



NEPAD African Network of Centres of Excellence on Water Sciences and Technology (Phase II)



Human Capacity Development Component

Phase II: Piloting

FINAL REPORT



CONTENT OF THE REPORT

LIST OF ANNEXES	5
ANNEX I: GHANA HCD FULL TRAINING REPORT ON “SUSTAINABLE ONSITE-SANITATION AND FECAL SLUDGE MANAGEMENT”	5
ANNEX II: GHANA ON SUSTAINABLE ONSITE-SANITATION AND FECAL SLUDGE MANAGEMENT	5
ANNEX III: NWRI REPORT ON THE VIRTUAL TRAINING ON BOREHOLE DRILLING AND SUPERVISION	5
ANNEX IV: NWRI COURSE 1: BOREHOLE DRILLING	5
ANNEX V: NWRI COURSE 2: PLUMBING	5
ANNEX VI: NWRI COURSE 3: BOREHOLE DRILLING AND SUPERVISION	6
ANNEX VII: NWRI COURSE 4: INDUCTION COURSE FOR FRESH ENGINEERS AND SCIENTISTS	6
ANNEX VIII: UNIBEN COURSE 1: WATER SUPPLY AND ENVIRONMENTAL ENGINEERING	6
ANNEX IX: UNIBEN COURSE 2: REMOTE SENSING AND GIS	6
ANNEX X: UNIBEN COURSE 3: BOREHOLE CONSTRUCTION AND MAINTENANCE	6
ANNEX XI: UNIBEN COURSE 4: OPERATION AND MAINTENANCE OF WATER DISTRIBUTION SYSTEM	6
ANNEX XII: UCAD IMPLEMENTED COURSE SYLLABUS	6
ANNEX XIII: UCAD COURSE 1: PROJECT MANAGEMENT	6
ANNEX XIV: UCAD COURSE 2: GIS & REMOTE SENSING APPLIED TO WATER AND SANITATION MANAGEMENT	6
ANNEX XV: UCAD COURSE 3: INTRODUCTION TO HYDROLOGICAL MODELLING USING SWAT	6
ANNEX XVI: UCAD COURSE 4: INTRODUCTION TO UAV PHOTOGRAMMETRY	6
LIST OF ILLUSTRATIONS	7
LIST OF TABLES	7
LIST OF FIGURES	7
LIST OF ACRONYMS AND SIGLES	8
PROJECT BACKGROUND	9
IMPLEMENTING TEAM AND ORGANIZATION	11
INTRODUCTION	13
IPA 1 ACTIVITIES: WATER SECTOR’S HCD NEEDS AND PRIORITIES	15
1. SCOPE OF REGIONAL AND COUNTRY ACTIVITIES	15
2. KEY FINDINGS AND COMMON GAPS	15
3. NEEDS AND PRIORITIES IN HUMAN CAPACITY DEVELOPMENT	16
4. SUMMARY OF DEVELOPMENT OF NATIONAL HCD FRAMEWORKS	18
5. IMPLEMENTATION OF HCD ACTIVITIES IN BURKINA FASO	20

HCD FRAMEWORK DISSEMINATION	22
1. GHANA	22
2. NIGERIA	23
3. SENEGAL	26
OUTLINE OF TRAINING COURSES	33
1. GENERAL OVERVIEW FOR WEST AFRICA	33
2. GHANA	35
2.1. COURSE 1: SUSTAINABLE ONSITE-SANITATION AND FECAL SLUDGE MANAGEMENT FOR WATER PROFESSIONALS	36
2.2. COURSE 2: WATER LABORATORY INSTRUMENTATION	36
2.3. COURSE 3: WATER SYSTEMS INSTRUMENTATION	37
2.4. COURSE 4: WASTE RESOURCE RECOVERY AND ENTREPRENEURSHIP	38
3. NATIONAL WATER RESOURCES INSTITUTE, NIGERIA	39
3.1. SHORT COURSE IN BOREHOLE DRILLING	40
3.2. SHORT COURSE IN PLUMBING AND SERVICE CONNECTION	41
3.3. INDUCTION COURSE FOR FRESH ENGINEERS AND SCIENTISTS	42
3.4. SHORT COURSE IN BOREHOLE DRILLING AND SUPERVISION	43
4. UNIVERSITY OF BENIN CITY, NIGERIA	44
4.1. COURSE 1: WATER SUPPLY AND ENVIRONMENTAL ENGINEERING	45
4.2. COURSE 2: REMOTE SENSING AND GIS	46
4.3. COURSE 3: BOREHOLE CONSTRUCTION AND MAINTENANCE	47
4.4. COURSE 4: OPERATION AND MAINTENANCE OF WATER DISTRIBUTION SYSTEM	48
5. CHEIKH ANTA DIOP UNIVERSITY (UCAD), SENEGAL	49
5.1. COURSE 1: PROJECT MANAGEMENT (DESIGN, PLANNING MONITORING AND EVALUATION, FUND RAISING, ETC.)	50
5.2. COURSE 2: GIS AND REMOTE SENSING APPLIED TO WATER AND SANITATION MANAGEMENT	50
5.3. COURSE 3: INTRODUCTION TO HYDROLOGICAL MODELLING USING SWAT	51
5.4. COURSE 4: INTRODUCTION TO UAV PHOTOGRAMMETRY	52
5.5. COURSE 5: DEVELOPMENT OF INSTITUTIONAL AND REGULATORY FRAMEWORKS	53
6. COURSE EVALUATION AND FEEDBACK	53
MONITORING AND EVALUATION PLAN	56
OUTCOMES OF THE TRAINING COURSES	59
EXCHANGES	63
USE OF SOFTWARE, CONSUMABLES AND TOOLS FOR PILOT COURSES	65
HCD RISK MAPPING AND E-READINESS SURVEY IN RESPONSE TO COVID-19	69
CONCLUSIONS	70
RECOMMENDATIONS	71

REFERENCES **72**

APPENDICES **75**

MONITORING AND EVALUATION FRAMEWORKS **75**

LIST OF ANNEXES

Annex I: Ghana HCD full training report on “Sustainable Onsite-Sanitation and Fecal Sludge Management”

Annex II: Ghana on Sustainable Onsite-Sanitation and Fecal Sludge Management

1. Unit 1 - course introduction (environmental sanitation challenges, sanitation as a barrier to disease transmission & to prevent groundwater pollution)
2. Unit 2 - Fecal sludge characterization
3. Unit 3 - On-site dry and wet sanitation technologies (ABR, biogas, biofilm, etc.)
4. Unit 4 - Engineering designs of Onsite sanitation technologies
5. Unit 5 - Fecal sludge Collection and transport
6. Unit 6 - Fecal sludge treatment options (settling/ thickening tanks, planted/unplanted drying beds, co-treatment with sewage, incineration, chemical stabilization,
7. Unit 7 - Fecal sludge co-treatment using composting and anaerobic digestion (fecal sludge reuse and land application, compost, charcoal briquettes and biogas production)
8. Unit 8 - Sanitation behavior change communication
9. Unit 9 - Sanitation strategies and action planning
10. Unit 10 - Sanitation business, contracts and private sector involvement

Annex III: NWRI Report on the virtual training on Borehole Drilling and Supervision

Annex IV: NWRI Course 1: Borehole Drilling

1. Geology and Hydrogeological Environment
2. Overview of Drilling Methods
3. Borehole Design and Completion
 - a. Borehole Drilling Process
 - b. Geophysical Well Logging summary
 - c. Pump Test
 - d. Pumping Test and Analysis of Data
 - e. Water Quality Assessment
4. Management of Drilling Construction
5. Codes of practice for water well
6. Borehole records, completion reports and Data base Management
7. Site Management and Supervision of Drilling Projects
8. Well Completion Report Writing

Annex V: NWRI Course 2: Plumbing

1. Pipeline Route Location and Profile
2. Plumbing Technology Note
3. Practical Manual
4. Repair of Pipeline

Annex VI: NWRI Course 3: Borehole Drilling and Supervision

1. Borehole Design and Completion
2. Borehole records, completion reports and Data base Management
3. Geophysical Well logging summary
4. Management of Drilling Construction Project
5. Site Management and Supervision Of Drilling Projects
6. Well Completion Report Writing

Annex VII: NWRI Course 4: Induction Course for Fresh Engineers and Scientists

1. Borehole records, completion reports and Database Management
2. Codes of practice for water well
3. Community Participation in Development Project
4. Introduction to Leak Detection
5. Maintenance of Water Supply System, Treatment and Operation
6. Pump and Pump Selection

Annex VIII: UNIBEN Course 1: Water Supply and Environmental Engineering

Annex IX: UNIBEN Course 2: Remote Sensing and GIS

Annex X: UNIBEN Course 3: Borehole Construction and Maintenance

Annex XI: UNIBEN Course 4: Operation and Maintenance of Water Distribution System

Annex XII: UCAD Implemented Course Syllabus

Annex XIII: UCAD Course 1: Project Management

Annex XIV: UCAD Course 2: GIS & Remote Sensing applied to Water and Sanitation Management

Annex XV: UCAD Course 3: Introduction to Hydrological Modelling using SWAT

Annex XVI: UCAD Course 4: Introduction to UAV photogrammetry

LIST OF ILLUSTRATIONS

List of tables

Table 1: List and contacts of Centres of Excellence and WANWATCE Secretariat-----	11
Table 2: List of sub-contractors -----	Erreur ! Signet non défini.
Table 3: Needs and priorities identified in Ghana, Nigeria and Senegal -----	17
Table 4: Agenda of National Consultation Meetings-----	19
Table 5: Activities, deliverables and milestones of the ACEWATER2/UNESCO-HCD Project in Burkina Faso-----	Erreur ! Signet non défini.
Table 6: List of organizations receiving the national HCD strategy during the workshop of 30 th September 2020----	23
Table 7: List of stakeholders and partners participating in the NWRI meeting on HCD Framework of 6 th August 2020 -----	24
Table 8: List of recipients of the National HCD Strategy from December 2019 to June 2020-----	26
Table 9: Distribution of gaps per country/CoE (the brown color represents the identified gaps)-----	34
Table 10: List of proposed short training courses in West Africa -----	34
Table 11: List of planned and implemented training courses in RWESCK-KNUST, Ghana -----	35
Table 13: NWRI's list of proposed training courses -----	39
Table 13: List of training courses planned and implemented by NWRI-----	40
Table 14: List of training courses planned by UNIBEN -----	45
Table 15: List of short training courses proposed by UCAD-----	49
Table 16: Global Monitoring and Evaluation Plan for ACEWATER2 Project - Human Capacity Development Component -----	56
Table 17: Synthesis of M&E Frameworks in West Africa -----	59
Table 18: Synthesis of M&E Frameworks in West Africa -----	62
Table 20: List of acquired material -----	65
Table 21: Results of the E-readiness for WANWATCE-----	69

List of figures

Figure 1: Percentage of satisfaction in terms of meeting initial expectations of participants -----	54
Figure 2: Percentage of satisfaction in terms of course design, methodologies and material -----	54
Figure 3: Rating of the training with regards to different indices in Ghana-----	54
Figure 4: Gender of participants per country in West Africa-----	60
Figure 5: Breakdown of participants by age groups-----	61

LIST OF ACRONYMS AND SIGLES

ZiE	: International Institute for Water and Environment Engineering
AMCOW	: African Ministers' Council on Water
ANBO	: Africa Network of Basin Organizations
AU	: African Union
AUC	: African Union Commission
BMZ	: Germany Federal Ministry for Economic Cooperation and Development
CCRE	: Centre de Coordination des Ressources en Eau
CIRAD	: Centre de coopération internationale en recherche agronomique pour le développement
CNRST:	: Centre National de la Recherche Scientifique et Technique
CoE	: Centre of Excellence
CREAF	: Ecological and Forestry Applications Research Centre, Spain
EC	: European Commission
ECOWAS	: Economic Community of West African States
EU	: European Union
GIZ	: Deutsche Gesellschaft für Internationale Zusammenarbeit
GMES	: Global Monitoring for Environment and Security
HCD	: Human Capacity Development
IHP	: International Hydrological Programme
INERA	: Institut National de l'Environnement et Recherches Agricoles
IPA	: Implementation Partners Agreements
IRSTEA	: Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture, France
IWEGA	: International Centre for Water Economics and Governance in Africa
JRC	: Joint Research Centre of the European Commission
KNUST	: Kwame Nkrumah University of Sciences and Technology
KNUST	: Kwame Nkrumah University for Sciences and Technology
KoM	: Kick off Meeting
MDG	: Millennium Development Goal
MEA	: Ministère de l'Eau et de l'Assainissement (Burkina Faso)
MESA	: Monitoring for Environment and Security in Africa
NBA	: Niger Basin Authority
NEPAD	: New Partnership for Africa's Development
NWRI	: National Water Resources Institute of Kaduna (Nigeria)
PSE	: Senegal Emerging Plan
RWESCK	: Regional Water and Sanitation Centre, Kumasi
UAV	: Unmanned Aerial Vehicle
UCAD	: Cheikh Anta Diop University of Dakar
UNESCO	: United Nations Educational, Scientific and Cultural Organization
UNIBEN	: University of Benin, Benin City (Nigeria)
USAID	: United States Agency for International Development
WANWATCE	: NEPAD West African Network of Water Centres of Excellence

PROJECT BACKGROUND

The Human Capacity Development component of the NEPAD WATER ACE2 project is supporting the implementation of the African Water Ministers' declaration urging AUC and NEPAD Centres of Excellence to develop a "Human Capacity Development Programme for junior professional and technician level capacity challenges in the water sector" at national level in the CoE countries. The Human Capacity Development component of the ACE2 project activities concern the establishment and implementation of the Human Capacity Development Programme at the national level in all the NEPAD CoE countries.

The project is funded by the European Commission, coordinated by UNESCO-IHP and implemented by the African Network of Water Centres of Excellence. In West Africa, the Human Capacity Development component supports the preparation of national human capacity development frameworks/strategies/plans that address junior professional and technician level capacity challenges in four NEPAD Centres of Excellence (CoE) in three countries. These pilot countries include Ghana, Nigeria and Senegal. The national HCD frameworks include an implementation plan and a monitoring and evaluation (M&E) framework.

A study funded by European Commission was conducted in 2013 on human resources and training needs in the water sector in West Africa. The idea were to estimate existing capacities and qualifications in the water sector in West Africa region (i.e. private, public, academia, NGO, utilities, international partners, etc.); to identify needs in the water sector in West African sub-region for advocacy and consultancy; and to establish priorities base on the results of the survey.

This study was further enhanced and completed in 2017 and 2018 as part of the Phase 1 of ACEWATER2 Project HCD Component, in the umbrella of UNESCO. The first results provide an overview on human resources in the water sector on different countries in West Africa (Ghana, Nigeria, Senegal and lastly Burkina Faso). According to the data, it was established that our regional water sector is highly marked by gaps and deficits in terms of human resources. The frameworks for WASH sector human capacity development (HCD) in West Africa highlight difficulties to deliver quality WASH services to meet the Sustainable Development Goal 6 (SDG 6).

The studies carried out in Ghana, Senegal and Nigeria identified of the needs, priorities and skill gaps with the national government through a multi-stakeholder participative approach. Based on these results, the CoEs defined implementation frameworks for the human capacity development and to provide a monitoring and evaluation (M&E) framework.

