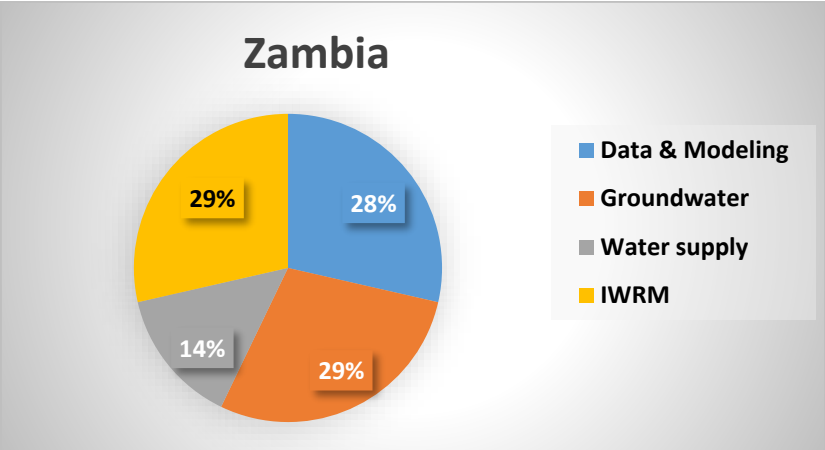
Figure 38 Distribution of course / modules content within themes for UBZA

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, UNZA identified which additional resources were needed for them to continue. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Human Resources (Teaching Assistants, Technicians, Instructors)	Teaching Assistants (2) and (2) technicians			
Training Materials (Data, information, presentation graphics, video, other)	PowerPoints and field data available			

Table 16: Existing resources available and additional resources needed for e-learning

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	**Prepare HCD Courses**		**Deliver HCD Courses**	
	Existing	**Needed**	**Existing**	**Needed**
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Moodle			
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities		Audio - visual tools required		Audio - visual tools required
Software, or software updates for earth science or social science modelling	PMWIN and GMS			
Where relevant, for online or e-learning course implementation: 1) GIS, related software 2) Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables	Multimeters, 3 GPS, Geophysics equipment (ERT, Resistivity and TEM)			Field instruments: multimeters, GPs, Dipmeter and digital discharge reader.

Table 17: Hardware, software and consumables for digitalisation, online and e-learning

Final courses / modules delivered

The course / modules decided upon for implementation within the COVID-19 context were:

1. Hydrogeology and Drilling Supervision training
2. Groundwater and Integrated Water Resources Management in practice

However, due to the lack of availability of key stakeholders and partners of the CoE in Zambia, it was not possible to implement the courses within the remaining time of the ACEWATER II Project.

Conclusions and recommendations

Conclusions

An enabling policy framework for skills development is in place, but problems remain with the implementation of skills development policies due to a variety of problems, especially financing. Studies conducted in the past by the Department of Water Affairs and other sector partners have made practical recommendations for meeting the skills and capacity needed to support the implementation of the New National Water Act and the Water Services Act, but only a limited number of these recommendations have been implemented. The lack of a coordinating body for training and capacity building for the water sector is hampering the effective development of skills required delivery in municipalities.

There is a mismatch between the water-related courses offered by tertiary institutions and the skills required by the water services institutions and / or including industry. Under the

current conditions, Zambia is threatened with a lack of/limited skilled technicians and professionals as there is no deliberate effort to ensure continuity. This problem is further compounded by new legal frameworks that have given the water sector new mandates. These mandates will not transform into meaningful development without skilled human capital especially at Junior Professional and Technician level.

Recommendations

The following actions are recommended:

- The Department of Water Resources Development and Water Resources Management Authority are new institutions with specific mandates. There will be a need for orientation courses to refocus the vision, mission and objectives of the Ministry and institutional mandates.
- The government should forge partnerships with other training institutions in and outside the country and implement policies of sponsorship, part time training and development, counterpart training, integrating learning with work.
- The Government should finance training and development activities through adequate budgetary allocations. Internships must be supported to allow graduates to acquire some industrial experience.
- Capacity building institutions must also continue to engage with industry to ensure that material is updated and responds to modern trends and demands.
- Further exploration of mechanisms in which experience would be recognised as a formal qualification (i.e. recognition of prior learning) besides knowledge-based certifications is highly recommended.

South Africa

Council for Scientific and Industrial Research (CSIR), Pretoria
University of KwaZulu Natal (UKZN), Durban
University of the Western Cape (UWC), Cape Town
Stellenbosch University (SU), Stellenbosch

Sector-wide Analysis

In South Africa, various initiatives are being implemented by the National Department of Water and Sanitation the water and sanitation sectors within a new Water and Sanitation Master Plan (2018), addressing various HCD needs. Under the Coordination of the SANWATCE Secretariat, the South African CoEs implemented a sector-wide analysis which reinforced quite closely the work of the Master Plan. Due to the recent timing of the Master Plan, there is there is the need for a structured and formalised Monitoring, Evaluation and Reporting (MER) Framework.

Priorities

The scoping and national dialogue found that capacity building institutions such as universities, have over the years introduced water related HCD programmes. Most of the programmes were developed in response to sector needs and were guided by the various policy and legislative instruments. However, such programmes continue to follow the liberal arts education philosophy of academic approach where academic theories/principles continue to be over-emphasised with limited practical skills and with almost no exposure to work experience. There was also a strong emphasis on the added value of Further Education Training (FET).From the country's scoping study report, six priority areas were identified:

1. Water planning and implementation
2. Water regulation requirements
3. Water monitoring and assessments
4. Institutional management and governance
5. Water resources infrastructure
6. Water use services and sanitation

In addition to the six priority areas based on the scoping study report, Monitoring, Evaluation and Reporting (MER) was identified to be implemented.

The distribution of the HCD skills gaps and needs for South Africa fall within the themes presented in Figure 40 below:
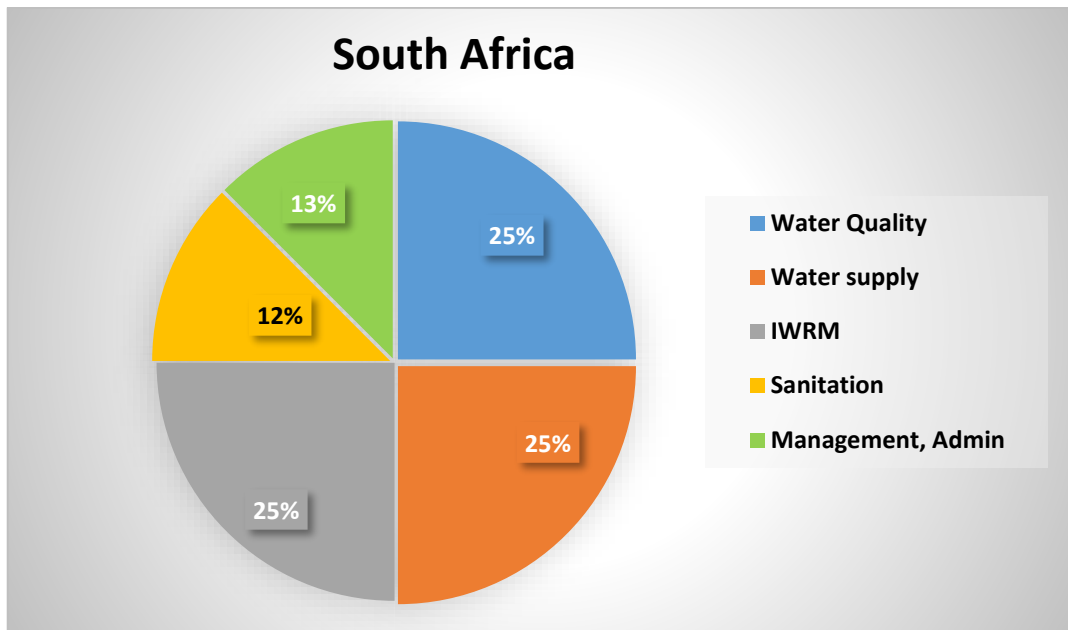
Figure 39 Distribution of main HCD Themes to be addressed for South Africa

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, CSIR and UWC identified which additional resources were needed for them to continue. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed to present e-learning courses at the CSIR and the University of Western Cape. Generally, the capacity and tools were attainable to switch to e-learning platforms.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	Needed	Existing	Needed
Human Resources (Teaching Assistants, Technicians, Instructors)	Teaching Instructors and Assistant	More Instructors, Assistants and Technicians	Teaching Instructors and Assistant	More Instructors, Assistants and Technicians
Training Materials (Data, information, presentation graphics, video, other)	Data, Information, graphics, videos	Repackaging of training material, additional course data	Data, information, graphics, videos	Repackaging of training material for online learning

Table 18: Existing resources available and additional resources needed for e-learning for South Africa

Hardware, software, and consumables for digitalization, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	**Needed**	**Existing**	**Needed**
Hardware and software required for digitalization of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Some are available through institutional support [UWC]	Nothing needed	Some are available through institutional support [UWC]	Nothing needed
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	Some are available	No	Some are available	No
Software, or software updates for earth science or social science modelling	Some software packages are available	Not needed due to lockdown/restriction of movements to fields and practical tasks	Some software packages are available	Not needed due to lockdown/restriction of movements to fields and practical tasks
Where relevant, for online or e-learning course implementation: 3) GIS, related software 4) Portable field equipment for survey, water quality/quantity measurement 5) Water laboratory facility materials or consumables	Some are available	Not needed due to lockdown/restriction of movements to fields and practical tasks	Some are available	Not needed due to lockdown/restriction of movements to fields and practical tasks

Table 19: Hardware, software, and consumables for digitalisation, online and e-learning

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended). Figure 13 below shows that adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context (see Figure 40) within the following themes:
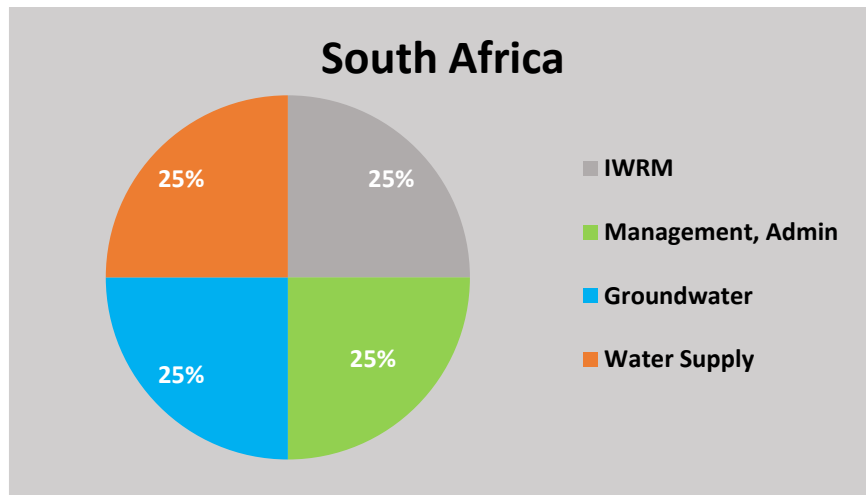
Figure 40 Distribution of adapted planned and implemented course / modules for South Africa

Four courses were presented online (see table 20 below), addressing four HCD theme distributions, now including Groundwater but with Sanitation and Water Quality not present (Figure 41).

Course title	Target group	Status	Type	Number of participants
Application of Academic Knowledge on Water Resource Management (WRM)	Junior Professional	implemented	E-Learning	124
Integrated Water Resource Management (IWRM) at the Workplace Environment: Theory and Practice				
Environmental Assessment & Management	Junior Professional	implemented	E-Learning	20
Introduction to groundwater hydrology	Junior Professional	implemented	E-Learning	99
Water Demand Management & Water Security	Junior Professional	implemented	E-Learning	5

Table 20 List of adapted planned and implemented course / modules for South Africa

Based on the country's scoping study report, six priority areas were identified, four courses were implemented online with E-learning modalities.

Conclusions and recommendations

Conclusions

There is a lack of monitoring of the existing policy, strategy and legislation on skill capacity initiatives, and coordination and collaboration among institutions involved in various initiatives. Inadequate linkages between academic and occupational-directed training programmes exist, as well as inadequate alignment between performance plans of agencies and type of water education being offered in capacity building institutions in terms of the curriculum (largely knowledge-based, practical skills), subjects (basic science subjects lacking for water students).

Recommendations

Based on the findings of the sector-wide analysis and above conclusions, the following recommendations can be made:

- An opportunity exists to design action plan for monitoring and evaluation and reporting the progress of the available initiatives about human capacity development in the water sector that would assess the impact, effectiveness, efficiency, relevance and sustainability of such initiatives. A good example would be to monitor, evaluate and report on the progress of the capacity development component of the 2017 draft of the National Water and Sanitation Master Plan.

- Sustained mentorship agreements should be developed to ensure sustainable supply of mentors for the interns at various levels
- A scoping study needs to be carried our yearly to capture new initiatives and institutions in the water sector on human capacity development.

Malawi

University of Malawi (UNIMA), Blantyre

Sector-wide Analysis

The sector-wide analysis undertaken by the University of Malawi confirmed that water sector skills gaps are in-line with current HCD needs prioritized by the Malawi Government. The new Water Resources Act (2013) has been updated with provisions for promoting the rational management and use of the water resources of Malawi. The Act spelt how the whole water sector can be revamped with regards to changing and institutions. It proposes new institutions, such as the National Water Resources Authority and catchment management authorities, which will create platform for some junior professionals to be provided with opportunity of employment. The sector however still faces some challenges despite the enactment of the updated water Act and other instruments that are available. Capacity building is one of the areas that have some key constraints and challenges. These challenges and constraints have direct impact on the junior profession and technical capacities in the sector. Some of the constraints and challenges are as follows:

1. Inadequate capacity and relevant skill set in the water sector. There is a high rate of vacancies in many departments and institutions in the water sector.
2. Need to introduce Water Resources Engineering School/Programmes with a specific focus on technicians, including necessary equipment for the delivery of the practical aspects of these and existing capacity building programmes.
3. Need to incorporate internship into existing programmes and formalise Memorandum of agreements (MOAs)/Memorandum of Understanding (MOUs0 between capacity building institutions and private sector and industry actors in the water sector

Priorities

List of Priorities

In the development of the national HCD Framework, a long list of human resources capacity gaps were identified as particularly important as priority needs in the country's water sector:

1. Engineering
2. Water Quality Monitoring
3. Pollution Control
4. Project management
5. GIS and remote sensing
6. Surveying, data collection
7. Communication
8. Leadership and management skills
9. Gender Analysis
10. Need to develop E-learning alternatives

Shortlist of priorities

Following a final national consultation and a validation workshop, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps:

1. Engineering
2. Water Quality Monitoring
3. Surveying, data collection
4. Project Management

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:

1. Water quality Modelling
2. Hydrological Modelling
3. Water Supply
4. Water and Sanitation Technology and Management

The proposed course / module contents, some of which are cross-cutting such as Water and Sanitation Technology, fall within the following main themes as shown in Figure 42:
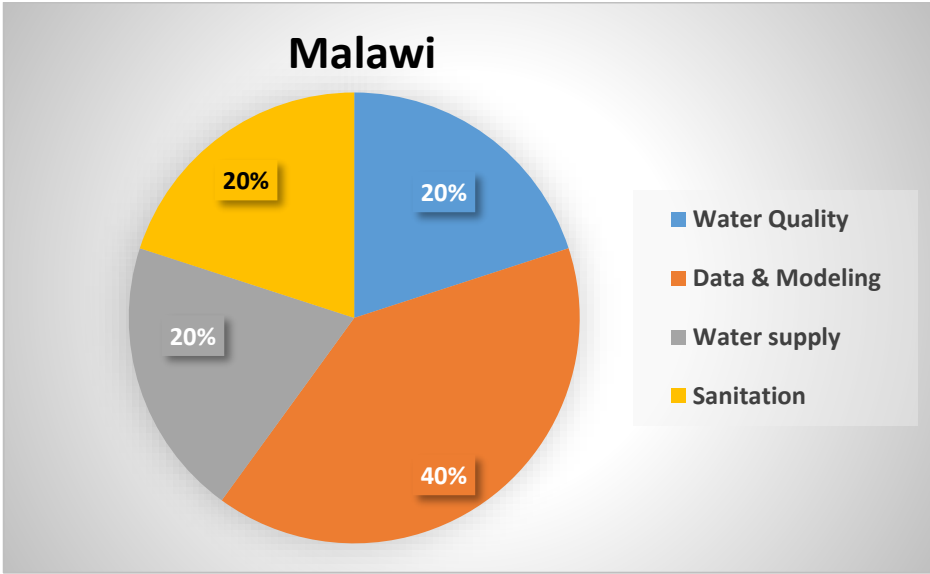
Figure 41 Distribution of course / module content within themes for UNIMA

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, UNIMA identified which additional resources were needed for them to continue. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Human Resources (Teaching Assistants, Technicians, Instructors)	Lecturers and ICT Technicians,	Teaching Assistants and Technicians	Lecturers, ICT Technicians	Teaching Assistants and Technicians
Training Materials (Data, information, presentation graphics, video, other)	E-books, Desktops, Microsoft Office	Data information, Presentation graphics, Video	E-books, Desktops, Microsoft Office	Presentation graphics, Video

Table 21: Existing resources available and additional resources needed for e-learning for UNIMA

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	**Prepare HCD Courses**		**Deliver HCD Courses**	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Desktops Microsoft Office	Laptops, Zoom Licence,	Desktops, Microsoft Office	Laptops, Zoom Licence
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	LCDs, Microphones	Smart Screen (A projector with interactive whiteboard functionality)	LCDs, Microphones	Smart Screen (A projector with interactive whiteboard functionality)
Software, or software updates for earth science or social science modelling	Hydrological model, Water Quality Model	Groundwater Model Licence	Hydrological model, Water Quality Model,	Groundwater Model Licence
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables	1	2,3	1	2
Other: Internet Data Bundles for staff and students		500 Gb for staff		2500 Gb for staff and students

Table 22: Hardware, software, and consumables for digitalisation, online and e-learning for UNIMA

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended). Figure 43 below shows that adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes:
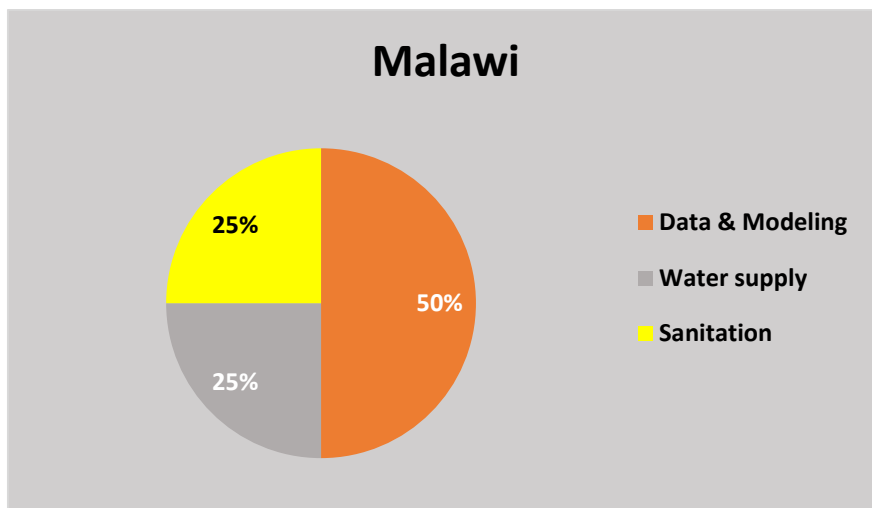
Figure 42 Distribution of adapted planned and implemented course / modules for UNIMA

Two courses address Data and Modelling, while one course addresses Water Supply and Sanitation. Water Quality as a priority theme is not directly addressed by a specific course.