The National HCD Frameworks are developed to formulate, monitor and evaluate the capacity building activities. The framework helps to effectively plan, implement and evaluate the capacity building activities in a systematic way. Findings from the study were finally presented at a validation workshop to key sector stakeholders. The training needs were identified through

individual training needs identified in the organizations survey, national dialogue workshop, and by the individual employees.

The first phase of ACEWATER2 (IPA 1) was intended to “Establish a national Human Capacity Development Programme addressing junior professional and technician level capacity challenges in the NEPAD CoE Countries in West Africa”. The four countries have been supported by UNESCO through WANWATCE Coordination to “identify needs and define priorities with national governments through a multi-stakeholder participative approach.

In each CoE country, support have been provided to CoE for:

- Study on Water Sector needs at national level (scale) including scoping study, surveys, interviews and consultations of national partners and stakeholders
- Organization and implementation of national dialogue for human capacity building in the water sector with all stakeholders and partners: Defining priorities from the needs consultations.
- Designing a National framework for Human Capacity Development in the water sector, including an implementation framework, together with an M&E framework and indicators
- Organization and facilitation of a national validation workshop in which the National Framework for Human Capacity Development is validated

The second phase of the HCD component (IPA 2) involves the implementation of the Human Capacity Development Programs in four countries in western Africa in collaboration with relevant institutions fostering a sustainable capacity development approach. Specifically, activities in this phase include:

- Facilitating the selection of the pilot countries in western Africa, in partnership with countries’ authorities and CoEs, for the implementation of the national framework on Human Capacity Development
- Providing support for the dissemination of national frameworks and implementation frameworks to stakeholders, donors and training institutions at national level
- Providing support for the design and or review and implementation of courses or course curricula material addressing junior and senior professional and technician level capacity for a minimum of top two priorities (minimum of 4 courses) per pilot country
- Providing support for the implementation of the courses for junior and senior professionals and technicians
- Managing the regional staff and/or human resources and student exchanges (improving regional networking) within and between Networks.

The piloting of activities in this second phase of the HCD component have been conducted in Ghana, Nigeria, and Senegal. However, a significant effort has been made to upgrade the data on Burkina Faso with a good mapping of the water sector.

IMPLEMENTING TEAM AND ORGANIZATION

The WANWATCE (West African Network of Water Centres of Excellence of NEPAD) is constituted by five centres in four countries (Table 1):

1. The Regional Water and Sanitation Centre of Kwame Nkrumah University of Sciences and Technology (RWESCK-KNUST), Ghana;
2. The National Water Resources Institute (NWRI), Nigeria;
3. The University of Benin City (UNIBEN), Nigeria;
4. The Cheikh Anta Diop University (UCAD), Senegal;
5. The International Institute for Water and Environmental Engineering (2iE), Burkina Faso

INERA (Institut International d'Ingénierie de l'Eau et de l'Environnement) was the sub-contractor in charge of desk studies and water sector analysis in Burkina Faso.

Table 1: List and contacts of Centres of Excellence and WANWATCE Secretariat

Country	CoE Name & Address	Contact person
<i>Ghana</i>	RWESCK-KNUST Regional Water and Sanitation Centre, Kumasi	<i>Prof. Sampson ODURO-KWARTENG</i> +233 244598999 sokwarteng@gmail.com
<i>Nigeria</i>	NWRI National Water Resources Institute, Kaduna, Nigeria	<i>Dr Martin O. EDUVIE</i> +234 8036400061 martineduvie@gmail.com
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<i>Burkina Faso</i>	2iE The International Institute for Water and Environmental Engineering (2iE)	<i>Prof. Harouna KARAMBIRI</i> <i>Dr Babacar LEYE</i> babacar.leye@2ie-edu.org
<i>WANWATCE Secretariat: Prof. Awa NIANG FALL</i> Tel. +221 33 826 41 49 / Email: awa10.fall@ucad.edu.sn / coe.nepad@ucad.edu.sn		

The WANWATCE Secretariat is responsible for coordinating activities in the different centers and countries (Burkina Faso, Ghana, Nigeria and Senegal). The secretariat of WANWATCE is also responsible for the implementation of the contract binding the CoEs to UNESCO via UCAD. The Secretariat performs tasks related to the implementation of the action plan defined and validated in agreement with UNESCO. All other CoEs are linked to the WANWATCE Secretariat through a sub-contract allowing the execution of the tasks assigned to each of the centers. The secretariat is also in charge of providing and executing the budget allocated to CoEs, providing support in the preparation and implementation of activities, and orientation in the reporting activities. In addition, the secretariat organizes and coordinates the workshops and international meetings in the West African region.

The Secretariat also provides administrative and financial follow-up, through the support of the International Cooperation Directorate of Cheikh Anta Diop University. This Directorate of UCAD is responsible for accompanying the international strategy of UCAD and for contributing to the implementation of the guidelines defined by the university. It works closely with various components and provide many services to students, researchers and partner organizations; Develop and monitor of cooperation agreements with partner institutions and financial management of research projects related to cooperation, mobility and management of grants allocated under the institution's partnerships. In this ACEWATER2 project, the Cooperation Department is responsible for the financial implementation and administrative follow-up of the project in accordance with a mandate received from the University's Rectorate, which is a signatory of the project with UNESCO.

INTRODUCTION

The Human Capacity Development component of the NEPAD ACEWATER2 was funded by the European Commission, coordinated by UNESCO-IHP and implemented by the African Network of Water Centres of Excellence. In this context, UNESCO-IHP and UCAD have signed two Implementation Partners Agreements (IPA) between December 2016 and mid-November 2020 to conduct activities in West Africa. The aim of this HCD Component is to support the preparation of national human capacity development frameworks/strategies/plans that address junior professional and technician level capacity challenges in four NEPAD Centres of Excellence (CoE) in three countries. These pilot countries include Ghana, Nigeria and Senegal. The national HCD frameworks include an implementation plan and a monitoring and evaluation (M&E) framework.

During the previous pilot phase of the NEPAD Centres of Excellence for Water Science and Technology project (2009-2013), the studies conducted provided an overview on human resources in the water sector on different countries in West Africa (Ghana, Nigeria, Senegal and lastly Burkina Faso). According to the data, it was established that the West African regional water sector was highly marked by gaps and deficits in terms of human resources. The frameworks for WASH sector human capacity development (HCD) in West Africa highlighted difficulties to deliver quality WASH services to meet the Sustainable Development Goal 6 (SDG 6).

Within the framework of the ACEWATER2 project, the studies carried out in Ghana, Senegal and Nigeria identified the needs, priorities and skill gaps with the national government through a multi-stakeholder participative approach. Based on these results, the CoEs defined implementation frameworks for the human capacity development and to provide a monitoring and evaluation (M&E) framework. Findings from the study and the national HCD Framework were finally presented at a national validation workshop in each CoE country to key sector stakeholders. The training needs were identified through individual training needs identified in the organizations survey, national dialogue workshop, and by the individual employees.

The following activities have been undertaken by UCAD within these IPAs:

Activities undertaken within IPA 1:

- Support the preparation of a national strategy on Human Capacity Development addressing junior professional and technician level capacity challenges in four NEPAD CoE Countries from Western Africa (namely Senegal, Ghana, Burkina and Nigeria), including an implementation framework together with a Monitoring and Evaluation (M&E) Framework.

Activities undertaken within IPA 2:

- Support the implementation of the National Frameworks on human capacity development in at least three countries: Deliverables: National Frameworks widely disseminated to at least 30 partners and key stakeholders; software and consumables for laboratories or

tools for numerical computational modelling will be distributed to Pilot Countries and four training courses prepared/and delivered to at least three countries;

- Manage an exchange programme for students and researchers within the NEPAD West Africa Network of Centres of Excellence and, where feasible, with the other NEPAD Networks of Centres of Excellence in Southern and Central/East Africa: Deliverables: agreements signed between universities for the exchange program including topics or objectives of the exchange; up to 10 students or researchers complete visiting or research exchanges within the sub-region.

However, due to the COVID-19 pandemic and its consequences, the exchanges were cancelled and most of the courses were organized by distance learning. This situation has also caused delays in the various agendas as well as program adjustments. Indeed, the health situation in West Africa since March 2020 has meant that most university campuses have remained closed for at least six months. Despite the gradual reopening from September onwards, in most centers, social distancing measures as well as health regulations have not always allowed the organization of face-to-face training courses. In addition, there are severe restrictions on international travel.

This final report combines a synthesis of activities undertaken under IPA 1 and IPA 2 and contains the following:

- A synthesis and summary of previous reports submitted under IPA 1
- The preparation and implementation of national strategies on HCD, including the dissemination process
- The launch of training activities as outlined in the action plan
- The Monitoring & Evaluation results on outcomes of the training courses

IPA 1 ACTIVITIES: WATER SECTOR'S HCD NEEDS AND PRIORITIES

1. Scope of regional and country activities

The main activities carried out under this ACE2 Human Capacity Development component consisted of:

1. Analysis of results from surveys and exchanges with institutions in the water sector in Ghana, Nigeria and Senegal;
2. identification and validation of national priorities for Human Capacity Development in the water sector of Ghana, Nigeria and Senegal;
3. Elaboration of National Frameworks for Human Capacity Development in the water sector in three countries in (Ghana, Nigeria and Senegal);
4. Finalization, validation and submission of National HCD Frameworks to UNESCO;
5. Identification of a partner (INERA/CNRST) and organization of a meeting in Ouagadougou in July 2018, in order to implement a strategy for carrying out studies in Burkina Faso
6. Contract arrangement with INERA for carrying out studies in Burkina Faso;

2. Key findings and common gaps

The WASH sector present different configuration in the three countries where surveys were made. The common findings in the three countries are:

- Insufficient human resources to implement water policies and programmes at the national and sub-regional levels;
- Staff qualification levels that are not in line with the real needs of the sector;
- A significant shortage of skilled technicians and workers, particularly for tasks and operations related to monitoring (hydrometry) and mobilization (gate operation) of water resources and the management and definition of sustainable sanitation plans, particularly in rural areas;
- A sector that is not sufficiently attractive in terms of salaries, so that recruitment and replacement of staff are not always guaranteed, leading to the retention of retirees for several years;
- Staff capacity building initiatives, but generally leading to losses in human resources (strengthened staff generally change position or permanently leave the water and sanitation sector for other sectors that are more attractive in terms of salary treatment);
- The existence of many general training institutions, from which graduates with limited employability in the water and sanitation sector emerge;
- A lack of control over the management of water projects;
- Many problems of financing and/or renewing infrastructure and upgrading salaries, in order to attract more qualified staff;

- The need to set up vocational training courses specifically dedicated to the water and sanitation sector and enabling graduates to take charge of the sector's development.

Generally, the structures working in the water and sanitation sector face enormous problems in the execution of their tasks, largely related to a lack of qualified human resources, insufficient equipment's and financial resources. To these problems are added constraints related to:

- The difficulty of accessing data and quality information,
- Lack of enforcement agents and failure to comply with donor implementation manuals,
- Problems of coordination between national institutions,
- Organizational problems of State structures (change of project coordinators in the full exercise of their mission),
- Lack of production infrastructure,
- The inadequacy of the legal and institutional framework to meet the needs of the water and sanitation sector.

This results in almost insurmountable challenges for the water sector in all countries concerned by the study. Generally, countries send their agents in capacity building programs, short-term internships or in-service training in foreign countries.

3. Needs and priorities in Human Capacity Development

At national level, the training needs and priorities for the water sector personals depend largely on the policies and guidelines defined and on the major projects under development. The 2013 study had shown the significant shortage of technicians, senior technicians and skilled workers. This observation is still valid today and has emerged from all the reports in the four countries. The needs and priorities recorded from surveys carried out in the three countries are reported in the Table 2 below.

In Ghana, needs and priorities at national level are linked to training of technicians and artisans with non-tertiary certificates. The critical skills gaps identified by KNUST (Kwame Nkrumah University of Sciences and Technology) for Ghana Water Sector were: Sanitary engineering; Sediment/costal engineering; Eco-toxicology, Environmental law; Water resources modelling (surface and sub-surface), Ecological assessment and modelling expert etc.). Some skills (eg. mechanical, electrical, civil engineers, Hydro-geologist, Remote sensing and GIS specialist) exist in the country but the difficulty in getting them was due to the unattractive salary and conditions of service in the WASH sector.

In Nigeria, two CoEs were in charge of conducting studies to reflect the reality of human resources in the Nigerian WASH sector. The northern part of the country was covered by the National Water Resources Institute (NWRI) in Kaduna. The southern part of the country was covered by UNIBEN (University of Benin City). The particularity of Nigeria is that it is a federal state with important

disparities from the north to the south but also quite important differences in legislation and organization at administrative and technical level.

The two CoEs involving in the project reported some urgent actions to be carried out in the sector. Factors militating against the development of the Nigerian Water sector that need to be addressed include:

- Lack of enforceable legislation for water practitioners in the country;
- Lack of awareness on the importance of hydrological data in the planning and management of the nation’s water resources;
- Lack of adequately trained manpower in the sector;
- Inadequate collaboration among all stakeholders in the water sector;
- Inadequate funding of the water sector.

In Senegal, the situation is slightly different with a unified water sector with 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. However, the staff working in the water and sanitation sector are mainly senior technicians (45%); 33% of them are volunteers. The water sector is highly affected by the low qualification of human resources, with engineers representing only 7% of the total workforce. Therefore, the skill gaps are numerous and considered as highly important.

Table 2: Needs and priorities identified in Ghana, Nigeria and Senegal

Country	Needs and Priorities	
Ghana	<ul style="list-style-type: none"> - Practical water quality laboratory skills - Construction of WASH facilities - GIS training - ICT skills in specialized software - Project Management - Monitoring and evaluation 	<ul style="list-style-type: none"> - Sanitary engineering, - Sediment/costal engineering - Eco-toxicology - Environmental law - Water resources modelling (surface and sub-surface) - Ecological assessment and modelling
Nigeria	<ul style="list-style-type: none"> - Plant/maintenance & operation, - Field Assistant / Drivers - Mechanical Engineering - Animal Science / Livestock - Water Resources Engineering - Microbiology - Agronomy - Computer / System Analyst - Hydraulic Engineers 	<ul style="list-style-type: none"> - Water Treatment, - Research and Development, - Construction Project Managers, - Environmental Health - Chemical Engineering - Water Conservation - Agriculture and Agricultural Engineering - Coastal Engineering - Waste Disposal

Country	Needs and Priorities	
	<ul style="list-style-type: none"> - Office Assistant / Clerical - Artisans and technicians (e.g. boiler makers, welders, plumbers, drillers) - Water Analyst - Administrative Officers - Mining Engineering - Agriculture/Agricultural Engineering - Geography - Policy - Environmental Health / Sanitation 	<ul style="list-style-type: none"> - Financial Management - Waste Handling - Climatology - Occupational Health and Safety Skills - Sanitation - Conflict Resolution/Mediation - Institutional Management - Plant Maintenance and Operation - Rainwater Harvesting Technologies - Freshwater Systems - Marketing and Communications - Cultural and Social Science - Environmental Law - Hydrochemistry - Geochemistry - Industrial Ecology
Senegal	<ul style="list-style-type: none"> - Water and waste water treatment - Groundwater management - Water for agriculture - Water technology and innovations 	<ul style="list-style-type: none"> - Wastewater treatment - Management of sludge - Knowledge of ERs - Modern drilling techniques - Groundwater quality - Groundwater protection and pollution management - Modeling Project Management - Negotiations and financing of the water sector - Water security and sustainability of AEP systems - Standardization and application of charters - Modern irrigation techniques - Water saving and protection of resources - Drainage water management - Management of pollutants and pollution of agricultural origin - Technological innovations - Modeling - Geomatics applied to the management of water resources

4. Summary of Development of National HCD Frameworks

The studies carried out in Ghana, Senegal and Nigeria identified the needs, priorities and skill gaps with the national government through a multi-stakeholder participative approach. Based on these results, the CoEs defined implementation frameworks for the human capacity development

and to provide a monitoring and evaluation (M&E) framework. The National HCD Frameworks have been developed to formulate, monitor and evaluate the capacity building activities. The framework would help to effectively plan, implement and evaluate the capacity building activities in a systematic way. Findings from the study and the national HCD Framework were finally presented at a national validation workshop in each CoE country to key sector stakeholders. The training needs were identified through individual training needs identified in the organizations survey, national dialogue workshop, and by the individual employees.