Course title	Target group	Status	Type	Number of participants
Hydrological Modelling & Water Quality Modelling	Junior Professional	implemented	Face to Face	6
Water and Sanitation Systems	Junior Professional	implemented	Face to Face	10

Conclusions and Recommendations

Conclusions

Key challenges identified include relevancy to national development goals of HCD programmes currently being offered by the CBIs, lack of fellowship support for candidates and sustainability mechanisms, lack of modalities for internship. In the short term, a need for a school of water resources engineering was prioritised to fill a Capacity Building gap in training programmes for technicians. In addition, the introduction of e-learning and distance mode to accommodate JPTL personnel, Student Internships and procurement of basic equipment for practicals were also identified among the priorities that can be piloted in Malawi.

Recommendations

The following actions are recommended to address HCD skills gaps and needs in the water sector of Malawi:
- Create joint supervision and research groups for the water sector composed of industry, government and academia

- Expose academics at Capacity Building Institutions s to industrial practices and experiences - attachments for a specified number of months per year
- Promote formalised adjunct positions at CBIs for personnel from industries to assist in delivery of HCD programmes
- Facilitate introduction of e-learning and distance mode to accommodate Junior Professional and Technical Level personnel

Mozambique

The International Centre for Water Economics and Governance in Africa, Universidade Eduardo Mondlane, Maputo

Sector-wide Analysis

In Mozambique, the process of developing a National Water Sector HCD Framework was initiated by the Ministry of Science and Technology as this was required to deal with national directives. The processes for this analysis included research into the status of human resources in the water- and sanitation sectors through a combination of desktop reviews, interviews, meetings, focus groups, etc.

IWEGA at Universidade Eduardo Mondlane undertook the desk-top study in investigating the status quo of HCD activities in the Mozambican water sector, and further support the Ministry of Science and Technology in the process to identify sector skills needs and undertake consultative workshops while focussing on Southern and Northern Mozambique.

Priorities

Longlist of priorities

From the sector-wide analysis and consultations, a long list of human resources capacity gaps were identified as particularly important as priority needs in the country's water sector:

1. Assessment of water quality
2. Water purification and recycling technologies
3. Control and reduction of losses in water infrastructures
4. Participation and Community Education
5. Water economics and governance
6. Hydraulics and hydrology
7. Hydrometry
8. Design and assembly of different water supply systems
9. Design and assembly of irrigation systems
10. Cartography, topography and use of water resource management software
11. Borehole and water drilling
12. IWRM
13. Installation and maintenance of electric, manual and diesel pumps
14. Supervision of water supply works and procurement
15. Environmental Impact
16. Effects of climate change in the management of water resources
17. Ecological flows assessment
18. Urban Flood Management

Shortlist of priorities

The long list of priorities encompasses HCD needs targets for immediate, mid-term and long-term planning of course / module topics until 2023. There **first five priorities** are targeted for immediate attention via pilot course / modules.

19. Assessment of water quality
20. Water purification and recycling technologies
21. Control and reduction of losses in water infrastructures
22. Participation and Community Education
23. Water economics and governance

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:

24. Management and maintenance of networks and water loss
25. Community education
26. Environmental Impact Assessment
27. Water quality assessment

The proposed course / module contents fall within the following main themes as shown in Figure 44 below:
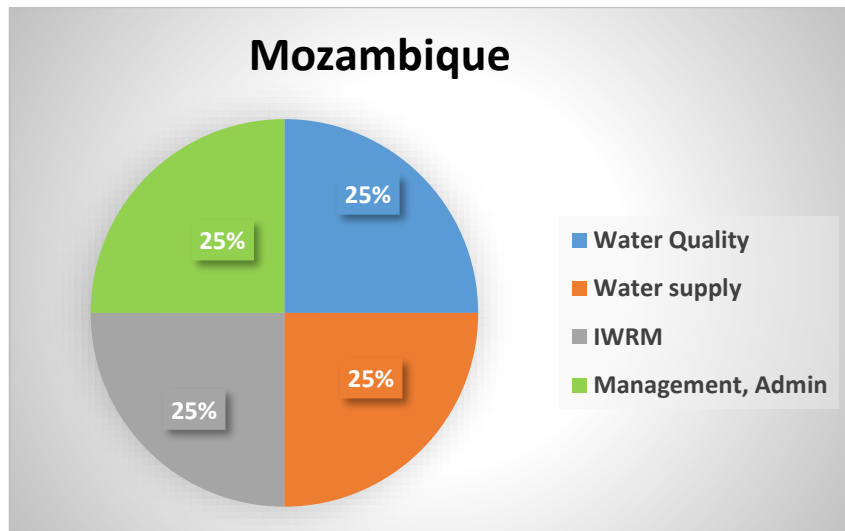
Figure 43 Distribution of course / module content within themes for IWEGA

The main difference between the short list of priorities and the course / modules is that Water Economics and Governance are not addressed in a targeted course and there is an introduction of Environmental Impact Assessment.

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, IWEGA identified which additional resources were needed for them to continue. The tables 23 and 24 below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Human Resources (Teaching Assistants, Technicians, Instructors)	4	4	4	4
Training Materials (Data, information, presentation graphics, video, other)	Training Material for presential training	Presentations and demonstration materials	Training Material	Adapt the existing material to deliver as e-learning. Presentation, photos and videos

Table 23: Existing resources available and additional resources needed for e-learning

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms		Laptop Computer and Digital camera		Laptop, Computer and Digital camera Stable Internet facilities
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities		Scanner and External disc for back up		Data show, scanner and flash disc for back up
Software, or software updates for earth science or social science modelling				Professional Zoom
Where relevant, for online or e-learning course implementation: • GIS, related software • Portable field equipment for survey, water quality/quantity measurement • Water laboratory facility materials or consumables				Laboratory operations manual / guide; Water sampling and analysis instruments and equipment; Water laboratory facility, Lab consumables for demonstration

Table 24: Hardware, software, and consumables for digitalisation, online and e-learning

Final courses / modules delivered

After adapting course content where possible to adjust to a mix of face to face and on-line modalities (blended). Figure 45 below shows that adjustments in course / module contend resulted in slightly different distribution from the pre-COVID context within the following themes:
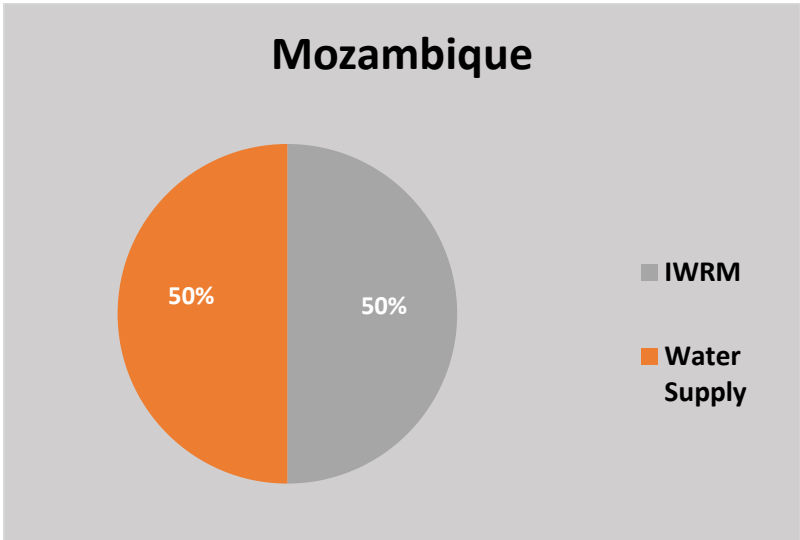
Figure 44 Distribution of adapted planned and implemented course / modules for IWEGA

IWRM and Water Supply remain as priority themes, with two course / module instead of the originally planned four courses presented. The course content retains Environmental Impact Assessment which, to recall, was not in the initial list of top five HCD priorities. Also of interest to note is that both courses were presented face to face, but according to reporting hygiene controls were implemented with alcohol spray and masks for staff and students.

Course title	Target group	Status	Type	Number of participants
MAINTENANCE OF NETWORKS AND LOSSES	Junior Technician	implemented	FACE 2 FACE	20
ENVIRONMENTAL IMPACT ASSESSMENT	Junior Professional	implemented	FACE 2 FACE	21

Figure 45 List of adapted planned and implemented course / modules for IWEGA

Conclusions and Recommendations

Conclusions

Various initiatives are being developed in the water sector, including the ACEWATER II HCD activities, and all recognise the role of training, capacity building and research in promoting the coordinated development of the use of natural resources, and the role of water as a vital resource for promoting the country's development in urban and rural areas. There is especially a big gap at the technical level, which has widened in recent years due to the

limited number of training institutions that provide technical trainings. There is also a lack of inter-sectoral coordination dealing with water resource management.

Recommendations

In order to address the current HCD challenges in Mozambique's water sector, and to assist in orienting ongoing HCD activities and interventions, the following actions are recommended:

- Promoting data collection surveys in the water resources sector;
- Development of teaching materials in priority areas in the water resources sector;
- Promotion of training in priority areas of the water sector;
- Promotion of the use of a specific qualifier for human resources in the water resources sector.

Botswana

University of Botswana (UB), Gaborone

Sector-wide Analysis

Botswana (UB) undertook a sector-wide analysis for the Water Sector of Botswana to identify HCD skills gaps and needs within their water sector as described in Process Section of this report. One of the key findings from a country-wide perspective was that while there is a national human resource development (HRD) strategy, there is no strategy specific to the water sector. In particular, the strategy for junior professionals and technical level capacity is non-existent. The In a final consultation for outlining a National HCD Framework for Botswana water sector, the following HCD priorities were selected for piloting and integrated into Botswana's National HCD Framework were:

Priorities

Consultations with stakeholders identified Human Capacity Development Gaps and Needs for the water sector ranging from management to professional, technical and artisanal skills gaps.

Longlist of priorities

From the sector-wide analysis and consultations, a long list of human resources capacity gaps were identified as particularly important as priority needs in the country's water sector:

1. Water Quality Monitoring of the resource
2. Implementation of water quality standards
3. Wastewater recycling and re-use
4. Water Conservation & Demand Management
5. Investigative and research skills
6. Sustainable economic development
7. Human and social development
8. Sustainable environment
9. Governance, peace and security

Shortlist of priorities

Following a final national consultation and a validation workshop, a short list of HCD priorities were selected to be addressed and a National HCD Framework of action was drafted and validated to address the following HCD gaps:

1. Isotope Hydrology
2. Integrated Groundwater-Surface water Hydrology
3. Borehole drilling and well maintenance
4. Groundwater monitoring and analysis

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:

1. Advanced hydrology
2. Water resources management
3. Applied and field hydrology for practitioners
4. Principles of hydrology for technicians

The proposed course / module contents fall within the following main themes as shown in Figure 47:
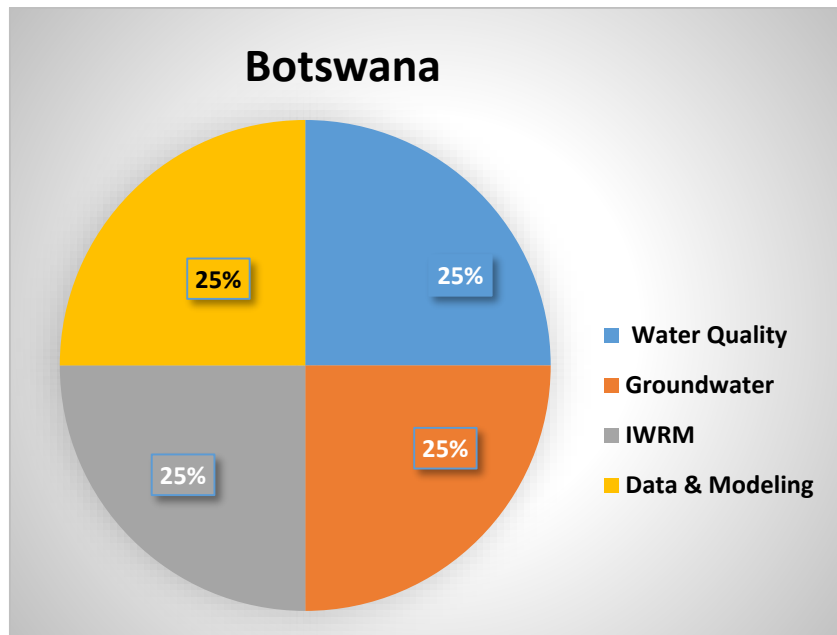
Figure 46 Distribution of course / module content within themes for UB

Impact of Covid-19

The University of Botswana undertook, a risk assessment, combined with the e-readiness to evaluate their capacity to implement their pilot course / modules. The results of this preliminary analysis on both the capacity and the potential needs to implement online e-learning courses indicated that they do not have the adequate hardware and software to prepare and deliver course / modules and also encountered problems with connectivity. Following the E-readiness survey, the area around Gabarone Botswana went into lockdown in August, including the CoE University with staff access to the University or its facilities. Given that this was a critical period in terms of timing for planning and preparation of any type of blended or on-line courses, it was decided that Botswana would not proceed with the final activities of presenting pilot course/modules.

Conclusions and recommendations

Conclusions

Although the CoE UB from Botswana was unable to finish the final project activities, a number of valuable conclusions were identified from the work in ACEWATER II. Considering the processes and activities undertaken within the context of the ACEWATER2 project in Botswana, it can be concluded that the project has contributed towards two main aspects. They are

- Identification of key issues and needs with regards to HCD issues for junior professionals and technicians in the water sector, and subsequently,
- The type of intervention needed to address these, including the development of a national HCD Framework which is considered to support the existing national HRD strategy.

An entry point for the proposed strategy was identified, being the existing sub sector committee specific to the water sector through which the proposed strategy could be channelled. The proposed strategy therefore fits very well in the national plans, vision and strategies to advance Botswana from a resource based economy into a knowledge based economy. The formation of partnerships with research institutions, the private sector and NGOs is essential to derive maximum benefits in areas such as research and development, infrastructure development and financing, stakeholder engagement and participation.

Recommendations

The following actions are recommended:

- A strong focus be put on active youth participation since they make up to 60% of Botswana's total population.
- Maintain up-to-date record of available skills within the water sector at institutional level (Government ministry and local levels, private and public sector actors, universities and training institutions).
- Efforts should be directed in making sure that the TVET institutions cover courses related to water (which is currently not the case).
- Access to funding for capacity building and development should be facilitated, for example by using locally available training funds.

CEANWATCE–Central-Eastern African Network of NEPAD Water Centres of Excellence

Introduction

As outlined in Chapter 1, the CoE Partners in the Central East African Region participating in the ACEWATER II HCD activities are:

CEANWATCE (Central and East Africa Network of Water Centres of Excellence

- University of Khartoum, Sudan (CEANWATCE Secretariat)
- Makerere University, Kampala, Uganda
- Ethiopian Institute of Water Resources, University of Addis Ababa, Addis Ababa, Ethiopia
- IGAD Climate Prediction and Application Centre (ICPAC), Nairobi, Kenya
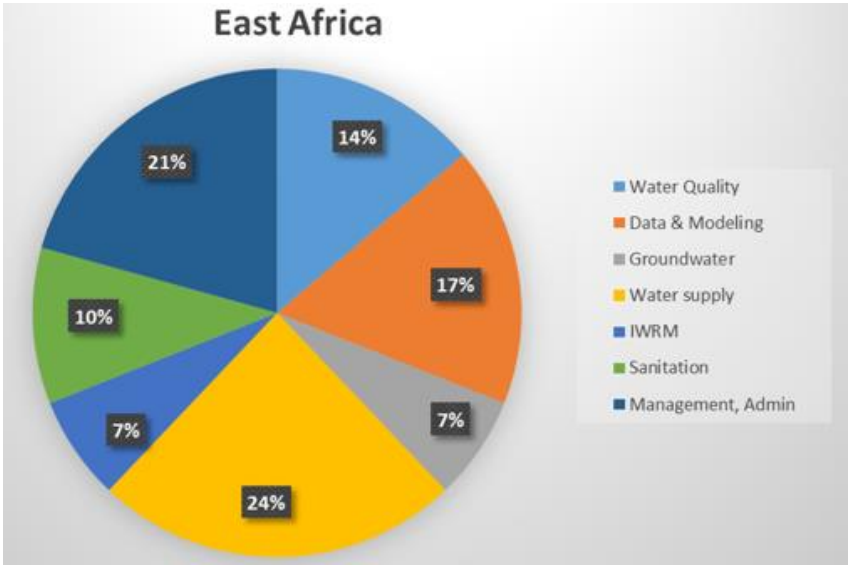
Figure 47: Human Resources Capacity gap priorities

The CEANWATCE network, with technical and financial support from UNESCO, undertook sector-wide analyses in their countries to identify HCD skills gaps and needs, supported by surveys, interviews and followed by consultations at national level to develop and validate National HCD Frameworks for each country. In all countries, many HCD gaps and needs were identified, with a short list prioritized for piloting.