The national consultation meetings in WANWATCE took place between May 2017 and February 2018 for Ghana, Nigeria and Senegal; in Burkina Faso, the dialogue process was conducted from August to December 2018 (Table 3).

Table 3: Agenda of National Consultation Meetings

Country	Dialogue dates	Validation workshop dates
Ghana	12 th September 2017	15 th February 2018
Nigeria - NWRI	14 th to 15 th August 2017	31 st October 2017
Nigeria - UNIBEN	27 th September 2017 29 th September 2017	12 th October 2017
Senegal	16 th May 2017	16 th February 2018
Burkina Faso	August to December 2018	-

Below are summaries of the prioritized needs of trainings area in each country for the Technicians / Senior Professionals and for Young Professionals in western Africa, except Burkina Faso:

- **Ghana:**
 - Water Resources Management and Development
 - Water Supply
 - Environmental Sanitation
 - Environmental Health and Hygiene
- **Nigeria:**
 - Water supply and Environmental Engineering
 - Remote Sensing and GIS
 - Water Treatment Techniques
 - Operation and maintenance of Pumps and Water Distribution System
 - Borehole Drilling and Construction
 - Hygiene and Sanitation Promotion and Education
- **Senegal:**
 - Project Management
 - Negotiations and financing of the water sector

- Standardization and application of charters
- Modeling
- Geomatics applied to the management of water resources

5. *Implementation of HCD activities in Burkina Faso*

After noting the unavailability of 2iE to carry out activities related to Human Capacity Development in the water sector in Burkina Faso, the WANWATCE network secretariat, in consultation with the European Commission Joint Research Centre (JRC) and the coordination of the project at UNESCO-IHP, took the decision to contract with INERA (Institute for Environment and Agronomic Research).

INERA is one of the four research institutes of the CNRST (Centre National de la Recherche Scientifique et Technologique). It is a specialized public structure officially mandated to ensure the formulation, execution and coordination of environmental and agricultural research in Burkina Faso. Under the umbrella of the Director of INERA, Dr Hamidou TRAORE, Dr Moussa SANON is responsible of the implementation of HCD activities in Burkina Faso's water sector.

The first workshop organized on July 30, 2018 at INERA in Ouagadougou with UNESCO and WANWATCE network secretariat, provided an opportunity to present the project and the partners' expectations. An implementation contract was co-signed by INERA and UCAD on August 1st 2018.

The first meetings and documents consulted show that there was a real need to update human resources capacity building needs in the water and sanitation sector in Burkina Faso. The updated information available is sectoral, did not concern NGOs and the private sector.

The INERA team carry out a survey based on the mapping prepared by USAID and updated with the database from the 2017 water user inventory.

A total of 138 organizations in 14 municipalities were touched by the survey. Twenty-five (25) types of activities related to water were identified. The main ones are water resources management; water service provision; decision-making; education and training; operations and public service management; agriculture or market gardening; planning and finance. Only 3% of the surveyed actors have sanitation and wastewater collection as main activity. Existing skills in water sector organizations reveal the need to train resource persons in several areas of expertise in order to ensure the proper functioning of organizations working in the water and sanitation sector. Concerning first-rate skills, they are mainly composed of craftsmen and boilermakers, plumbers, drillers (30.28%), agricultural engineers (13.76%), agronomists (6.42%), communicators (4.59%) and financial management managers (4.59%), etc. These first results

show that there is a real need to update human resources capacities in the water and sanitation sector in Burkina Faso.

HCD FRAMEWORK DISSEMINATION

The process of disseminating human capacity development programmes was an activity that started since their validation in 2018. As part of Phase II (IPA 2), Centres of Excellence continued to disseminate national frameworks and implementation frameworks to partners, stakeholders, and training institutions at national level including:

- Preparation of dissemination materials, including publishing the National HCD Frameworks of the Pilot Countries into information packages for distribution in each of the Pilot Countries.
- Dissemination of the frameworks in the network of institutions relevant to the water sector.
- Dissemination of the frameworks to sector stakeholders and partners.

Various dissemination activities were organized in the four centers, mainly through the Internet, sector meetings and sharing workshops. All CoEs, except UNIBEN, have disseminated their national HCD framework to at least 30 stakeholders and key partners as detailed below. As 2iE was not involved in the development of HCD Strategies, it is not concerned by the dissemination activity.

1. *Ghana*

In accordance with the requirement of the IPA, the national HCD framework was disseminated to at least 30 stakeholders and partners in Ghana. Dissemination of the national strategy was done in Ghana through workshops but also through electronic communication to key partners. Soft copy and printed hard copies of the HCD report were sent to all the organization participants of the national workshops (Table 4) and all the Centre Partners in Ghana, and CoE Sector Advisory Board members. The HCD Strategy were also disseminated to training and research institutions like:

- University of Education, Department of Environmental Health and Sanitation;
- University of Ghana
- School of Hygiene, Accra
- University of Cape Coast, Department of Water and Sanitation
- KNUST, Department of Planning
- National Board for Professional and Technical Examination
- Accra University of Technology
- Presby University.

Table 4: List of organizations receiving the national HCD strategy during the workshop of 30th September 2020

1.	ACARP	Accra Compost and Recycling Plant
2.	NABPTEX	National Board for Professional and Technician Examinations
3.	AMA-WMD	Accra Metropolitan Assembly – Waste Management Services
4.	CONIWAS	Coalition of NGOs in Water and Sanitation
5.	CSIR-WRI	Council for Scientific and Industrial Research - Water Research Institute
6.	CWSA	Community Water and Sanitation Agency
7.	NDPC	National Development Planning Commission
8.	RCN GHANA	Resource Centre Network Ghana
9.	SKYFOX LTD	Integrated Aquaculture & Crop Production
10.	EHSE/UEW	Environmental Health and Sanitation Education Department of Sanitation University of Education, Winneba
11.	ESPA	Environmental Service Providers Association
12.	TMA	Waste Management in Tema Ghana
13.	TREND	Training, Research and Networking for Development (TREND) Group
14.	U.C.C	University of Cape Coast
15.	GIDA	Ghana Irrigation Development Authority
16.	GLOWDEP	Global-Women-Development-Promoters
17.	UN-HABITAT	United Nations Human Settlements Programme
18.	GWCL	Ghana Water Company Limited
19.	UNESCO	United Nations Educational, Scientific and Cultural Organization
20.	WASH Consult	NGO committed to assisting sector players in researching, developing, and implementing evidence-based WASH strategies
21.	I.C.D	ICD Professional Training Centre, Accra-Ghana
22.	IESS	Institute for Environment and Sanitation Studies University of Ghana
23.	WaterAid	international NGO dedicated exclusively to the provision of safe domestic water, sanitation and hygiene education to the world's poorest people
24.	IRC Ghana	Independent, non-profit organization that drives resilient WASH systems from the ground up
25.	WRC	Water Resources Commission of Ghana
26.	WSUP	Water and Sanitation for the Urban poor
27.	MSWR	Ministry of Sanitation and Water Resources
28.	Zoomlion Ghana Limited	Sustainable Waste Management Solutions for homes, Businesses and Communities

2. *Nigeria*

In Nigeria, only one CoE (NWRI) has carried out the activity of HCD Framework dissemination. A large communication about the National Strategy has been made by NWRI during the meeting of National Council on Water Resources of Nigeria in August 2018. This was an opportunity to share the project's objectives and to communicate with all stakeholders of the Nigerian water sector

on the current work engaged on the definition of National Strategies for capacity building in the water sector.

As a result of the COVID-19, dissemination was done by NWRI using online platforms such as email, WhatsApp, phone calls, etc. This was done in July/August 2020 prior to the beginning of the training programmes. The list of stakeholders and partners include:

1. Federal Ministry of Water Resources
2. Federal Ministry of Health
3. Federal Ministry of Environment
4. Federal Ministry of Agriculture and Rural Development
5. Federal Ministry of Education
6. State Ministries of Water Resources, Environment, Agriculture, Health etc.
7. State Water Agencies or Boards
8. Rural Water Supply and Sanitation Agencies
9. River Basin Development Authorities
10. Local Government WASH, Health, and Works Departments
11. Universities especially the members of the National Water Resources Capacity Building Network
12. Polytechnics and Colleges of Education
13. Primary and Secondary schools
14. International and local NGOs
15. International partners like UNICEF, etc.
16. Community Based Organizations (CBOs)
17. Research and Training Institutes

In addition, NWRI had a meeting with some stakeholders and partners on the 6th of August, 2020 where the HCD framework for the Northern part of Nigeria was shared and the list of the participants is shown below in Table 5. Overall, NWRI had disseminated the HCD Framework to more than 30 partners and stakeholders.

Table 5: List of stakeholders and partners participating in the NWRI meeting on HCD Framework of 6th August 2020

S/N	NAME	DESIGNATION	ADDRESS (official)	Email Address
1	Dr. Paul Bata	Deputy Director	National Business and Technical Examinations Board (NATEB) National Head Quarters Benin City	polpitabata07@yahoo.com
2	Dr. Rose Nwaji	Director, PRS	National Commission for Nomadic Education KM4 Kaduna Zaria Road, Rigachikun, P.M.B. 2343, Kaduna	nwajirose@gmail.com

S/N	NAME	DESIGNATION	ADDRESS (official)	Email Address
3	Dr. Muktar Namadi Muhammad	Head, Chemistry Department	Nigerian Defence Academy, Kaduna	mmnamadi@nda.edu.ng
4	Dr. Funmilayo Morebise	Deputy Director	National Universities Commission (NUC), Abuja	morefun0606@gmail.com
5	Engr. Hamidu Isa Abba	Principal Programmes Officer	National Board for Technical Education, Plot 'B', Bida Road, Kaduna	hamiduabba@yahoo.com
6	Yusuf Shehu Aliyu	Deputy Director (AP)	National Commission for Colleges of Education, Abuja	yusufmht63@gmail.com
7	Mohammed Gambo Muazu	Deputy Director	National Teachers' Institute (NTI)	mgnuazu@gmail.com
8	Prof. Donatus B. Adie	Coordinator	Ahmadu Bello University Zaria, NWRCBNet – Zonal Office, North West	donadie2005@yahoo.com
9	Fashoyi Adewale Olabode	Deputy Director	Federal Ministry of Water Resources, Old Federal secretariat, Area 1, Abuja	olabodefashoyi@yahoo.com
10	Timeyin Uwejamomere	Consultant/ Interim National Coordinator	National Action Plan for Revitalization of the Water Sanitation & Hygiene Sector Federal Ministry of Water Resources	timeyin.uweja@gmail.com
11	Ibrahim Dalhatu	1 st Vice Chairman (NUTKDSW) Teacher	Nigeria Union of Teachers (Representing the NUT National President)	ibrahimdalhat3@gmail.com
12	Engr. Abubakar Sani Kazaure	Engineer/Lecturer	Department of Civil Engineering, College of Engineering, Kaduna Polytechnic, Kaduna	abukazaure@yahoo.com
13	Olatunji Abdulganiyy Adebunmi	Chief Education Officer	Federal Science and Technical College Ikare, Akoko, Ondo State	abdulganiyy23@gmail.com
14	Prof. John O. Ohu	Coordinator, NWRCBNet, Maiduguri	University of Maiduguri, Maiduguri, Nigeria	ohujohn@yahoo.com
15	Olukayode Oluwakemi Omolara	Head of Department, Water & Sanitation Tech.	Ogun State College of Health Technology, Ilese-Ijebu, Ogun State, Nigeria	kemi4jesus2011@gmail.com
16	Mailafiya Danlami Hassana (Mrs)	Education Officer	Federal Ministry of Education, Abuja	mailafiyahassana@yahoo.com
17	Abbas Ladi Audu (Mrs)	Supervisor	Federal Science and Technical College, Kafanchan, Kaduna State	ladiabbas@yahoo.com
18	Dr. M. I. Dikko	Lecturer	Federal College of Education, Zaria	dr.dikko@yahoo.com

S/N	NAME	DESIGNATION	ADDRESS (official)	Email Address
19	Nanpet Chuktu	Programme Manager	United Purpose, No.1B Abeena Housing Estate Calabar, Cross River State	nanpet.chuktu@united-purpose.org
20	Igbinovia Adesola Rabiati	Scientific Officer	Federal Ministry of Water Resources, Abuja	desolaigbinovia@yahoo.com
21	Akpa, Oluyemisi E,	Chief Scientific Officer	Federal Ministry of Water Resources, Abuja	yemisisas@yahoo.com
22	Dr. Vincent E. Weli	Asst. Director INRES, UNIPORT	Institute of Natural Resources, Environment and Sustainable Development, University of Port Harcourt	vincent.weli@uniport.edu.ng

3. Senegal

In Senegal, dissemination of the strategy has been an ongoing process that began in 2018 and continued through 2020; all forums and opportunities have been seized to share this experience with stakeholders in the water sector, research and training institutions. The first steps were to organize dissemination materials for distribution and to address informative letters to different institutions considered as major on Water and Sanitation issues:

- the Ministry of Hydraulics and Sanitation,
- the preparatory committee of the 9th World Water Forum Dakar 2021,
- the Ministry of Research and the General Directorate of Research (Senegal),
- the Vice Chancellor and the Director Research and Innovation of Cheikh Anta Diop University.

Other external communications were also made with other actors outside the project. Details of these communications may be found in national reports. The COVID-19 pandemic has led to the closure of all campuses in Senegal. As a result, no face-to-face meetings could be held during the lockdown. The choice was made to communicate the strategy and disseminate it online. At the end of the containment, every opportunity was taken to communicate on the national HCD strategy in the water sector. For example, forums such as the preparatory committee of the 9th water forum, meetings and workshops in preparation for the elaboration of the National Water Atlas, etc. The list of institutions that have received the dissemination of Senegal's national HCD strategy is provided in the table below. In Senegal, dissemination of the HCD framework, therefore, has reached over 70 partners and stakeholders.