Regional Perspective on HCD Priorities

The results of the individual sector-wide assessments for all countries in the region were combined to present a picture of what the region's top HCD priorities were for their water sectors. Figure 49 below shows the distribution of the HCD Priority themes for the Central and East African Region.
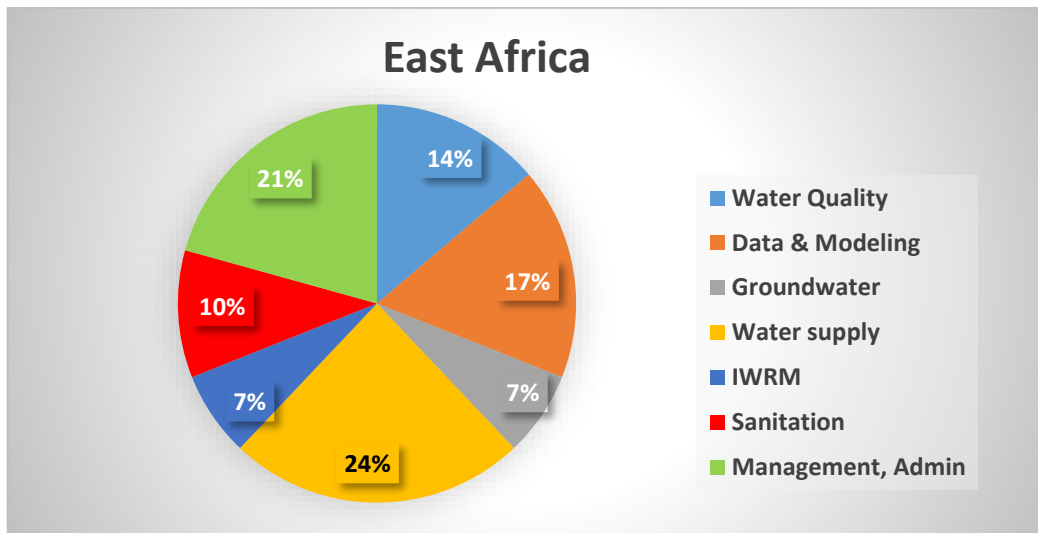
Figure 48 : Central and East Africa Human Capacity Development priorities

Compared to the other two regions in West and Southern Africa, Central East Africa engages within all of the thematic priorities. The highest priorities for the region are Water Supply and Management & Administration, with IWRM and Groundwater the lowest priority. From comparison of individual country reports, we can note the following differences in priority themes among countries in East Africa

- Sanitation: prioritized only in Sudan

- IWRM: prioritized only in Ethiopia and Kenya

- Water Quality: only in Kenya and Sudan prioritized

- Data & Modelling: prioritized in all countries except Uganda

The Regional Economic Community IGAD has not yet developed a fully formed strategy for HCD in the water sector for the region. They agree with the individual country-level HCD frameworks developed for national level in the CoEs for East Africa, but they also contribute another priority which does not fall into the top list of HCD priorities for the other CoE partner country National Priority studies except for Uganda: Negotiation and Water Diplomacy. The transboundary river basin experience in the region is especially prominent with the Nile River Basin and involves a large number of member state players who have strategic and economic interest in the basin management.

Adapting to COVID-19

Because of the COVID-19 pandemic, the CoEs were subjected to restrictive access measures to abide to social distancing and to reduce the risk for the students. Most of them were able to adapt to a certain extent, and have been using online tools for the lectures, discussions and assignments. Most of the WANWATCE institutions were not prepared for a rapid switch to online learning, and academics had were confronted with increased workloads to prepare online materials for E-learning. General observations from the CoEs indicate that it was easier to mount E-learning course / modules for theoretical training, usually at HE Level, whereas a number of planned-for technical trainings at TVET level, which required laboratory or field work, had limited implementation or were not implemented at all. In the following Country Profile sections it is shown that in some cases courses falling within the theme of Management and Administration were introduced (see also Figure 22 in M&E section).

Country Results and Analyses

Uganda

Makerere University, Kampala

Sector-wide Analysis

Within the ACEWATER II project, a sector-wide analysis to identify HCD skills gaps and needs was done by Makerere University with substantial input from the Ministry of Water and Environment (MWE) in Uganda. Key to the HCD activities in Uganda is the relationship between Makerere University and the Ugandan Ministry of Water which played an instrumental role in reviewing and finalising the pilot course / modules designed to address the water sector HCD priorities.

Institutionally and with internal administrative structures, Uganda is quite advanced conceptually for human resources capacity development in their water sector. The strategic sub-sector capacity development plan serves as a guide to prioritize capacity development activities. For the planning of human resources management at the MWE, a capacity development focal point/desk officer supports the Commissioners (who are the Heads of Departments) in the development of the annual training plan, in collaboration with the Head of Human Resources Division in the MWE. The training plan is based on the performance gaps identified during the individual Annual Performance Appraisal exercise. The Head HRM consolidates the Departmental annual training plans and submits to the Ministry Training Committee (MTC) for review and submission to the Permanent Secretary (PS) for final approval.

The Ministry for Water and Environment is the first ministry in Uganda that redefined its understanding of capacity development from human resources management (according to the Public Service Training Policy) to a more holistic approach that addresses capacity development not only within the ministry but for the WES as a whole. This approach is referred to as sector capacity development and has been defined in the Sector Capacity Development (SCD) Strategy. The SCD Strategy responds to the perceived lack of benefit of previous capacity development measures. It emphasises a result-oriented, integrated capacity development approach starting with the analysis of performance gaps and priorities, and integrating activities on three levels: the individual level, the organisational level and the level of the enabling environment.

However, that said, there is still a need for a comprehensive sector-wide assessment and developing a HCD Framework to address HCD skills gaps and needs; which is the added value of the ACEWATER II Project.

Priorities

The water sector in Uganda comprises two sub-sectors, being the water and sanitation sub-sector; and the water resources management sub-sector.

Longlist of priorities

From the sector-wide analysis and consultations, a long list of human resources capacity gaps was identified as particularly important as priority needs in the country's water sector:

1. Leadership with consideration of succession management.
2. Performance management which will help focus on the delivery of key indicators.
3. Integrated water-resources management and Catchment Management
4. Technical skills i.e., maintenance, Water modelling skills, designing of faecal sludge, Water sampling, testing and analysis as well as Retooling of experts
5. Communication and stakeholder engagement/ Stakeholder engagement e.g., communities, private sector
6. Information and knowledge management.

7. Governance with consideration to water integrity, transparency, accountability and participation.
8. Project management i.e., proposal writing, data analysis, report writing, monitoring and evaluation.
9. Procurement with an aim of enhancing quality of construction materials
10. Interdisciplinary and multidisciplinary approach to issues (holistic approach to handling issues i.e., engineers, sociologist's integration of holistic solutions)
11. Investment financing
12. Resource sustainability (policy review and formulation)

Shortlist of priorities

1. Leadership and Management
2. Technical Skills for both Theory and Practical Training

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:

1. Preparation of bankable project proposals
2. Negotiation and water diplomacy
3. Borehole drilling and pump testing supervision
4. Design, construction, operation and maintenance of solar water pumping system

The proposed course / module contents fall within the following three main themes as shown in figure
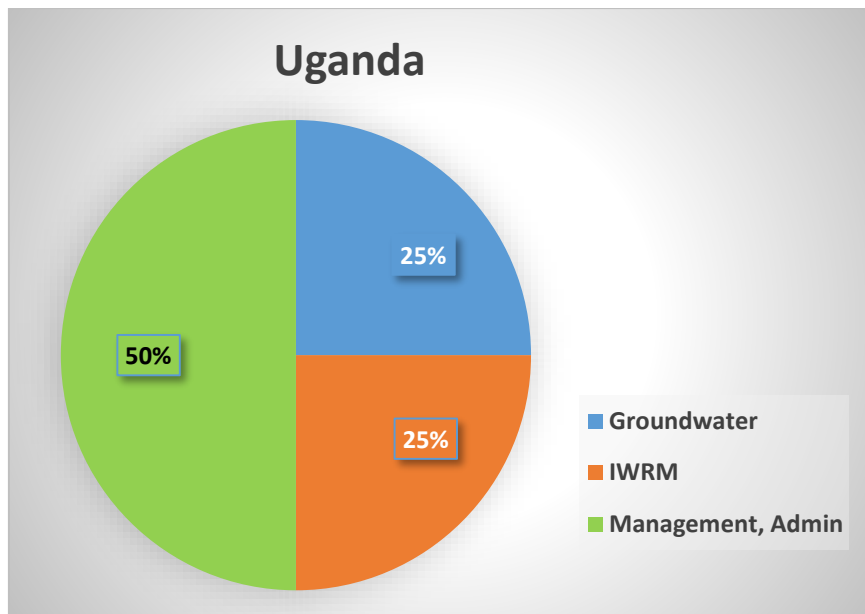
Figure 49 Distribution of course / module content within themes for Makerere

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, Makerere University identified which additional resources were needed for them to continue. The tables 25 and 26 below list what existing resources are available and what additional resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	**Needed**	**Existing**	**Needed**
Human Resources (Teaching Assistants, Technicians, Instructors)	Institute of Open, Distance and eLearning	Experts in the specific fields Trainers to prepare the experts in the E-modalities	Experts in GIS	Training Assistants Instructors Laboratory assistants
Training Materials (Data, information, presentation graphics, video, other)	Data servers, Multimedia Lab, Bandwidth of 2Gbps, local area network, Wi-Fi at campus, Zoom Licenses, Video conferencing systems	Data information, presentation graphics, video, Interactive screen Codec Microphone Speakers	Data servers, conferencing systems	Internet Data, information, presentation graphics, video, Masks Sanitisers Stationery

Table 25 Existing resources available and additional resources needed for e-learning for Makerere

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	**Prepare HCD Courses**		**Deliver HCD Courses**	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Laptops, Data servers, LAN, Wi-Fi at campus, Zoom Licenses	Laptops, Desktops, GIS software	Laptops, Data servers, LAN, Wi-Fi at campus, Zoom Licenses, Video conferencing systems	Laptop computers, Desktop computers, GIS Software Stationery Cartridges
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	Multi media Lab, Video conferencing systems, ZOOM Licenses		Multi media Lab, Video conferencing systems	
Software, or software updates for earth science or social science modelling	GIS software			
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables	Data servers, Zoom Licenses, Video conferencing systems		GIS software Data servers, Multimedia Lab, Bandwidth of 2Gbps, local area network, Wi-Fi at campus, Zoom Licenses, Video conferencing systems	

Table 26: Hardware, software and consumables for digitalisation, online and e-learning for Makerere

Final courses / modules delivered

Following the E-readiness survey, four pilot course / modules were planned to be implemented and summary of the pilot training course units is given in Table below.