Table 6: List of recipients of the National HCD Strategy from December 2019 to June 2020

N°	Structures	Téléphone	Email	Adresse
1	Direction de l'Administration et	33 889 21 00	infos@minfinances.sn	Rue René Ndiaye x Avenue Carde, 4017 Dakar

N°	Structures	Téléphone	Email	Adresse
	de l'Équipement Général (DAGE)			
2	Direction de la Gestion et de la Planification des Ressources en Eau (DGPRE)	33 822 21 54	niokhorndour@gmail.com	Ex Camp Lat Dior Dakar (Sénégal)
3	Direction de l'Hydraulique (DH)	77 306 50 81	sanemoust@gmail.com	Route des pères Mariste
4	Direction de l'Assainissement (DA)	33 864 63 12	dirass@sentoo.sn	5, Route du Front de Terre
5	Agence de Promotion du Réseau Hydrographique National (APRHN)	33 821 01 52	aprhn@yahoo.fr	Cité Keur Gorgui ex ministère de l'Hydraulique 3 ^e étage à côté de la muraille verte
6	Office du Lac de Giers (OLAG)	33 938 20 11	olag@olag.sn	Avenue des Grand Hommes Ndilofène St Louis
7	Société Nationale des Eaux du Sénégal (SONES)	33 839 78 00	sones@sones.sn	Route du Front de Terre Hann
8	Sénégalaise Des Eaux (SDE)	33 839 37 37	eau[at]sde.sn	Siège social : Centre de Hann, Route du Front de Terre
9	Office des Forages Ruraux (OFOR)	33 827 57 38	forages@forages-ruraux.sn	63 Immeuble Aïda, rond point VDN x Ouest-Foire
10	Office National d'Assainissement du Sénégal (ONAS)	33 859 35 35	onas@onas.sn	Cité TP SOM n°4 Hann
11	Ecole Doctorale Eau, Qualité et Usage de l'Eau (EDEQUE/UCAD)	33 864 01 04	edeque@gmail.com	UCAD 3 rue Eucalyptus
12	Agence Nationale de la Recherche Scientifique Appliquée (ANSRA)	33 864 43 49	info@anrsa.sn	Cplx Sicap-Point E 2 ^{ème} étage Immeuble D
13	Centre de Suivi Écologique (CSE)	33 825 80 66	dt@cse.sn	Fann résidence, Rue Léon Gontran Damas
14	Association des Jeunes Professionnels de	77 353 31 22 77 353 31 22 77 273 30 02	ajpeas@gmail.com	

N°	Structures	Téléphone	Email	Adresse
	l'Eau et de l'Assainissement Sénégal (AJPEAS)			
15	Direction de l'Environnement et des Établissements Classes (DEEC)	33 826 01 17 33 822 62 11	denv@orange.sn	Parc Forestier de Hann- Route des Pères Maristes 1 ^e étage
16	Agence Nationale de l'Aviation Civile et de la Météorologie (ANACIM)	33 865 60 00	anacim@anacim.sn	Aéroport Léopold Sédar SENGHOR BP : 8184 Dakar-Yoff
17	Programme d'Urgence et de Développement Communautaire (PUD)	33 859 67 67 77 569-96 338592710	ngone.sow @undp.org	Immeuble HCR King Fahd
18	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta (SAED)	33 832 59 57	saed@orange.sn	Hann Maristes-Routes des Maristes
19	Société de Développement Agricole et Industriel (SODAGRI)	33 821 04 26	soterco@orange.sn	2 stv immeuble Fahdd 9 ^e Secrétariat de la SODAGRI
20	Compagnie Sucrière Sénégalaise (CSS)	33 938 23 23	direction.generale@css.sn	Richatoll BP 49
21	OMVS		omvssphc@omvs.org	
22	OMVG			
23	ARD Saint-Louis			
24	Agence Nationale de la statistique et de la Démographie (ANSD)	33 869 21 39	statsenegal@ansd.sn	Colobane à côté de la maison du parti Socialiste Mme Sagna Directrice des ressources humaines
25	Direction de la Protection Civile (DPC)	33 889 39 00	dpcsen@hotmail.com	75 Passage le blanc AV Nelson Mandela
26	Agence de Développement Municipal (ADM)	33 849 27 10	contact@adm.gouv.sn pacadem@orange.sn	En face du Ministère des finances

N°	Structures	Téléphone	Email	Adresse
				à coté de l'ancien bureau des passeports - 2 ^e étage
27	Direction de la Restructuration et de l'aménagement des Zones d'Inondation (DARZI)	33 879 34 34 33 879 34 00	support@adie.fr	Pikine Technopole
28	Direction des Bassins de Rétention et Lacs Artificiels (DBRLA)		youssou57@gmail.com	Hann route des pères Mariste
29	Bassins de Rétention et de Valorisation des Forages (BARVAFOR)	33 864 64 69 33 864 64 70	contact@sakss.sn	Hann route des pères Mariste
30	Service National d'Hygiène (Ministère de la Santé)	33 820 96 49	snh@sante.gouv.sn	Nord foire Derrière Terminus 34
31	Direction des Parcs Nationaux (DPN)	33 859 14 39	dpn@sentoo.sn	Hann/ ministère de l'environnement
32	Agence National de l'Aménagement du territoire	33 832 15 06	contact@anat.sn	Hann Mariste Derrière Bat le « Soleil »
33	Grande Cote Opération (GCO)	33 869 31 81		Mboro, village de Diogo
34	Direction de l'agriculture (DA)			
35	Direction de l'Investissement (DI)	33 889 26 88		Rue Docteur Guillet
36	ASCOSÉN	77 635 07 07	ascosen@gmail.com	Rue ZGM 02, à côté de l'École élémentaire de l'unité 26, immeuble AAD, 2 ^e étage
37	Union Nationale des Consommateurs du Sénégal	33 824-01-18	uncs2007@hotmail.com	UCAD en face du canal 4
38	Agence nationale de l'intégration et du développement Agricole (ANIDA)	33 859 06 60		VDN Mermoz en face de la passerelle

N°	Structures	Téléphone	Email	Adresse
39	Union régionale des coopératives de construction et d'habitat de Thiès (URCCHT)	33 979 70 00	urccht@gmail.com	Zac de Thiès à côté du rondpoint
40	APTE Sénégal	33 821 44 44		Cité Gorgui Villa Num 17
41	Cabinet EDE	33 820 87 06	ede@cabinetede.com	Route de l' Aéroport, Sunugal NG 28, Dakar, Sénégal
42	Biotech Sénégal	33 877 95 08 77 201 63 10 77 313 34 22	biotechsenegal@gmail.com	Fith Mith n° 651 Golf Sud
43	Cabinet IDEV-IC	33 855.95.90	idev-ic@idev-ic.sn	Patte d'Oie Builders villa n° B11 & D11 jumelées Dakar, Sénégal
44	SETICO	33 869 21 11 33 864 08 97	setico@sentoo.sn	Sacré Cœur III VDN Extension Villa n°157 Lots B-D
45	Eau vive	33 951 35 24	evthies@eau-vive.org	cité Malick Sy n 54 A thiès
46	ACRA	33.827.6413	acradk@orange.sn	Villa N°8613E, Quartier Sacré Cœur II
47	EAA ex CREPA	33 832 29 97		Route Ecobank Mariste Villa N 32 D
48	ENDA/RUP	77 285 58 53	dif-enda@endatiersmonde.org	Rue Félix Eboué
49	ENDA GRAF	33 827 20 25	endagrafsahel@endagrafsahel.org	Cité Millionnaire Grand yoff
50	ENDA ECOPOP	33 859 64 11	ecopop@endatiersmonde.org	Avenue Cheikh Anta DIOP Complexe Administratif Sicap Point E, Bâtiment B-2ème étage
51	CARITAS Dakar	33 834 00 20	Caritas@orange.sn	Km 11, route de Rufisque
52	WORLD VISION	33 865 17 17	worldvision_senegal@wvi.org	Sacré coeur 3 VDN Villa 145 M/S, Malick Sy
53	ADEMAS	33 865 01 88	ademas@ademas.sn	Sacré Coeur Pyrotechnique à côté de la Pharmacie Mame Oumy Gueye
54	SOTRACOM	33 869 07 67	sotracomsa@sotracomsa.sn	82, VDN Sacré Coeur III Dakar/SENEGAL

N°	Structures	Téléphone	Email	Adresse
55	CONGAD	33 827 54 94 77 538 25 71	congad@orange.sn congad@congad.org	2 voies Liberté 6 vers Samu Municipal
56	PLAN INTERNATIONAL	33 865 35 50	senegal.co@plan- international.org	91- Sotrac Mermoz Ancienne Piste
57	SCIEPS	33 832 26 80	scieps@orange.sn	3444 Immeuble Orange espace Residence Hann Maristes Dakar
58	RC CONSTRUCOES	33 961 00 66	geralsenegal@rodriguesca macho.com	91, Qrt. Route de Khor/ ST. LOUIS
59	SONED AFRIQUE	33 825 88 02	sonedaf@orange.sn	Immeuble Ndiaga DIOP, Parc à Mazout Colobane
60	École Supérieure Polytechnique de Dakar	33 824 05 40	esp@esp.sn	Université Cheikh Anta Diop de Dakar, Corniche Ouest
61	École Polytechnique de Thiès	33 951 15 48	ept@ept.sn	A10, Thiès Nones, Thiès, Sénégal
62	Université de Thiès	33 939 76 00 33 939 76 07	unithies@orange.sn	Thiès
63	ENSA (Thiès)	33.939.59.26	ensath@orange.sn papndiaye10@hotmail.co m	Thiès route de Khombole
64	GRET	33 849 35 38	gret@gret.org	s/c IRD Hann Maristes Route des Pères Maristes, Dakar
65	ENDA Eau Populaire	77 638 49 04	se@endatiersmonde.org	Mermoz en face de la SONATEL
66	DELGAS	33 939 71 70	contact@delgas- assainissements.com	247, Saly station, route de Saly
67	DELTA	33 867 23 76	lenatall@orange.sn	Liberté VI Extension VDN
68	HYDROCONSEIL	+ 33 (0)4 90 22 57 80	hydroconseil@hydroconse il.com	
69	HYDROPLAN	+49 6241 9103- 0	info@hydroplan.de	
70	AGERROUTE	33 869 07 51	ageroute@ageroute.sn	Rue F x David Diop – Fann Résidence
71	APIX	33 823 94 89	contact@apix.sn	52 - 54 Rue Mohamed V
72	EIFFAGE	33 839 73 39	eiffage.senegal@eiffage.c om	Avenue Félix Éboué x Route des Brasseries

N°	Structures	Téléphone	Email	Adresse
73	Compagnie Sahélienne d'Entreprises (CSE)	33 859 03 00	csesn@groupecse.com	Rocade Fann Bel-Air
74	Consortium d'Entreprises (CDE)	33 839 59 59	cde@orange.sn	Avenue Félix Eboué X Bld Mariste Bel Air

OUTLINE OF TRAINING COURSES

1. General Overview for West Africa

The water sector in West Africa is characterized by the weakness of their human resources. This is due to the lack of attractiveness of the sector where salaries generally remain very low, excepted in the top management.

According to the results of the surveys conducted in Ghana (KNUST), Nigeria (NWRI & UNIBEN) and Senegal (UCAD) and preliminary results from Burkina Faso, the gaps are very numerous and different from one country to another. The common observation is the need to renew human resources, particularly in the public sector, which is not very attractive due to low salaries. There are many critical gaps identified in the three countries (Table 7) according to the results of surveys carried out in the water sector. These gaps correspond to urgent needs in terms of technical and administrative staff to achieve the sector's objectives in these countries. The main thematic areas concerned are:

- Sanitation and health;
- Water treatment;
- Groundwater management;
- Water uses management (agriculture, environment, etc.);
- Project management and negotiation processes;
- Integrated water resources management...

According to studies carried out in West Africa initially in 2013 and under the ACEWATER2 project in 2018 in the water sector, the most common gaps in the three countries include:

- Insufficient human resources;
- Staff qualification levels not in line with the needs of the sector;
- Shortage of skilled technicians and workers;
- A sector that is not sufficiently attractive;
- Losses in human resources (strengthened staff generally change position or permanently leave the sector);
- A lack of control over the management of water projects;
- Problems of financing and/or renewing infrastructure and upgrading salaries, in order to attract more qualified staff;
- Need to set up vocational training courses specifically dedicated to the water and sanitation sector.

The Table 7 summarizes the distribution of identified gaps in the Western Africa's water sector where there is a lack of qualified human resources, insufficient equipment and financial resources. Added to that, there is huge constraints related to:

- difficulty of accessing data and quality of information;
- lack of enforcement agents and failure to comply with donor implementation manuals;
- problems of coordination between national institutions;
- lack of production infrastructure;
- inadequacy of the legal and institutional framework to meet the needs of the water and sanitation sector.

**Table 7: Distribution of gaps per country/CoE
(the brown color represents the identified gaps)**

Thematic area	Ghana KNUST	Nigeria UNIBEN	Nigeria NWRI	Senegal UCAD
1. Water Quality				
2. Data & Modelling				
3. Groundwater				
4. Water Supply				
5. IWRM				
6. Sanitation				
7. Management				
8. Administration				
9. Others				

Legend: ■ Gaps

Generally, in West Africa, HE and TVET training doesn't really reach expectation of the water sector, with

- Lack of special vocational training programme dedicated to water sector;
- Existing general curricula not adequate to meet expectations in the sector;
- Need of refreshment and re-adaptation of curricula at regional level;
- Development of in-house on-the-job trainings for those whose job schedule may not allow them to leave their organization;
- Introduction of long-term trainings by capacity building institutions;
- Lack of professional dedicated schools in the WASH sector either in water supply (Hydraulic Engineer, technician, electromechanical) and sanitation work.

The table below summarizes the list of proposed training courses for Technicians / Senior Professionals and for Young Professionals in western Africa, except Burkina Faso.

Table 8: List of proposed short training courses in West Africa

Centre of Excellence (CoE)	Technicians / Seniors Professionals	Young professionals
KNUST – Ghana	Water laboratory instrumentation	Waste resource recovery innovations and entrepreneurship
	Water systems instrumentation	Onsite sanitation and faecal sludge management

Centre of Excellence (CoE)	Technicians / Seniors Professionals	Young professionals
NWRI - Nigeria	Borehole Drilling and Supervision	Borehole Drilling
	Induction course for Fresh Engineers and Scientists	Plumbing
UNIBEN - Nigeria	Operation and maintenance of Pumps	Water supply and Environmental Engineering
	Operation and Maintenance of Water Distribution System	Remote Sensing and Geographic Information System
	Borehole Drilling and Construction	Water Treatment Techniques
UCAD - Senegal	Project Management (Design, Planning Monitoring and Evaluation, Fund Raising...)	GIS and Remote Sensing technologies applied to Water and Sanitation Management
	Development of institutional and regulatory frameworks	Introduction to UAV photogrammetry
		Hydrological Modelling using SWAT

2. Ghana

Regional Water and Environmental Sanitation Centre (RWESCK) of the Kwame Nkrumah University Science and Technology, Kumasi (KNUST), in collaboration with UNESCO Intergovernmental Hydrological Programme (UNESCO-IHP) implemented a WASH Sector Human Capacity Development in Ghana to train the critical mass of young Professionals and Technicians for the WASH Sector. The UNESCO-IHP is supporting the implementation of the African Ministers' Council for Water (AMCOW) declaration urging the African Union Commission (AUC) and the New Partnership for Africa's Development Water Centres of Excellence (NEPAD CoE) to develop a "Human Capacity Development Programme for junior professionals and technicians in the water sector". The list of four training courses for technicians and young professionals planned by RWESCK-KNUST are presented in Table 9 below. One course has been implemented and delivered.

Table 9: List of planned and implemented training courses in RWESCK-KNUST, Ghana

Course title	Target group	Status		Type	Number of participants
		Start	End		
Sustainable Onsite-Sanitation and Fecal Sludge Management	Junior Professional	31/08/2020	17/09/2020	E-Learning	62 15 F, 47 M
Water laboratory instrumentation	Senior Technician	Not implemented		Blended	-
Water systems instrumentation	Junior Technician	Not implemented		Blended	-

Course title	Target group	Status		Type	Number of participants
		Start	End		
Waste resource recovery innovations and entrepreneurship	Senior Professional	Not implemented		Blended	-

2.1. Course 1: Sustainable Onsite-Sanitation and Fecal Sludge Management for Water Professionals

a. Course description

The objective of this course is to equip participants with knowledge, skills and competence to design, operate and manage sustainable on-site sanitation technologies and fecal sludge treatment systems.

The target participants are: environmental Health officers, Non-governmental organizations, Public service providers.

c. Course content

The course cover following topics:

- Unit 1 - course introduction (environmental sanitation challenges, sanitation as a barrier to disease transmission & to prevent groundwater pollution)
- Unit 2 - Fecal sludge characterization
- Unit 3 - On-site dry and wet sanitation technologies (ABR, biogas, biofilm, etc.)
- Unit 4 - Engineering designs of Onsite sanitation technologies
- Unit 5 - Fecal sludge Collection and transport
- Unit 6 - Fecal sludge treatment options (settling/ thickening tanks, planted/unplanted drying beds, co-treatment with sewage, incineration, chemical stabilization,
- Unit 7 - Fecal sludge co-treatment using composting and anaerobic digestion (fecal sludge reuse and land application, compost, charcoal briquettes and biogas production)
- Unit 8 - Sanitation behavior change communication
- Unit 9 - Sanitation strategies and action planning
- Unit 10 - Sanitation business, contracts and private sector involvement

2.2. Course 2: Water Laboratory Instrumentation

The learning objective of the laboratory instrumentation course is to equip participants with the knowledge, practical skills and in-depth understanding of the working principles of instruments, operation and maintenance. At the end of the short course, participants will be able to:

a. Course description

- Describe laboratory safety, the management and technical requirements of laboratory accreditation standards (for example, ISO/IEC 17025) ;

- Explain configuration, working principles and operation of the instruments (AAS, HPLC, GC, spectrophotometers and mass spectrometers) ;
- Calibrate, troubleshoot and maintain Instruments (AAS, GC, HPLC and mass spectrophotometers).

The target participants are Water and Sanitation Technician, Laboratory technicians involved in water and wastewater treatment and operations.

b. Course content

The course will cover following topics:

- Unit 1 – ISO Laboratory management, Laboratory Accreditation & Quality Systems Management,
- Unit 2 – Practical laboratory instrumentation (instrument working principles, types and generalized configuration of instruments and equipment handling)
- Unit 3 – Laboratory protocols (sampling, sample preparation, transport and storage, data handling, results and reporting)
- Unit 4 – Instrumental calibration, troubleshooting and equipment maintenance
- Unit 5 – Instrumental Analysis and operation of UV/ Visible Spectrometer & Fourier-transform infrared Spectrophotometer
- Unit 6 – Operation of atomic absorption spectrophotometer (AAS),
- Unit 7 – Instrumental Analysis and operation of Gas Chromatography (GC)
- Unit 8 – Operation of High-Performance Liquid Chromatography (HPLC) and mass spectrometers
- Unit 9 – Operation of X-ray fluorescence spectrometer, diffractometer, and NMR

2.3. Course 3: Water Systems Instrumentation

a. Course description

At the end of the short course, participants will be able to:

- Demonstrate understanding of operation and maintenance of water instruments, pumps,
- Demonstrate how to identify faulty meters, valves, pumps and how to repair them,
- Repairs and calibrate meters and instruments in machine workshop,
- Recognize pumping system faults and undertake remedial actions.

Target participant are: Water and Sanitation Technicians, instrumentation technicians, private sector companies.

b. Course content

The course will cover following topics:

- Unit 1 – SMART/digital technologies in water industry
- Unit 2 – Flow measurement
- Unit 3 – Level and pressure measurements

- Unit 4 – water Instrumentation and telemetry
- Unit 5 – Laboratory sessions on Instruments Calibration and Maintenance
- Unit 6 – Water data management
- Unit 7 – Leakage detection and water loss management

2.4. Course 4: Waste resource recovery and entrepreneurship

a. Course description

The objective of this course is to equip participants with skills, knowledge and competence on how to design, construct, operate and manage waste recovery facilities to produce value added products such as biogas, compost, briquettes, biochar, animal feed and pellets among others.

Target participants are entrepreneurs in the sanitation sector, postgraduate students, private sector solid waste companies, waste managers, waste engineers, and staff working with the Municipal Assemblies.

b. Course content

The course will cover following topics:

- Unit 1 – Characterize waste materials for transformation and treatment processes (composition, energy/calorific value, quantification - generation rate),
- Unit 2 – Overview of waste resource recovery (compost, biogas, biochar, animal feed, material recycling)
- Unit 3 – Nutrients amendment organic fertilizer production and marketing
- Unit 4 – Biogas production technology and business case planning
- Unit 5 – Pyrolysis of waste-to-energy and ethanol production
- Unit 6 – Briquettes and biochar production and marketing
- Unit 7 – Metals, plastics and paper waste value chain and marketing
- Unit 8 – Waste-to-animal feed production and marketing
- Unit 9 – Entrepreneurship, business start-up and business development.

The Ghana HCD training report and full course materials on “Sustainable Onsite-Sanitation and Fecal Sludge Management” is provided separately in Annex I. The report includes proceedings of the 10-day training, results of the training evaluation as well as the full list of participants. The interest of this training on "sustainable on-site sanitation and fecal sludge management" is that it is integrated in the curriculum of RWESCK-KNUST. This facilitates its sustainability as part of the capacity building of water and sanitation services in Ghana.

3. *National Water Resources Institute, Nigeria*

The National Water Resources Institute (NWRI) located in Kaduna is a Nigerian institute in charge of training and applied research in the water sector. Located in Kaduna, NWRI covered the Northern part of Nigeria. NWRI's main missions are: basic and professional trainings, basic and applied research, documentation and database management. During the 2nd Phase of ACEWATER2 Project, the institute initially proposed eleven (11) training courses intended for Junior and Senior Professionals (Table 10).

Table 10: NWRI's list of proposed training courses

Target group	Course title	Duration
Junior Professionals / Technicians	Borehole Drilling	3 Weeks
	Plumbing and Service Connection (House hold Managers Course)	3 Months
	Hand pump Installation, Operation and Maintenance	2 Weeks
	Borehole Rehabilitation and Maintenance	1 Week
	Alternative Water Sources Development	8 Weeks
Senior Professionals	Borehole Construction, Supervision and Management	3 Weeks
	Induction course for Fresh Engineers and Scientists for new Entrants in to the Water Sector	8 Weeks
	Groundwater Investigation Techniques	2 Weeks
	Drilling Machinery Maintenance Technology	2 Weeks
	Sanitation and Hygiene Promotion	1 Week
	Community Mobilization and Sensitization	1 Week

Finally, four training courses have been planned, developed and three were implemented, two (02) for Junior Professionals and two for Senior Professionals:

- Course 1: Borehole Drilling
- Course 2: Plumbing and Service Connection
- Course 3: Borehole Construction, Supervision and Management
- Course 4: Induction course for Fresh Engineers and Scientist.

Table 11: List of training courses planned and implemented by NWRI

Course title	Target group	Status		Type	Number of participants
		Start	End		
1. Borehole Drilling	Senior Professional	10/09/2020	01/10/2020	Blended	29 05 F, 24 M
2. Plumbing (Household Water Manager Course)	Junior Technician	Not implemented		Blended	-
3. Borehole Drilling and Supervision	Senior Professional	12/08/2020	28/08/2020	E-Learning	68 10 F, 58 M
4. Induction course for Fresh Engineers and Scientists in the Water Sector	Senior Professional	05/10/2020	30/10/2020	Blended	9 1 F, 08 M

3.1. Short course in Borehole Drilling

a. Course description

Appropriate borehole drilling and construction are essential for the provision of long-lasting water boreholes/wells. This course is designed to expose participants to techniques and methods involved in borehole drilling, design and completion in all geological formations to ensure that boreholes are produced as designed. It is also structured to equip participant in procurement processes and carry out maintenance in boreholes. In addition, that all necessary data collected during the drilling process and pumping test including water quality appraisal are accurately recorded and reported to the client and relevant authorities for documentation and hydrogeological maps preparations.

The course is designed to target Drillers, Geologists, Hydro-geologists, Engineers and Water Supply Officers who are responsible for water supply facilities development especially groundwater.

The learning objectives are:

- i. To enable participants, acquire knowledge and skills on general borehole, basic exploration, drilling and construction for groundwater development and utilization;
- ii. To enable participants use basic hydrogeological and well logging techniques required for aquifer identification, pumping tests; and
- iii. To enable participants drill low cost and efficient functional boreholes.

b. Course content

- i. Overview of geology/ hydrogeology and basic exploration in Nigeria
- ii. Outline of borehole drilling methods

- iii. Borehole design, construction and completion (drilling, logging, casing and screen installation, gravel packing, grouting, borehole development, pumping test, water quality analysis, borehole head construction and pump installation)
- iv. Management of drilling construction project
- v. Safety issues in drilling
- vi. Borehole code of practice in Nigeria
- vii. Costing of borehole construction project
- viii. Borehole completion report writing
- ix. Supervision of water well drilling and borehole report writing
- x. Design and installation of storage tanks

Pedagogical methods:

- i. Participatory training method that will cover a wide range of classroom and field-based innovative teaching field and technical visits will be deployed for the training;
- ii. The training will be structured to include hand-on activities, syndicate sessions, group presentations and reporting to test the applicability of knowledge gained;
- iii. On-line equipment and facilities;
- iv. A lot of practical including drilling and completion of borehole will be carried out in the course of the training.

3.2. Short course in Plumbing and Service Connection

a. Course description

This course is designed to enhance participants' knowledge and upgrade their skills on general plumbing works, pipe laying and installations. The course is also structured to impart entrepreneurial skills to enable participants to practice plumbing in all infrastructures as an enterprise.

The course is designed for secondary school graduates, plumbers, network distribution Officers and other Technicians in the water supply and sanitation sector.

Learning objectives:

- i. To help participants understand basic principles of household plumbing and service connection;
- ii. To acquaint participants with characteristics of different types of pipes joints and fittings;
- iii. To help participants understand the types, function and installation of water service appurtenances;
- iv. To enhance skills of participants in the installation of service lines and house connections

b. Course content

- i. Introduction to Plumbing
- ii. Installation of Water Mains
- iii. Backfilling and Restoration.
- iv. Pipes and Jointing.
- v. Installation of Valves and Meters.
- vi. Installation guidelines for service connections.
- vii. Procedures for Installation of Service Lines.
- viii. Procedures for Installation of House Connections
- ix. Rehabilitations and maintenance of plumbing in all buildings

Pedagogical methods:

- Participatory training method that will cover a wide range of classroom and field-based innovative teaching, field and technical visits will be deployed for the training
- The training will be structured to include hand-on activities, syndicate sessions, group presentations and reporting to test the applicability of knowledge gained including on line.
- A lot of practical will be carried out in the course of the training on coupling/fixing and dismantling of plumbing fittings and fixtures.

3.3. Induction course for Fresh Engineers and Scientists

a. Course description:

This course is designed to enable participants acquire the necessary knowledge, skills and techniques in water exploration, development and supply which they require to function effectively in their various organizations. It is structured to provide the requisite knowledge on the structure of the Nigerian water sector, guidelines and policies.

The course is designed for new entrants into water sector with no previous experience in the water sector. Participants must be holders of at least National Diploma and include fresh Engineers, Technologists, Scientists, Administrators and Finance officers.

Learning objectives:

- i. To build the capacity of various stakeholders in the Nigerian water sector through the acquisition of new knowledge and skills
- ii. To broaden the skills and knowledge of fresh Engineers, Technologists, Scientists and Administrators working in the water sector.
- iii. To expose participants to guidelines and policies in the water sector, and integrate and promote coexistence among water sector personnel.
- iv. To develop workers motivation and attitude towards inter-disciplinary approach for solving problems in the water sector.

b. Content

The course is structured into the following Modules:

- i. General Module – Water Resources;
- ii. Irrigation and Drainage Modules;
- iii. Water Supply and Sanitation Module;
- iv. Dams and Reservoir Module;
- v. Administration and Governance Module and;
- vi. Finance Module.

The following methods will be used in delivering the training:

- i. Lecturing
- ii. Participatory approaches; films facilities
- iii. On-Line/ICT facilities
- iv. Use of audio-visuals for presentations
- v. Fieldwork and Practical
- vi. Study Tours and
- vii. Industrial Attachments.

3.4. Short Course in Borehole Drilling and Supervision

a. Course description

This course is structured to expose participants to techniques of borehole supervision and management. It is also structured to enhance participant's knowledge on efficient groundwater exploration, development and exploitation.

The course is designed for Geologist/Hydrogeologists, Engineers, Drillers and Administrators who are involved in the supervision and site management of groundwater exploration and development.

Learning objectives:

- i. To enable participants, familiarize with steps involved in the procurement of drilling contracts;
- ii. To enable participants, understand how to carryout effective borehole supervision;
- iii. To enlighten participants on the emphasis of maintenance requirements for effective drilling operation including trouble shooting and functionality maintenance.

b. Course content

- i. Drilling contract
- ii. Bill of Quantities
- iii. Tendering procedures

- iv. Field operation management
- v. Supervision of drilling commencement
- vi. Supervision of drilling and material utilization
- vii. Supervision of borehole completion and pumping tests
- viii. Drilling equipment management
- ix. Spare parts management
- x. Safety management and
- xi. Report writing.

Pedagogical methods:

- i. Participatory training method that will cover a wide range of classroom and field-based innovative teaching skills, field and technical visits will be deployed for the training
- ii. The training will be structured to include hand-on activities, syndicate sessions, group presentations and reporting to test the applicability of knowledge gained.
- iii. On line teaching and ICT facilities operations
- iv. A lot of practical will be carried out in the course of the training.

The NWRI report on the virtual training on Borehole Supervision and Management held from 12 to 28 August 2020 is provided separately in Annex III. The report includes the full list of participants and the results of the evaluation of the training. Overall, NWRI has provided detailed list of contents and developed full course materials for all 4 courses (Annexes IV to VII). However, course evaluation was only available for one out of the three implemented courses.

4. *University of Benin City, Nigeria*

The University of Benin (UNIBEN) is a research institution located in Benin City, Edo State, Nigeria. UNIBEN was founded in 1970 by the Federal Government of Nigeria. Since 2010, UNIBEN is one of the five centers composing the NEPAD West African Network of Centers of Excellence for Water Science and Technology.