Course title	Target group	Status	Type	Number of participants
Geospatial Tool for Water Systems Resilience		Not Implemented	E-learning	
Borehole Drilling and Pump Testing Supervision		Not Implemented	E-learning	
Negotiation and Water Diplomacy	Senior Professional	implemented	Blended	31

Table 27 List of adapted planned and implemented course / modules for Makerere

Due to administrative challenges in addressing key project activities, only one out of three proposed courses was implemented. Makerere was able to do so in a blended modality of face to face and on-line course / module design with PPE equipment and safety controls.

Conclusions and recommendations

Conclusions

The identified priorities a lack of formalised links with the water sector organisations, which limits the academic institutions to explore the skills required by the sector and thus design courses that address actual sector requirements. Because of this, most higher education institutions provide their students with theoretical knowledge, resulting in the graduates lacking the technical capacities required to manage and operate water schemes. Given the fact that most lecturers are not encouraged to regularly renew their lecturing materials, these materials rarely provide new concepts and insights. Excellent policies with in the water sector exist in Uganda; however, these are not fully complied with and objectives are not regularly met.

Recommendations

- More involvement of the private sector and industry in the training of junior water professionals by attaching students for industrial training, participation in course design(content), teaching and presentation of awards to best-performing students as well as offer career guidance.
- The sector should participate in the development of the JDs for people to be recruited to the water sector.
- The professional association and regulatory bodies should play more prominent role e development of course content, accreditation of universities, monitoring and regulation of practitioners.
- Scheme of service should be developed and adhered to where all junior professionals enter service as pupil engineers for the probationary period of six months (for exposure and mentorship), engineer, senior engineer and principal engineer. In each of these stages, the candidates should be subjected to continued professional development programmes (CPDs).

Kenya

IGAD Climate Prediction and Applications Centre (ICPAC), Nairobi

Sector-wide Analysis

One area in the governance of water sector in Kenya that needs capacity development is the lack of an effective institutional framework for integrated water supply and sanitation, which has led to myriad of challenges across the sector such as overlapping roles and responsibilities between various institutions. This in turn leads to inefficient use of human and financial resources, duplication of effort, and gaps in effective provision of services. In the sector-wide analysis of Kenya's water sector, this and other HCD skills gaps and needs priorities were identified.

Priorities

Longlist of priorities

From the sector-wide analysis and consultations, a long list of human resources capacity gaps were identified as particularly important as priority needs in the country's water sector:

1. Skills and knowledge on Operational Hydrology
2. Water resources Data and Management
3. Skills on Instrumentation
4. WASH
5. Monitoring and Evaluation
6. Climate variability and water resources / flood modelling
7. Early Warning Systems
8. GIS and Remote Sensing
9. IWRM
10. Non-revenue water reduction
11. Desalination of sea water and ground water
12. Instrumentation and maintenance

Shortlist of priorities

1. Early Warning Systems (Climate variability & change)
2. Data management (GIS/Remote Sensing technology)
3. Catchment management
4. Instrumentation and maintenance
5. Water, Sanitation & Hygiene (WASH)
6. Non-Revenue water reduction

They would be addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics taken directly from the shortlist of priorities:

1. Early Warning Systems (Climate variability & change)
2. Data management (GIS/Remote Sensing technology)
3. Water, Sanitation & Hygiene (WASH)
4. Non-Revenue water reduction

The proposed course / module contents fall within the following main themes:
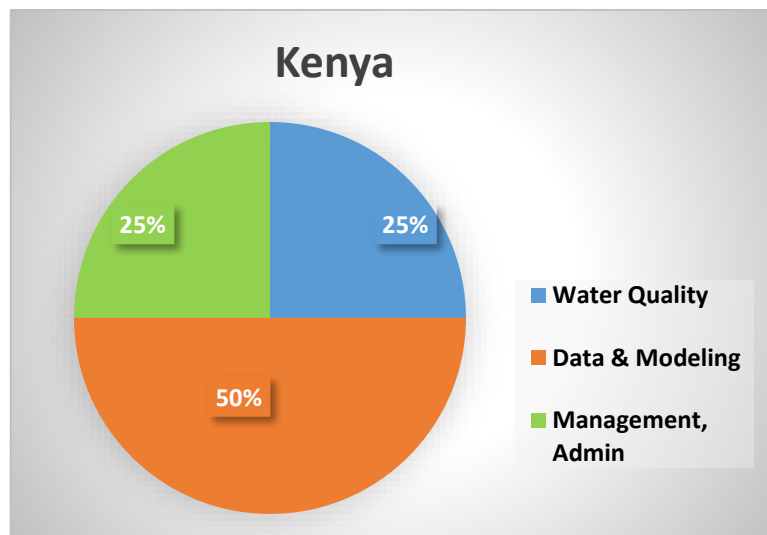
Figure 50 Distribution of course / module content within themes for ICPAC

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, ICPAC identified which additional resources were needed for them to continue. The tables below list what EXISTING resources are available and what ADDITIONAL resources are needed.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Human Resources (Teaching Assistants, Technicians, Instructors)	2 Instructors	IT Support to configure training material for online use	2 Instructors	IT Support for configure training material for online use and support training
Training Materials (Data, information, presentation graphics, video, other)	Training Materials	Audio visual materials		

Table 28 Existing resources available and additional resources needed for e-learning ICPAC

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	Computers & Server	Need to procure LMS and associated software for online training	Server and reliable internet	Need to procure LMS and associated software for online training
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities	Computers	Webcam, video hosting equipment		Webcam, video hosting equipment
Software, or software updates for earth science or social science modelling		Hydrological and water resources modelling software		Needed
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables				GIS

Table 29 Hardware, software and consumables for digitalisation, online and e-learning for ICPAC

Final courses / modules delivered

ICPAC does tens of face-to-face trainings every year but in 2020 with the COVID-19 pandemic, this was not possible, pushing to the postponement of not only the UNESCO trainings but others as well. The institution now has a plan to improve its training materials, IT and Software and staff capacity to make online training possible. Since almost all trainings are regional, they anticipate that other restrictions (e.g visa) will make it necessary to blend or combine face-to-face learning with e-learning. Given these challenges, it was only possible for ICPAC to implement final pilot activities in 2021, after the close of project. Therefore, they did not implement any of the planned course / modules for the ACEWATER II project.

Conclusions and recommendations

Conclusions

Overall, there is a lack in partnership between different institutions, funding, and employee retention since many employees are aging and young people are shifting or advancing careers to obtain formal academic papers, while skills and experience are not the priority. One area in the governance of water sector in Kenya that needs capacity development is the lack of an effective institutional framework for integrated water supply and sanitation, which has led to a myriad of challenges across the sector such as overlapping roles and

responsibilities between various institutions. This has lead to inefficient use of human and financial resources, duplication of effort, and gaps in effective provision of services. Finally, there is lack of data on training needs as well as clear policies and guidelines on capacity building. There is uncoordinated training programs; inadequate linkages between training outputs and labour market; lack of monitoring and evaluation mechanisms of measuring training outcomes and impact.

Recommendations

The following actions are recommended:

- More data on training needs and clear policies are needed, and connections between the different trainings and the market could lead to more dynamic and up to date trainings that are complementary with the actual water sector needs.
- Develop more monitoring and evaluation mechanisms to assess the training outcomes and impacts.

Ethiopia

Ethiopian Institute of Water Resources (EIWR), Addis Ababa

Sector-wide Analysis

The water sector in Ethiopia has been generally characterized by bad planning and fragmentation. There are key targets related to water and food that Ethiopia has aligned in its development plans. Ethiopia is among the countries that are severely affected by the impacts of climate change and variability. As such building the resilience of communities to drought is a priority for national security. Achieving these goals definitely largely rely on availability of skilled personnel in the water sector. Consequently a sector-wide analysis of HCD skills gaps and needs is both relevant and timely.