Based on surveys conducted in the southern part of Nigeria initially in 2013 and particularly, under the ACEWATER2 project in 2018, several gaps were identified in the training of water sector staff. To address these gaps, several training areas have been identified as relevant to fill the identified gaps. Six training courses were initially proposed by UNIBEN: 1) Operation and maintenance of Pumps; 2) Operation and Maintenance of Water Distribution System; 3) Borehole Construction and Maintenance; 4) Water supply and Environmental Engineering; 5) Remote Sensing and Geographic Information System; 6) Water Treatment Techniques. The aim of these training courses is to enhance efficient service delivery, and promote sustainable water supply and

sanitation services. Four courses (Table 12) have been planned, fully developed but not implemented, partly due to restrictions resulting from COVID-19. Full course materials from UNIBEN are available in Annexes VIII to XI.

Table 12: List of training courses planned by UNIBEN

Course title	Target group	Duration	Type	Status
Water supply and Environmental Engineering	Young professionals	10 days	Blended	Not Implemented
Remote Sensing and Geographic Information System	Young professionals	8 days	Blended	Not Implemented
Borehole Construction and Maintenance	Technicians / Seniors Professional	5 days	Blended	Not Implemented
Operation and Maintenance of Water Distribution System	Technicians / Seniors Professional	5 days	Blended	Not Implemented

4.1. Course 1: Water Supply and Environmental Engineering

Module 1: Legal and Institutional Framework for Water Supply and Environmental Engineering

Status of water supply and factors affecting water supply (at the national and sub-national levels), legal aspects of water supply (the human rights of water and sanitation, contract management and dispute settlement), economic aspects of water supply (water supply and demand, sources of financing, different tariffs/payment structure, affordability and instruments for ensuring the financial sustainability of water supply infrastructure) and inclusive and sustainable development principles for water supply and environmental engineering (including the relevant sustainable developments goals).

Module2: Urban Water Supply System

Introduction, Water demand/uses, Water treatment, Water Distribution, Open channel network, Pressure pipes networks, Water quality.

Urban water supply system modeling, model selection, Model simulation and Optimization, Reservoir storage capacity yield models.

Module 3: Monitoring and Adaptive Management of Water Supply System

Introduction to system status, information needs, Monitoring plans, Adaptive monitoring, Water quality monitoring, Water quantity monitoring, data sampling, Collection and storage, Water metering, Leakage detection.

Module 4: Waste Water Management

Waste water production, sewer networks, waste water treatment, urban drainage, runoff, surface water pollution loading, storm water sewer and pipe flow networks, sediment transport, water quality impacts.

Module 5: Wetlands and Estuarine

Water quality and hydrology, flood and erosion, types of estuaries, catchment areas, water movement, flood and erosion control systems.

4.2. Course 2: Remote Sensing and GIS

Module 1: Overview of GIS and Remote Sensing

- Introduction to GIS and Remote Sensing,
- Digital representation,
- Nature of geographic data (Raster and Vector data),
- Coordinate systems and map projections,
- GIS software (ArcMap, QGIS, Envi, etc.),
- Web-based mapping
- Data models - Raster and Vector data models,
- GIS data collection, maintenance and creation of GIS data base, Spatial Data Collection and Analysis (GPS Data, online databases)
- Spatial data analysis and spatial modeling application in water resources planning and management.
- Watershed / Basin Analysis / Water Distribution (Network Analysis, Spatial Analysis in Hydrology)
- GIS visualization,
- Statistics in GIS, Map Algebra/ Geo-statistical Analysis, (Spatial analysis, Kriging, IDW etc.)

Module 2: Fundamentals of Remote Sensing

- Electromagnetic spectrum,
- Satellite remote sensing systems,
- Remote sensing data acquisition platforms and sensors systems,
- Geo-morphology, Image interpretation,
- Digital image processing and map production.
- Remote sensing data source for GIS in Water Resources. (USGS, Google Applications, etc.)
- Application in water resources planning and management.
- Cloud based GIS/RS analysis (Web based analysis, Google Earth Engine)

Module 3: Application of GIS and RS in Water Resource Planning and Management

- Model introduction and selection,
- Data collection and preparation,
- Model development and running,
- Model application and interpretation of results.
- Hydrological / Environmental Modeling (pollution mapping, surface/ground water etc.)
- Decision support system for Integrated Water Resource Management

4.3. Course 3: Borehole Construction and Maintenance

Module 1: Introduction and Current Challenges of Groundwater Management

- Well siting, Testing and Sampling
- Site selection
- Test Boreholes and Well Drilling
- Drilling logs and Reports
- Sampling Reports of Geophysical Investigation for a Borehole

Module 2: Wells

- Types of wells (Dug wells, Bored wells, Driven wells, Jetted wells, Drilled wells)
- Water Well Drilling, Well Construction and Development methods
- Problems in Water well Drilling

Module 3: Well Construction Procedures

- Well components
- Well casing selection and Installation
- Selection of casing diameter
- Well grouting, purpose of well grouting
- Well development
- Pumping tests, materials for pumping test reporting

Module 4: Water Sampling and Analysis

- Background and practice in sampling and Analysis for wells
- Sampling considerations for chemical analysis
- Sample collection for analysis
- Water quality standards (WHO, NESREA, European Commission etc)
- Water quality indicators
- Hardness classification
- Common nuisance contaminants and their effects

Module 5: Well Operation and Maintenance

- Borehole failure
- Trouble shooting
- Indicators of water well problems
- Causes of water well drilling problems
- Well management and Facilities maintenance

4.4. Course 4: Operation and Maintenance of Water Distribution System

Module 1: Introduction to Water Distribution System

- Types of distribution system and their application,
- Branched network, Gridiron Distribution Network, Ring and Radial pipe geometry
- Requirement of a good distribution system

Module 2: Elements of Water Distribution System

- (Sub-sub components, Sub-components and Components)
- Pipe systems and pipe materials
- Operation of water distribution system
- Water Quality Operation and Emergency Operation

Module 3: Critical Appurtenances in Water Distribution System

- Valves, fire hydrants, water meter, pumps and reservoir
- Types of Pumps, storage Reservoir

Module 4: Maintenance of pipes, pumps and fitting of water distribution system

- Common operation and maintenance tasks
- locating pipes
- locating leaks
- repairing leaking pipe
- Pumps:
 - Common operation and maintenance tasks
 - Common pump problems
 - Possible causes and remedies

Module 5: Valves Maintenance, Fire Hydrants

- Isolation valve maintenance
- Air valves
- Scour Valves
- Non - return valves
- Control Valves
- Maintenance of fire hydrant

5. Cheikh Anta Diop University (UCAD), Senegal

UCAD is one of the oldest researches and training institutions in West Africa and has the only thematic doctoral school exclusively dedicated to the issue of water in West Africa. Designated as a NEPAD centre of excellence in 2010, UCAD also coordinates the WANWATCE network.

In Senegal, despite the existence of TVET in the water sector and related areas, gaps in technical skills and personnel persist. The main objective of the trainings developed by UCAD is to offer an upgrade for professionals and provide young graduates with adequate tools for a good management of the problems of the sector. Under the umbrella of the ACEWATER2 Project and based on identified skill gaps in the Senegal's Water Sector have developed five (05) short training courses. The table below summarizes the implemented courses with their current status.

Table 13: List of short training courses proposed by UCAD

Course title	Target group	Status		Type	Number of participants
		Start	End		
Project Management in the Water Sector	Senior Professional	14/09/2020	16/10/2020	E-Learning	63 25 F, 38 M
GIS and Remote Sensing technologies applied to Water and Sanitation Management	Junior Professional	15/10/2020	30/10/2020	Blended	39 12 F, 27 M
Hydrological Modelling using SWAT	Junior Technician	12/10/2020	29/10/2020	Blended	30 08 F, 22 M
Introduction to UAV photogrammetry	Junior Professional	14/10/2020	07/11/2020	Blended	28 10 F, 18 M
Development of institutional and regulatory frameworks	Senior Professional	Not Implemented		E-Learning	-

In addition to the detailed course contents provided below, UCAD also developed detailed syllabus, with full course calendar, full course materials and organized participants' evaluation and feedback for all four implemented courses. Overall, for the courses organized by UCAD, the evaluation of the participants was unanimous. The criteria evaluated were relevance, usefulness in the context of capacity building in the water sector. The majority of participants, more than 85%, asked for the organization of a second session for these courses. Several requests were also received from people who were unable to participate in the first sessions and asked for the organization of special sessions. Geomatics and aerial photography with the help of drone are particularly requested.

The course syllabus and full course materials, available in French, are provided in Annexes XII-XV.

5.1. Course 1: Project Management (Design, Planning Monitoring and Evaluation, Fund Raising, etc.)

a. Course description

To provide participants with a good understanding of the strategic and operational activities of project management in the water sector. At the end of the training, learners will acquire the following skills:

- Understand strategic project selection and prioritization
- Develop a project charter and a project plan
- Define activities, relationships and duration of activities in order to develop the project schedule
- Manage project resources (financial, material and human)
- Anticipate and plan project risks
- Monitor the project (progress and results)
- Conclude and complete a project

This short course is intended to technicians or senior managers leading or part of a project team in the field of water and sanitation.

b. Course content

The course contains the following units:

- Unit 1 - Situation analysis (needs assessment, stakeholder analysis and problem analysis)
- Unit 2 - Organizational capacity assessment of
- Unit 3 - Project design and planning framework
- Unit 4 - Project monitoring and evaluation plan
- Unit 5 - Project budgeting and Fund raising
- Unit 6 - Project implementation and monitoring
- Unit 7 - Final evaluation and dissemination
- Unit 8 - Case studies

5.2. Course 2: GIS and Remote Sensing applied to Water and Sanitation Management

Geographical information sciences (remote sensing and GIS) applied to water and sanitation management enables the development of spatially integrated approaches. Watershed management, flow forecasting through hydrological modelling, considering the different uses and users of water, presuppose a good knowledge of their spatial and temporal distribution. This short training course is intended to give to practitioners the basic tools necessary for the application of geomatics to water and sanitation sciences.

a. Course description

Empower learners to use GIS and remote sensing tools for water and sanitation management on a routine basis:

- To have a good basic knowledge on concepts and methods of remote sensing and geographic information systems applied to the water sector;
- To understand, through concrete examples, the role that geomatics can play in water and sanitation management;
- To be able to use geomatics tools to implement the main missions in the field of water resources management, including watershed delimitation, hydrological modelling, mapping both water resources and water uses.

The target participants are Master and doctoral Students, Junior Professionals from the Water Sector (National institutions, private companies, NGO, etc.).

b. Course content

The Annex VI is referred to the full course “*GIS & Remote Sensing applied to Water and Sanitation Management*”.

5.3. Course 3: Introduction to Hydrological Modelling using SWAT

Hydrological modelling is now an indispensable tool for water management, particularly in the context of climate change and economic and social development implying the increased use of water resources. The application of robust models, such as SWAT, Mike or WEAP models, allows the integration of physical flow parameters, major uses, hydro-sedimentary and pollution aspects.

a. Course description

Acquiring the fundamentals of hydrological modelling, particularly in transboundary watersheds using different tools (SWAT, Mike 11, GR4J, TopModel and WEAP). During this course, participants will improve their knowledge and understanding of hydrological and hydraulic modelling, not only from a process perspective but also from the perspective of the practical use of the results. This training will make it possible to model a complex watershed, simulate hydrological and hydraulic processes, obtain the desired flows, analyze the results and evaluate their quality.

This short training course is intended to Master and doctoral students, junior professionals from Water and Sanitation companies.

c. Course content

This introductory course on Hydrological Modelling using SWAT comprise ten (10) topics:

1. Flow factors
2. Analyze the manifestations of surface runoff in a watershed
3. Analyze the world's river regimes

4. Principles and key issues of hydrological modelling
5. Typology of hydrological models used in Hydrology and Hydrogeology
6. Presentation of the SWAT Model
7. Model calibration and validation with SWAT
8. Parameter estimation in SWAT
9. Calage and validation of SWAR Model
10. Using SWAT in the Bafing Catchment (Senegal River Basin)

5.4. Course 4: Introduction to UAV photogrammetry

Photogrammetry is a methodology which uses the characteristics of reproducing the parallax for the relief, so the third dimension. UAVs allow boarding instrumentation via an air carrier. The coupling of these two concepts gives the idea of photogrammetry by drone.

a. Course description

This course is intended to students with no knowledge on photogrammetry. At the end of this training, the objective will be that the trainee will be perfectly capable of making flights adapted to this technology. He will also be introduced to the use of Pix4D or other processing software and will therefore be able to provide good quality results for his research work (ortho photo, 3D view, topography, etc...).

b. Course content

Theoretical training

1. What is the purpose of photogrammetry? Who are the potential customers? What are the results that the dronist can propose?
2. Initiation training to the photogrammetry software PIX4D MAPPER PRO.
3. Elaboration of the point cloud and the 3D model
4. Calculation of distances, surfaces and cubature
5. Elaboration of DSM (Digital Surface Model)
6. Elaboration of orthophotos
7. Recovery of results
8. Output of usable files

Practical training

1. Flights in real conditions on drones supplied by DRONE VOLT.
2. Production of the adapted grids (NADIR and/or OBLIQUE) and image capture with the Pix4d capture software.
1. Putting the images under Pix4D and launching the software which will work at night.

5.5. Course 5: Development of institutional and regulatory frameworks

The general objective of this training course is to develop skills and sensitize on needs of institutional and regulatory frameworks for Technicians and Senior Professionals. The course is intended to Technicians or senior professionals leading or part of a project team in the field of water and sanitation.

The aim of the training course is understanding institutional regulatory mechanisms and legislation are crucial aspects of good water sector management. It is designed to provide learners with the basic knowledge necessary to implement a well-functioning approach to institutional and legislative regulation in the water sector.

The learning objectives are:

- To know the legislation and institutional organization in the water sector;
- To develop learners' capacities to develop and implement mechanisms to regulate the water sector;
- Case studies based on learned experiences in similar context and countries.

The duration of the training course is two (02) weeks. The course was not implemented because of the overload of activities after the lockdown. But this course is planned to be finalized and delivered during this year 2021 as part of the activities of our doctoral school.

6. Course Evaluation and Feedback

Generally, the trainings organized in Ghana, Nigeria and Senegal were well received by the water and sanitation sector. The participants found the proposed courses adequate to very adequate and useful for their career development or business. The courses organized met the expectations of the participants (Figure 1) according to the responses from the online survey. The evaluation was also intended to determine the satisfaction and the impact of the training on the participants. The participants rated the training to be very good and believed that the training would have an impact on their daily activities at the workplace (Figure 2).

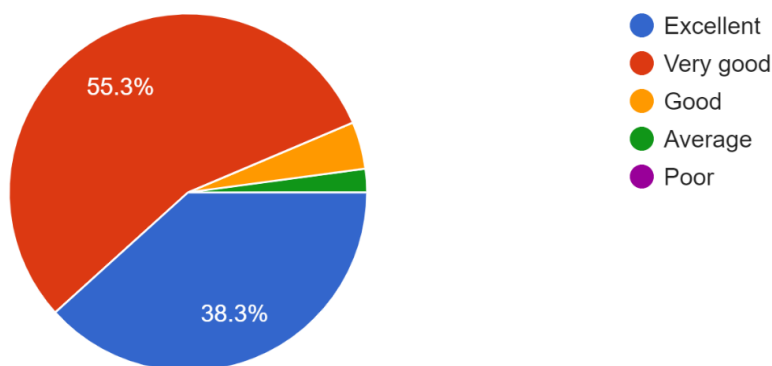


Figure 1: Percentage of satisfaction in terms of meeting initial expectations of participants

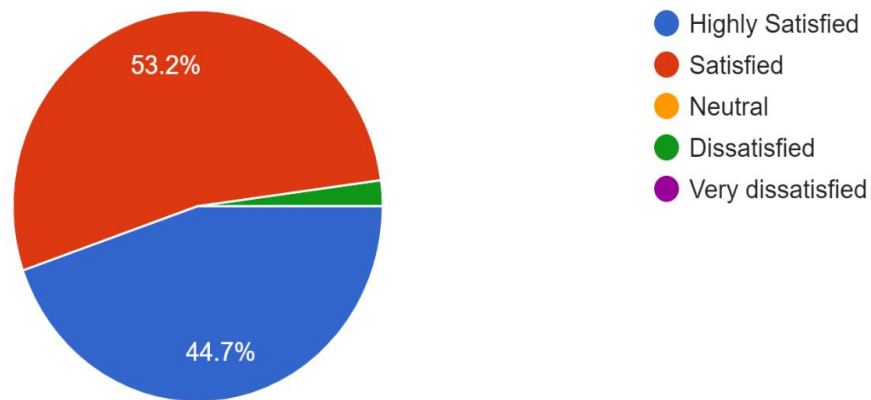


Figure 2: Percentage of satisfaction in terms of course design, methodologies and material

In Ghana, the participants found the training organized to be highly satisfactory and interesting (Figure 3). According to the participants, the training has introduced new knowledge and methods on fecal sludge management and enhanced knowledge on technical and complex concepts, etc. The use of standard training materials mean it can be used by all other countries in the West African region.

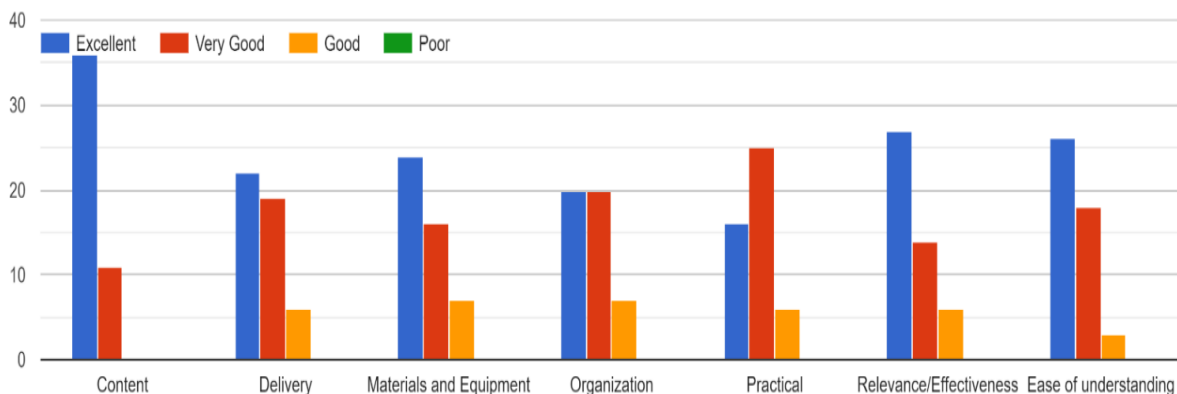


Figure 3: Rating of the training with regards to different indices in Ghana

In Nigeria, evaluation and feedback was only provided for one course, with all 68 participants responded. Over 90% of participants indicated that the course was very satisfactory. The evaluation also showed that the course objectives were attained, the workshop was very relevant and that the facilitator’s delivery during the sessions was very satisfactory.

In Senegal, the training sessions organized were considered very satisfactory, according to the participants. Many participants requested a second face-to-face session as soon as sanitary conditions improved, so as to be able to conduct practical training sessions (drone piloting, hydrological modeling exercises, etc.). Several employees from Department of Water were unable to attend these 2020 sessions and requested that new sessions to be held during 2021.

Some of them would even be willing to contribute financially to the organization of these trainings.

One of the objectives is clearly to include these courses in the training curricula of the centers of excellence, in order to make them sustainable. The choice of UCAD to move towards blended training, even beyond the COVID-19 pandemic, represents an opportunity to be seized to sustain these trainings and even develop others in the field of water and sanitation.

Distance learning courses can sometimes pose a problem because the participants are not always at the same level of equipment; not including the difficulties of access to the Internet connection. Indeed, in Ghana as in Senegal, the training experienced the challenge of an effective and efficient internet connectivity for the online teaching.

MONITORING AND EVALUATION PLAN

The table below present a summary of the general M&E Plan approved by the different partners during the last regional meeting in February 2020. The details regarding the M&E results for each Centre of Excellence are reported in the excel sheets and annexed to this report.

Generally, targeted pilot activities in the different centers of excellence are running smoothly, with some exceptions. The delays noted in the execution of training activities are mostly due to scheduling problems and problems with the availability of human and material resources.

The table below present a synthesis of Global Monitoring and Evaluation Plan for Human Capacity Development Component of the ACEWATER2 Project. All training courses and modules developed are based on the National HCD Frameworks developed in the three countries (Senegal, Nigeria and Ghana). The National HCD Frameworks have been disseminated in these countries within the Water Sector Stakeholders and National Institutions.

Table 14: Global Monitoring and Evaluation Plan for ACEWATER2 Project - Human Capacity Development Component

OBJECTIVES	ACTIVITIES	INDICATOR	COMMENTS
OBJECTIVE GLOBAL			
Implement the Human Capacity Development Program in up to four countries per region in collaboration with relevant institutions and fostering sustainable capacity development approach (per country) - each one of the activities will be implemented in each of the pilot countries: Ghana, Nigeria and Senegal.			
OBJECTIVE 1			
Dissemination of the strategy to stakeholders, donors and training institutions at national level	Prepare the National Framework into an information package for dissemination partners and stakeholders (pamphlet, report, PPT etc.)	An information package was developed	Provide a copy of the dissemination information in attachment to the M&E frame in whatever format you developed
	Disseminate the strategy to national training institutions?	Number of national training institutions receiving the information package	
	Disseminate the strategy to other stakeholders?	NR of other stakeholders receiving the information package	
	Based on the strategy and on the implementation framework, design at least 2 courses or curricula adaptation and/or modules for Higher Education training	NR of courses/modules developed	Please provide a synopsis of the courses as an attachment to the M&E framework

OBJECTIVES	ACTIVITIES	INDICATOR	COMMENTS
	for Junior and Senior professionals.		
	Implement at least 2 pilot courses/modules for junior and/or senior professionals	Number of courses/modules implemented	Provide in annex 1 additional information incl. age, gender, background etc.
	Based on the strategy and on the implementation framework, design at least 2 courses or curricula adaptation and/or modules for vocational training for junior and senior technicians including education material	Number of courses/modules developed	Write the course titles in Annex 1? Please provide a synopsis of the courses as an annex to the M&E framework
	Implement at least 2 courses/modules for junior and/or senior technicians	Number of courses/modules implemented	Provide in annex 1 additional information incl. age, gender, background etc.
OBJECTIVE 2 The Pilot courses/modules and laboratories are supplied with the relevant Software, Tools and Consumables in a timely manner	Purchase the Software, Tools and Consumables for courses/modules and labs	% of items purchased	Provide a list of items purchased including the cost in annex 2
	Distribute and employ the Software, Tools and Consumables for the courses/modules and Labs	% of items distributed	Provide a list of items distributed and for which course/module or lab trainings in annex 2
OBJECTIVE 3 A strategy for Regional HR and student exchanges is implemented to improve regional networking	Participate in the Regional HR and Student exchange scheme	Are you participating in the Regional HR and Student exchanges scheme?	
		Number of staff exchanged with another CoE?	Complete additional information annex 3
		Number of students exchanged with another CoE?	Complete additional information annex 3

OBJECTIVES	ACTIVITIES	INDICATOR	COMMENTS
OBJECTIVE 4 A quality review of the implemented courses/modules is undertaken including student and course interlocutors' feedback with the results analyzed and course adjustments implemented, where appropriate	Undertake a quality review of the course outcomes with Staff and Student participation	Has a quality review taken place for each course?	In Annex 1 record if a course has undergone a Quality review or not.
		Number of Staff consulted in the review?	Provide copy of the review template in attachment to the M&E frame in whatever format you developed (questionnaire, survey etc.)
		Number of students included in the review?	Provide copy of the review template in attachment to the M&E frame in whatever format you developed (questionnaire, survey etc.)

OUTCOMES OF THE TRAINING COURSES

In its overall assessment, the initial results obtained on the implementation of the pilots in the three target countries of the HCD program are rather encouraging. The Table 16 summarizes the results in Ghana, Nigeria and Senegal; the Table 16 provides details on the status of the different courses and modules.

Table 15: Synthesis of M&E Frameworks in West Africa

LOCATION	GENDER OF PARTICIPANTS		AGE GROUPS				NUMBER OF PARTICIPANTS
	MALE	FEMALE	18-25 years	26-35 years	36-45 years	46-60 years	
Ghana	47	15	28	18	10	6	62
Nigeria	90	16	0	52	45	9	106
Senegal	105	55	48	52	49	11	160
TOTAL	242	86	85	81	104	64	328
%	72%	26%	25%	24%	31%	19%	100%

Out of a total of seventeen (17) courses and modules proposed, eight (8) have been effectively implemented. The remaining nine (09) have not yet been started, although plans for further launches have been proposed, particularly for Senegal. In terms of socio-professional groups, the 8 courses started in the three countries (Senegal, Nigeria and Ghana) are distributed as follows: four (4) courses for Junior Professionals; three (3) courses for Senior Professionals and one (1) course for Junior Technicians.

However, the levels and types of participation somewhat confirm the results obtained in identifying human resource gaps in the water sector (Table 16). A total of 328 junior/senior professionals and technicians were trained, including 242 men and 86 women.

The representation of women in the various training courses (23%) remains relatively low but reflects their percentage in the water sector (Table 16 and Figure 1). The percentage of women is much higher at the junior level, reflecting the effects of the gender policy implemented throughout West Africa. Another observation is that women, when they are enrolled in the water sector, are generally found in the top management (example of the Project Management course organized in Senegal with the participation of 25 women out of a total of 63 participants).

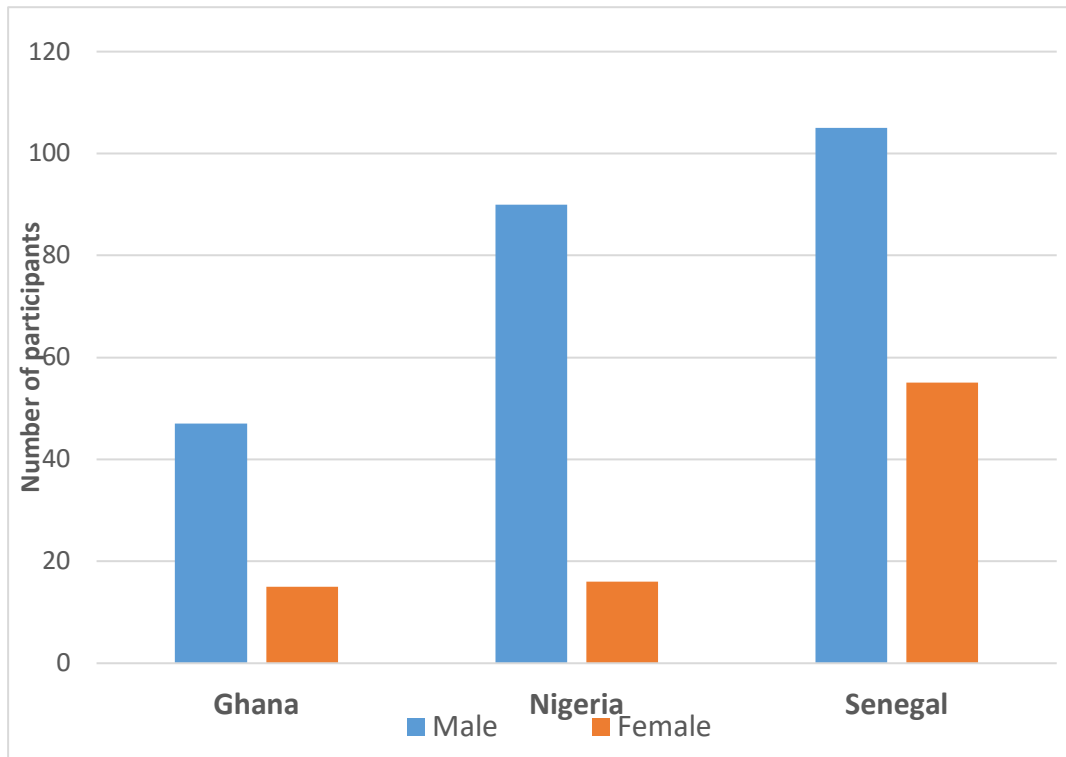


Figure 4: Gender of participants per country in West Africa

The age distribution of the people trained almost accurately reflects the composition of water sector personnel in the countries covered by the study. Indeed, this was largely revealed during the first phase of the project. The general observation was that the Water sector in West Africa was experiencing a serious human resource deficit, mainly due to the sector's lack of attractiveness, insufficient financial resources and training that was not adapted to the needs of the sub-sectors.

Most of those trained are in the 26-45 age group. People aged 46 and over represent 19% of the total workforce.