Priorities

The sector-wide assessment of HCD skills gaps and needs identified a long list of priorities as follows:

1. Drilling technologies
2. Spring development
3. Water harvesting techniques
4. Water quality monitoring
5. Operation and Maintenance of supply
6. Surface and ground water resources assessment
7. Hydrological data collection and analysis
8. Floods and drought analysis and modelling
9. Irrigation systems management and performance improvement
10. Geo-spatial analysis for water resources
11. Climate change and impacts on water resources
12. CAD for water resources systems
13. Water quality laboratories
14. Hydraulics laboratories
15. Irrigation and soil physics laboratories

Shortlist of Priorities

Courses to address these needs were planned to be synchronised and linked to existing training courses at the EIWR. The relationships of the technical and professional level training courses with the HCD priorities are shown below:

No	HCD Priority	Training Course	Remark
1	Operation and Maintenance of Water Infrastructure	Irrigation systems diagnosis, operation and maintenance	Technical level courses
2	Stream Flow and Water Quality Monitoring	Operational Hydrology: Flow and Sediment monitoring in streams	
3	Irrigation Systems Performance Evaluation and Improvement	Water Productivity in Agriculture and Potentials for Saving Water	Professional courses
4	Water Resources Assessment	Surface Water Resources Assessment Using Advanced Modelling Technics	

Table 30 Relationship between technical and professional level training courses and HCD priorities for ICPAC

The proposed course / module contents fall within the following main themes:
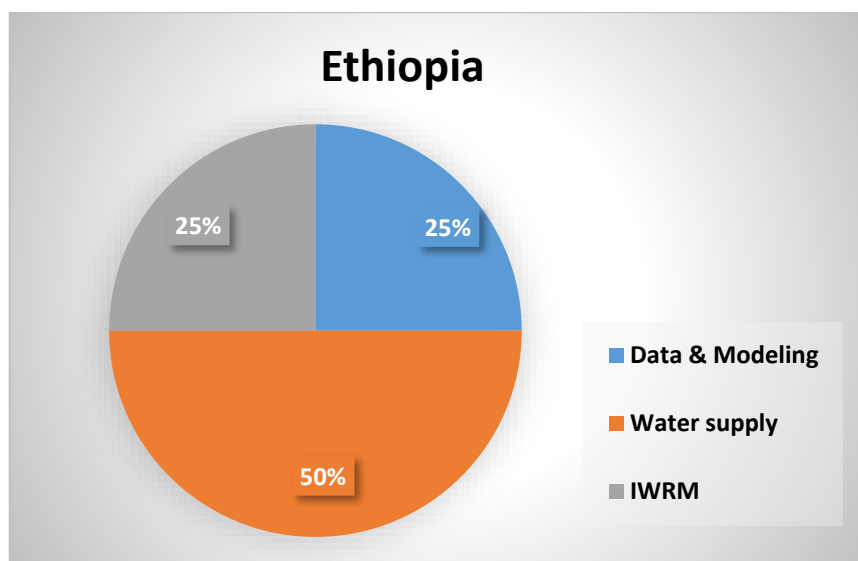

Figure 52 Distribution of course / module content within themes for EIWR

Two technical level training courses were conducted from January 10-18, 2020:

1. Operational Hydrology: Flow and Sediment Monitoring in Streams
2. Irrigation Systems Diagnosis, On-farm Water Management, Operation and Maintenance

Course title	Target group	Status	Type	Number of participants
Operational Hydrology	Junior Technician	implemented	face 2 face	12
Irrigation Systems Diagnosis	Junior Technician	implemented	face 2 face	12
Surface Water Resources Assessment Using Advanced Modeling Techniques	Junior professional	Not Implemented	N/A	24 selected
Water Productivity and Irrigation Systems Modelling	Junior professional	Not Implemented	N/A	24 selected

Table 31 List of adapted planned and implemented course / modules for EIWR

Impact of Covid-19

Following the Risk Mapping and E-readiness surveys, and in order to implement the priority trainings, adapting, if possible, training interventions from face-to-face to incorporate e-learning platforms, The EIWR identified which additional resources may be needed for implementing them to present the final two courses either on-line or blended. No extra

resources were found to be necessary, however, the course duration of the final two courses was accepted to be too close to the end of project deadline, and they were not delivered.

Conclusions and recommendations

Conclusions

The water sector in Ethiopia is characterised by poor infrastructure, inexperienced sector human capacity and low service delivery. There is a large gap in infrastructure such as ICT and laboratories at university level, gaps at the technical level exist in installation, operation and maintenance of water infrastructures. A continuous skills development scheme is lacking and as a result, there are big skills gaps at technical levels. Many skills are non-existent for the available positions. For the professional levels, human capacity in terms of numbers is not a challenge, but they generally lack state-of-the-art knowledge and skills in using techniques, technologies and methodologies for water resources engineering and management.

Recommendations

The following actions are recommended:

- Tailored/short term and long-term university level training schemes should be developed.
- State-of the art water laboratories for the ministries and selected universities/research institutes/training institutes should be established and IT infrastructures should be built.
- The pay scale for technical staff engaged in the water sector should be improved, as technical issues related to design, installation, operation and maintenance are the main challenges.
- Extension workers in irrigation and water supply sectors need to be trained and deployed as extension is limited, which results in poor water management and service delivery.
- New mid-career and technical staff should be hired and trained, while experienced staff retained through different mechanisms: incentives, training opportunities, changing of the working environment,

Sudan

Water Research Centre (WRC), Khartoum University, Khartoum

Sector-wide Analysis

Sudan's transboundary surface and groundwater basins, which border the Sudan to 13 of its African neighbour countries, accentuates the urgency of collaboration and an urgent call for cooperation. Given the present challenges and the growing projected pressures on water resources in the Sudan, there is a concomitant need to increase the cadre of competent and well trained water management practitioners especially at the young professionals and technicians levels. To address these challenges, the Water Research Centre (WRC) implemented a sector-wide analysis HCD skills gaps and needs in Sudan's water sector.

Priorities

Longlist of priorities

1. Design and evaluation of hydrological networks (monitoring networks)
2. Hydrological characteristics of arid zones
3. Groundwater water resources assessment, development and management
4. Enhancement of irrigation water use efficiency
5. Water quality analysis and standards
6. Environmental impact assessment of water projects
7. GIS and Remote sensing applications in water resources management
8. Sediment management in reservoirs and irrigation schemes
9. Design and management of water harvesting systems
10. Water, sanitation and hygiene (WASH)
11. Design and management of Irrigation Systems
12. Surface water resources assessment and management
13. Groundwater modelling, design, and operation
14. Public awareness and community participation for sustainable watershed management
15. Climate change impact: adaptation and resilience
16. Water diplomacy and transboundary cooperation
17. Theme 6: Data Acquisition and Management Tools
18. Hydroinformatics and data management

Shortlist of priorities

A short list of six priorities were identified and were each addressed by targeted course / modules as follows:

1. Data Acquisition in Water Resources Management
2. Water Sanitation and Hygiene (WASH
3. Integrated Water Resources Management
4. Data Acquisition in Surface and Groundwater
5. Water and Wastewater Quality Monitoring and Analysis
6. Construction and Installation, Operation and Maintenance in Urban surface drainage

They addressed in pilot activities such as the proposed courses / modules at HE and TVET levels addressing the following topics:

1. Water Sanitation and Hygiene (WASH)
2. Data Acquisition in Water Resources Management
3. Data Acquisition in Surface and Ground water (Practical Aspects)
4. Water Quality Monitoring and Testing

Course title	Target group	Status	Type	Number of participants
Water Sanitation and Hygiene (WASH)	Junior Professional	implemented	Face 2 face	30
Data Acquisition in Water Resources Management	Junior Professional	implemented	Face 2 face	42
Data Acquisition in Surface and Ground water (Practical Aspects)	Junior Technical	implemented	Face 2 face	22
Water Quality Monitoring and Testing	Junior Technical	implemented	Face 2 face	26

Table 32 List of implemented course / modules for WRC

The proposed course / module contents, some of which are cross-cutting, fall within the following main themes:
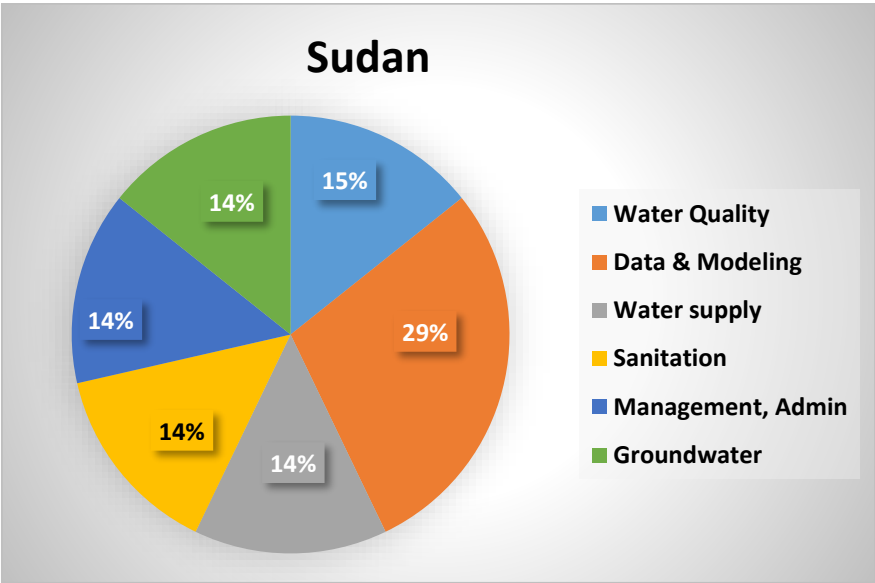

Figure 53 Distribution of course / module content within themes for WRC

Impact of Covid-19

While the WRC University of Khartoum did succeed in delivering their course / modules before the outbreak of COVID-19 and the subsequent lockdown, they also participated in

106

the preliminary analysis on both the capacity and the potential needs for each CoE to implement online e-learning courses. The WRC did not report any challenges, because their Pilot courses were implemented in the latter part of 2019 and early 2020, before restrictions of movement due to COVID-19 were put in place.

Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Human Resources (Teaching Assistants, Technicians, Instructors)		*14 Trainers*		*14 Trainers*
Training Materials (Data, information, presentation graphics, video, other)		*Notes, information, presentation graphics, video*		*Notes, information, presentation graphics, video*

Table 32 : Existing resources available and additional resources needed for e-learning WRC

Hardware, software, and consumables for digitalisation, online and e-learning:				
Resources	Prepare HCD Courses		Deliver HCD Courses	
	Existing	*Needed*	*Existing*	*Needed*
Hardware and software required for digitalisation of course curricula, online and e-learning modalities; including fees/licenses for on-line learning platforms	*Router* *Laptops*	Internet Access Zoom license Google Drive Extra storage Mic Externals	*Router* *Laptops*	Camera Internet Access Zoom license Google Drive Extra storage Mic Externals
Audio-visual and/or IT equipment necessary for developing and sharing course curricula via online or e-learning modalities		*Camera*		
Software, or software updates for earth science or social science modelling	*GIS Software*		*GIS Software*	
Where relevant, for online or e-learning course implementation: GIS, related software Portable field equipment for survey, water quality/quantity measurement Water laboratory facility materials or consumables				

Table 33 Hardware, software and consumables required for digitalisation, online and e-learning for WRC

Conclusions and recommendations

Conclusions

Inadequate human resources capacity development particularly in the water and sanitation sector leading to unsustainable water resources management and slow progress towards the sustainable development goals (SDGs). Weak institutional arrangements and lack of policy framework and adequate national funding for human capacity development in the water sector and reliance on funds from overseas. Minimum political will to address the water needs and access, to meet the growing water demand in all sectors, and to invest in infrastructures and capacity building for improving the management and maintenance of water resources systems. Lack of training institutions that provide high quality training, especially for technicians. Minimum involvement of the private sector in designing, implementing and financing water resources projects. Problems related to data collection, privacy, storage, management sharing and accessibility. Brain drain due to poor working environment affecting the professional and skill's capacity of both the water sector and the training institutions. COVID-19 and restrictions on international travel did not allow the student and staff exchange program between the centres of excellence CoEs to be implemented.

Recommendations

The following actions are recommended:

- Implementation of more pilots in HCD priorities to fill the huge capacity gap that still exists.
- E-learning should be implemented and the capacity of the centers to perform E-learning should be enhanced.
- Implementation of the student and staff exchange program, since it enhances collaboration and sharing of experiences and information as well as promoting joint research.
- There is a need to involve the private sector in water infrastructures projects, especially in their designing and financing phases .
- Promote collaboration between CEANWATCE centers both in HCD training and scientific research .
- Establishment of a platform for data sharing including national and regional data
- Enhance collaboration with key Regional Actors for the sustainability of the HCD (eg IGAD, NBI).
- The output of the project should be used as a foundation for developing comprehensive framework for HCD for the water sector in Africa.
- The framework should further shape the current curriculum at different training institutions for technicians and professionals training.
- Periodic monitoring and evaluation should be done to assess how the training course is achieving its stated objectives and targets in order to ensure sustainability and impact of the training programmes.
- In addition to the key training areas identified for each targeted group, there are similarities in the areas of training for both targeted groups. Therefore, it is important to identify within each thematic training area, the components that belong to professionals and engineers on one hand, and technicians on the other hand.
- Sustainability of the HCD programme is crucial. To ensure sustainability, adequate financial support is required from the government and donors. State agencies such as the National Council for Training and regional agencies such as the Nile Basin Initiative (NBI) and IGAD could be approached.

CONCLUSION AND RECOMMENDATIONS

There are a number of sources and contributions to conclusions and recommendations arising from the HCD activities of the ACEWATER II project. This section includes conclusions and recommendations from the CoEs arising from their sector-wide assessments and the consultations and workshops that led ultimately to the HCD Frameworks. Also included are contributions from associated partners collaborating with ACEWATER II Partners in project activities and regional discussions such as Government Ministries, Regional Economic Communities and River Basin Organisations.

Sector-wide Assessments and HCD Frameworks

Conclusions

- Manpower development and training for institutional strengthening and capacity development are critical requirements for improved service delivery in the water sector in Nigeria. The often-fragmented approach to water sector management is not conducive to an effective analysis of HCD skills gaps and needs in the water sector. Therefore, the sector-wide assessments of HCD skills needs and gaps, centrally coordinated by the AUDA-NEPAD CoEs, were hugely important in providing insights and guide to the development of capacity development and trainings to address identified capacity gaps.
- The abundance of professionally degree-qualified human resources is regularly identified. However, one of the major limitations noted is the lack of qualified junior and senior technicians for the implementation of operational work in the water sector. While top management is well staffed, the operational sector is struggling to find sufficient skilled staff. There is a need for capacity-building to address junior and senior professional and technical staff to advance along a career path without interrupting or putting at risk their work activities.
- There is a lack of comprehensive national policies regarding the systematic support of capacity development of personnel involved in the water sector (professionals and technicians). This can be reflected in the fact that there is a lack of active partnership between Government institutions, educational institutions and sector actors such as service providers and private sector in terms of identifying sector needs and HCD responses.

Recommendations

- Government decision-makers in the water and water-related sectors should be sensitised to embed and / or implement existing human resource development policies and resources along with project implementation or service provision. This should be done in consultation with key implementing partners such as education institutions and private sector, especially in cases where capacity development policies exist but are poorly or not at all implemented.
- Regular sector-wide assessment should be implemented, perhaps in a cycle of three to four years (South Africa has suggested yearly updates) within a single consultation framework for the water sector, rather than the often-fragmented landscape of existing institutions addressing HCD issues. This can allow for more data on training needs across a wide selection of HCD themes on the actual water sector needs at a given point in time, allowing for coordinated and thus better targeted policy and capacity development response.
- Training institutions should conduct regular follow-up tracing studies to identify how their students perform in the market. Internships must be supported to allow graduates to acquire some industrial experience.

- Succession planning for the existing sector staff is needed to develop and maintain *mentoring* policy. Short-term training such as refresher training for people who need to upgrade their knowledge and skills in the identified areas of need, in-house on-the-job training for those whose job schedule may not allow them to leave their organisation. This also allows for young professionals and technicians, or actors seeking further education training, to develop and pursue a career path.
- Further exploration of mechanisms in which experience would be recognised as a formal qualification (i.e. recognition of prior learning) besides knowledge-based certifications is highly recommended.

Regional Priorities

Conclusions

1) Both the Regional Economic Community of SADC for Southern Africa and CEDEAO / ECOWAS for West
2) Africa have developed frameworks for addressing HCD needs in the water sector at the regional level. ECOWAS has a priority focus on IWRM while the priorities in the WANWATCE CoE partner countries address other priorities. This does demonstrate the difference in perspective from regional actors and national level actors and national priorities, and the need to first focus on national level sector-wide analysis. SADC has identified regional HCD priorities that correspond to their future strategy of industrial development for the region and the role of the water sector. While some priorities such as Climate and Economic Accounting diverge from those of the national water sector priorities, others such as groundwater, data and Monitoring & Evaluation are common. That said, SADC was very clear on the importance of national level sector-wide surveys on HCD gaps and needs, stating that the national-level surveys feed valuable information into the regional strategies and that it will be, at the end of the day, at the national level with SADC Member States that a regional strategy will be implemented. The Regional Economic Community IGAD has not yet developed a fully formed strategy for HCD in the water sector for the region, but they identify a priority which does not fall into the top list of HCD priorities for the other Regions. The transboundary river basin experience in the region is especially prominent with the Nile River Basin and involves a large number of member state players who have strategic and economic interest in the basin management.

Recommendations

Following are recommended activities to address priorities at the regional level:

- In order to contribute to a Regional HCD Framework, the RECS support the idea of regular sector-wide assessments at National level to feed into a regional strategy. For RECS, a more active dialogue such as between ECOWAS and WANWATCE should be regularly implemented to contribute to bringing the two perspectives closer together and build a stronger foundation for regional HCD priorities.
- Monitoring & Evaluation of HCD activities such as pilot course/modules and exchanges of skills and capacities are as important as the sector-wide surveys. All RECS, including IGAD who is still developing regional HCD policy, request the development of a strategy to roll-out and upscale all water sector activities.
- Negotiation and Water Diplomacy should be more prominent.

Global Perspective

Conclusions

From a global perspective of the Network across three regions of Africa the power of the AUDA-NEPAD CoE Network cannot be underestimated as an institutional power on the continent for science, research and capacity building to promote the African Union agenda for Sustainable Development. Confronted by the COVID-19 pandemic, some of the key activities of the ACEWATER II project to implement the AMCOW mandate on HCD in Africa's water sector were expected to be abandoned due to the restricted context. However, the CoE Network collaborated together to profile a reorientation of the project to allow not only continue activities, but to address the original objectives for HCD in their countries. This demonstrated a level of resilience and sustainability of the AUDA-NEPAD CoEs as an Institutional Entity, and not just a project.

Recommendations

Include in the recommended roll-out and scaling up of HCD pilot activities in-country and the rolling out of the HCD program in other countries. With the current experience and lessons learned from the pandemic, this should include COVID-19 response Risk Mapping and E-readiness activities to address not only the long-term effects of the pandemic yet to be manifested, but also to explore the future trends in human capacity development online.

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