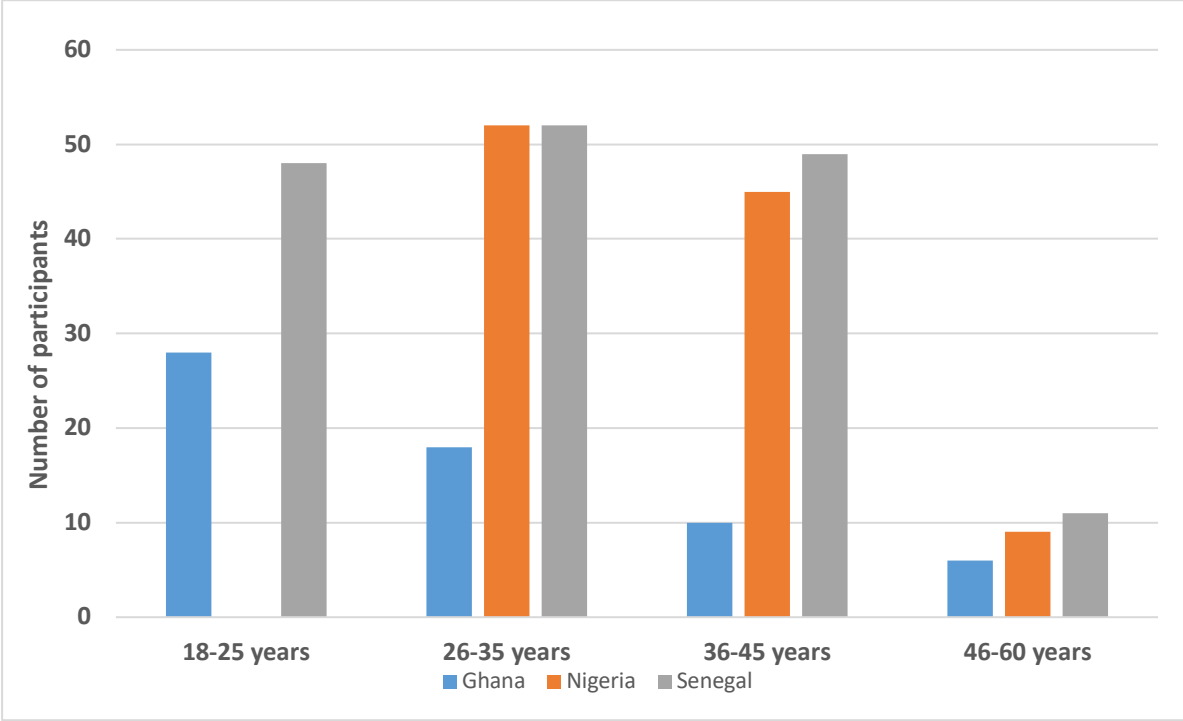


Figure 5: Breakdown of participants by age groups

Table 16: Synthesis of M&E Frameworks in West Africa

COURSE / MODULE TITLE	Status	TARGET GROUP	LOCATION	MODE OF TEACHING	E-LEARNING PLATFORM	GENDER OF PARTICIPANTS		AGE GROUPS				NUMBER OF PARTICIPANTS
						M	F	18-25	26-35	36-45	46-60	
Sustainable Onsite-Sanitation and Faecal Sludge Management	Completed	Junior Professional	Ghana	E-Learning	Zoom	47	15	28	18	10	6	62
Water laboratory instrumentation	Not implemented	Senior Technician	Ghana	Blended	-	-	-	-	-	-	-	-
Water systems instrumentation	Not implemented	Senior Technician	Ghana	Blended	-	-	-	-	-	-	-	-
Waste resource recovery innovations and entrepreneurship	Not implemented	Senior Professional	Ghana	Blended	-	-	-	-	-	-	-	-
Borehole supervision and management	Completed	Senior Professional	Nigeria	E-Learning	Zoom	58	10	-	28	35	5	68
Borehole drilling	Completed	Senior Professional	Nigeria	Blended	Other	24	5	-	15	10	4	29
Plumbing (household water manager course)	Not implemented	Junior Technician	Nigeria	Blended	Other	-	-	-	-	-	-	-
Induction course fresh engineers and scientist in the water sector	Completed	Senior Professional	Nigeria	Blended	Other	8	1	-	9	-	-	9
Water Supply and Environmental Engineering	Not implemented	Junior Professional	Nigeria	-	-	-	-	-	-	-	-	-
Remote Sensing and GIS	Not implemented	Junior Professional	Nigeria	-	-	-	-	-	-	-	-	-
Borehole Construction and Maintenance	Not implemented	Senior Professional	Nigeria	-	-	-	-	-	-	-	-	-
Operation and Maintenance of Water Distribution System	Not implemented	Senior Professional	Nigeria	-	-	-	-	-	-	-	-	-
Project Management in the Water Sector	Completed	Senior Professional	Senegal	E-Learning	Teams	38	25	15	26	17	5	63
GIS and Remote Sensing technologies applied to Water and Sanitation Management	Completed	Junior Professional	Senegal	Blended	Teams	27	12	8	13	15	3	39
Hydrological Modelling using SWAT	Completed	Junior Technician	Senegal	Blended	Teams	22	8	10	6	12	2	30
Introduction to UAV photogrammetry	Completed	Junior Professional	Senegal	Blended	Other	18	10	15	7	5	1	28
Development of institutional and regulatory frameworks	Not implemented	Senior Professional	Senegal	E-Learning	Teams	-	-	-	-	-	-	-

EXCHANGES

The WANWATCE exchange Program was intended to strengthen the Network through the movement of both staff and students.

1. Staff exchange

The exchange of staff would mainly concern the Centres of Excellence that compose the network. However, exchanges could be extended, as appropriate and relevant, to water sector institutions in the network countries, particularly to partner institutions.

Staff exchanges would take place at different scales:

1. facilitating professional and technician level courses;
2. sharing experience and developing joint course curriculum;
3. working on joint research development and or the use of specialized equipment;
4. working on joint scientific publications.

The minimum duration of a staff exchange was planned for three (03) weeks. The number of staff exchanges was planned for at least five (05) weeks.

2. Student exchange

The student' exchange was planned mainly of three (03) types:

1. full-time students (Master or doctoral Students);
2. part-time students (specialization courses and/or access to specialized equipment);
3. students in co-direction or co-supervision (doctoral student).

The minimum duration was planned for 1 month and up to 3 months. The timeline would be defined including delays. The number of students' exchange was expected to be five (05).

Exchanges would take place primarily within the WANWATCE network between the following institutions:

- Cheikh Anta Diop University
- Kwame Nkrumah University of Sciences and Technology
- University of Benin City
- National Water Resources Institute (NWRI), and
- International Institute (2iE).

It was also envisaged that there was justified need, exchanges could also take place with partner institutions of the WANWATCE network such as AGHRMET, CEMR/ECOWAS, ABN, OMVS, DGPRESN, etc.

Unfortunately, due to the health crisis linked to COVID-19, which has been raging everywhere since the beginning of 2020, exchange programs have been cancelled.

Indeed, the Centers of Excellence making up the WANWATCE network remained closed for more than six months, generally from mid-March to September 2020. In most of these countries, travel and mobility conditions remain very harsh and, in some cases, even tending to be impossible.

USE OF SOFTWARE, CONSUMABLES AND TOOLS FOR PILOT COURSES

The table below summarizes the list of equipment acquired within the framework of the short training courses organized and/or planned in the different centres. The equipment acquired under this project will be used exclusively for the implementation of training activities during and after the project. The objective is to ensure a certain sustainability of the project, notably by continuing capacity building beyond the end of the project. This is the case for centres such as KNUST (1 course) and UNIBEN (0 course), which were unable to implement all of the planned activities, mainly because of the COVID-19 Pandemic.

Table 17: List of acquired material

CoE	MATERIAL DESCRIPTION	PURCHASED FOR	NUMBER OF UNITS	COST USD PER UNIT	TOTAL COST IN USD
		COURSE / MODULE / LAB			
KNUST	WACOM tablet cintiq pro 24 with stand	Online courses	1	3500	3500
	Computer and TURBONET Router	Online courses	1	2600	2600
	HDD Storage Disk	Online courses	1	800	800
	Video Camcorder, fixture, Prompter	Online courses	1	2100	2100
	Hdmi Splitter, Hdmi Cables, Video Switcher, Blackmagic ATEM Mini	Online courses	1	1000	1000
	Audio and Network Cables, Lights and Background	Online courses	1	1500	1500
	Sub-total				
NWRI	Smart Board, Projector and accessories	Induction Course for Fresh Engineers and Scientists	2	1 225	2 450
	Smart Board Software	Induction Course for Fresh Engineers and Scientists	1	1 555	1 555
	Course Autorizing Software (Lectoral)	Plumbing and Service Connections	1	895	895
	Learning Experience Platform Software (Sibme)	Borehole Supervision and Management	1	520	520

CoE	MATERIAL DESCRIPTION	PURCHASED FOR	NUMBER OF UNITS	COST USD PER UNIT	TOTAL COST IN USD
		COURSE / MODULE / LAB			
	Virtual Reality Box with Software	Borehole Supervision and Management	1	300	300
	E-learning Autorizing Tool Software	Plumbing and Service Connections	1	1 630	1 630
	PC Pro Gamer Intel i7-9700KF, RTX 2070, 32Go RAM 500Go SSD NVMe, 2TBHDD	Borehole Supervision and Management	1	2 450	2 450
	HDD Storage Disk and Video Camcorder, fixture, Prompter	Borehole Drilling	1	550	550
	Ecran 27' and Tablettes de terrain / Georeferencement	Borehole Drilling	1	550	550
	ZOOM Webinar	Borehole Supervision and Management	1	550	550
	WACOM tablet cintiq pro 24 with stand, TURBONET Router (Any SIM)	Plumbing and Service Connections	2	275	550
	Sub-Total				
UNIBEN	Laptops: 2020 Lenovo Legion Y540 15.6x (Developer Laptop)	Blended Session	4	1 200	4 800
	ERDAS imagine	Blended Session	1	3 500	3 500
	ArcGis 10.7	Blended Session	1	1 500	1 500
	Multi Parameter Water Quality Test Kit (conductivity, pH, TDS, and salinity)	Blended Session	1	236	236
	Five Compartment Floc/Jar tester with temperature and speed regulator	Blended Session	2	350	700
	Portable Salinity Tester	Blended Session	2	100	200
	Sub-total				

CoE	MATERIAL DESCRIPTION	PURCHASED FOR	NUMBER OF UNITS	COST USD PER UNIT	TOTAL COST IN USD
		COURSE / MODULE / LAB			
UCAD	Drone MAVIC2 PRO + accessoires	Introduction to UAV photogrammetry	1	2 113	2 062
	Tablettes de terrain / Georeferencement	GIS and Remote Sensing technologies applied to Water and Sanitation Management	10	122	1 221
	Station d'accueil USB-C Multimédia Hub avec RJ45	Hydrological Modelling using SWAT / GIS and Remote Sensing	2	85	170
	PC Pro Gamer Intel i7-9700KF, RTX 2070, 32Go RAM 500Go SSD NVMe, 2To HDD	Hydrological Modelling using SWAT / GIS and Remote Sensing	2	2 844	5 688
	USB Keys 128 Go	Hydrological Modelling using SWAT / GIS and Remote Sensing	4	75	300
	DD 2 To	Hydrological Modelling using SWAT / GIS and Remote Sensing	4	135	540
	Ecran 27"	Hydrological Modelling using SWAT / GIS and Remote Sensing	2	330	660
	Keyboard	GIS and Remote Sensing technologies applied to Water and Sanitation Management	2	15	30
	Mouse	GIS and Remote Sensing technologies applied to Water and Sanitation Management	2	12	24
	Sub-Total				
TOTAL			45 131 USD		

HCD RISK MAPPING AND E-READINESS SURVEY IN RESPONSE TO COVID-19

Four CoEs in WANWATCE participated in the Risk Mapping exercise and E-Readiness Evaluation conducted by UNESCO-IHP regarding implementation of the HCD training.

The risk mapping consisted of a questionnaire circulated to all CoEs and was launched in April 2020. Initial results from the risk mapping indicated that on-line learning and distance activities were seen as options for re-orientation if activity implementation trending to on-line options, but that there were current challenges and needs to be addressed.

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. An e-readiness evaluation was done to produce an overview of each 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.

The results presented in the Table 18 below show that the Centres of Excellence have different levels of adaptation to the COVID-19 pandemic. This has led to a greater or lesser responsiveness in the implementation of training activities. It is also clear that there are significant gaps in terms of equipment for research and training in the water sector, as well as in the availability of distance learning platforms.

Nevertheless, despite the initial reluctance and the strong need for technical equipment, the centres of excellence were still able to hold some training, mainly blended learning (6 courses) and e-learning (02 courses). This allows us to foresee the development of these types of education, even beyond the COVID-19 pandemic. At UCAD, the development of distance learning and blended learning is now an absolute priority, not only as a response to the COVID-19 pandemic but also for the management of the increasingly large number of students.

Table 18: Results of the E-readiness for WANWATCE

WANWATCE		Capacity			Readiness	
Centre of Excellence	Country	Materiel & Equipment, Hardware	Software licences, fees, data	HR Costs, Staff, Tech Support	Ready for online e-learning	Ready for blended learning
Kwame Nkrumah University of Science and Technology	Ghana	Low	Medium	High	Yes	Yes
National Water Resources Institute	Nigeria	Medium	Medium	Medium	Partly	Partly
University of Benin City		Medium	Medium	Medium	Yes	Yes
Cheikh Anta Diop University	Senegal	Low	Low	High	Partly	Partly

CONCLUSIONS

A general observation in West Africa is that Higher Education Institutions and Technical and Vocational Educational Training (TVET) training doesn't really reach the expectations of the water sector. In most institutions in the water sector, the continuous training of agents is done abroad. This poses a problem of financial efficiency.

In 2013, the study conducted by the WANWATCE network on human resources in the water sector had highlighted the following findings:

- Lack of awareness on the importance of hydrological data in the planning and management of the nation's water resources;
- Lack of adequately trained manpower in the sector;
- No proper coordination in research and monitoring of water related activities in various institutions, both at the Federal, States and even non-governmental levels need to be addressed

Even today, these findings remain relevant and were confirmed by the country surveys conducted in 2018, which led to the development of national capacity building frameworks in the West African water sector.

However, the short-term training experience under the ACEWATER2 Project has resulted in the training of more than 300 people in Ghana, Nigeria and Senegal. Evaluation and feedback from participants in all three countries showed that generally, the participants found the proposed courses adequate to very adequate and useful for their career development.

UNESCO's effort to implement such training in the field of water is very much appreciated. However, in a perspective of sustainability, efforts will have to be made at the level of each center for the sustainability of its training. These trainings were excellent moments of exchange and interaction between practitioners and academics from different countries of the WANWATCE network.

The main challenge remains the sustainability of these short training courses and their inclusion in the training curricula of the Centers of Excellence for a good management of training needs. There is also a need for the development and inclusion of water resources curriculum in schools (primary, secondary and tertiary levels), so that it can stimulate interest in younger generations to take up career in water related courses.

RECOMMENDATIONS

The main recommendations resulting from the various studies and the organization of training sessions are as follows:

- Include Pilots training on academic curricula and/or develop tailor made training;
- Build an effective capacity building initiative and programmes funded by the governments;
- Develop induction training package for fresh engineers or scientists entering the sector;
- Follow up after trainings to ensure that skills and knowledge acquired during training are put into practice;
- Implement a water capacity development strategy targeting sector staff, while strengthening and deepening their knowledge on water resources.

As previously recommended in 2013, the following actions should be carried out:

- Develop Formal Knowledge management systems in the water and sanitation organisations;
- Set up mechanisms of dialogue among water actors for water resources management
- Develop collaboration among research centres, academia and development partners (government and donors) for research and development in water resources and sanitation management.

Beyond this project, these experiences need to be extended to other sub-sector that have linkages with water and sanitation. That would help to develop and formulate an integrated capacity development strategy.

There is need to institutionalize assessment of manpower and training needs analysis of the sector stakeholders in order to facilitate institutional strengthening and capacity development in the Water Sector.

High level advocacy is required to mobilize Policy Makers for adequate funding and mandatory policy framework for manpower development and training in the Water Sector. Lastly, it is an opportunity to appropriate the WEF nexus approach and to integrate it into the policies and actions of the water and sanitation sector.

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APPENDICES

Monitoring and Evaluation Frameworks

1. KNUST, Ghana
2. NWRI, Nigeria
3. UNIBEN, Nigeria
4. UCAD, Senegal