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

Volume I: Draft Report on

Human Capacity Development priorities in the Water Sector in Africa

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Disclaimer

The views expressed in this report are those of the consultant do not necessarily reflect the views of AMCOW, the AUC, EC-JRC or UNESCO-IHP.

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Acronyms and abbreviations

ACE-Water	African Networks of Centres of Excellence on Water Sciences and Technology
AfDB	African Development Bank
AMCOW	African Ministers' Council on Water
ARMC	African Resources Management Satellite Constellation
AU	African Union
AUC	African Union Commission
AUDA	African Union Development Agency
AU-HoSG	African Union Heads of State and Government
AWV 2025	African Water Vision 2025
CEANWATCE	Central-Eastern Africa Network of Water Sciences and Technology Centres of Excellence
CESA	Continental Education Strategy for Africa
CPA	Consolidated Plan of Action
DREA	Department of Rural Economy and Agriculture, African Union Commission
EAC	East African Community
ECA/UNECA	United Nations Economic Commission for Africa
EC-JRC	European Commission Joint Research Centre
ECOWAS	Economic Community of West African States
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HCD	Human Capacity Development
HYCOS	Hydrological Cycle Observing System
ICT	Information, Communication and Technology
IGAD	Inter Government Authority on Development
M&E	Monitoring and Evaluation
NEPAD	New Partnership for Africa's Development
NHS	National Hydrological Services
PRC	Permanent Representatives Committee of the African Union
RLBO	River/Lake Basin Organisation
REC	Regional Economic Community
SADC	Southern African Development Community
SANWATCE	Southern Africa Network of Water Sciences and Technology Centres of Excellence
SHCD	SADC Water Sector Human Capacity Development Plan (2014-2020)
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
STC-ARDWE	Specialised Technical Committee on Agriculture, Rural Development, Water and Environment
STC-EST	African Union Specialised Technical Committee on Education, Science and Technology
STI	Science, Technology and Innovation
TVET	Technical and Vocational Education and Training
UMA	Union du Maghreb Arabe
UNESCO-IHP	United Nations Educational, Scientific and Cultural Organisation International Hydrological Programme
UNICEF -	United Nations Children's Fund
WANWATCE	Western Africa Network of Water Sciences and Technology Centres of Excellence
WHYCOS	World Hydrological Cycle Observing System
WMO	World Meteorological Organisation

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Executive Summary

As one of the activities under the ACE-Water project, the Water and Marine Resources Unit of the Institute on Sustainable Resources commissioned a review of available information to prepare a report on the *Human Capacity Development (HCD) priorities in the Water Sector in Africa.* The requirement was to analyse both the information gathered by the European Commission Joint Research Centre; and information from strategic documents of the project partner institutions and organisations.

The demand for human capacity development in the water sector is defined by the role water plays in Africa's ambitions for socio-economic development as espoused by the African Union Agenda 2063. A key priority area of Agenda 2063 is water security. The report, therefore, employs the UN definition of water security, which is developing the capacity *"... to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability"* (UN Water, 2013). By this approach, the continental aspirations for growth and transformation are juxtaposed with the influence of water access and use on overall economic output. In this perspective, capacity constraints in the water sector are understood to pose grave implications for the realisation of Africa's development agenda.

Due cognisance is also given to the strategic directions of the education and training sector to develop the requisite human capital to sustain the vision of an integrated, prosperous and peaceful Africa. And it being that improvement of water wisdom is one of the facets of that undertaking, the ongoing strategic reforms in the education and training sector provide the framework within which the water sector HCD priorities are identified.

The review, thus, focused on the following documents:

i) the African Union agenda 2063: "the Africa we want";
ii) the Africa water vision 2025 and framework for action;
iii) the AfDB human capital strategy for Africa;
iv) the continental education strategy for Africa;
v) the Science, technology and innovation strategy for Africa;
vi) the African space policy and strategy;
vii) the agreement on the African resources management satellite constellation;
viii) the continental strategy for Technical and Vocational Education and Training (TVET);
ix) the AMCOW strategy 2018 – 2030;
x) the AMCOW policies and strategies on mainstreaming the youth and gender in the water and sanitation sector in Africa;
xi) various decisions and declarations of the policy organs of the African Union and the African Ministers' Council on Water (AMCOW); and,
xii) relevant human capacity development instruments currently under implementation by the East African Community; the Economic Community of West African States; the Intergovernmental Authority on Development; the Southern African Development Community and the Union du Maghreb Arabe.

Four broad categories of priorities are deduced from the derivational linkages between the African Union clarion call for a revolution to a knowledge-based and productive society; and the vitality of a vibrant water sector to the advent of sustainable development in Africa. And as such, the water sector HCD priorities are identified within the framework of the strategic reforms in the education and training sector as follows:

i) Building critical skills – particularly as relates to sustainable development, utilisation and management of water and related resources – to enhance economic growth and social transformation. The strategy is to utilise approaches encouraging technological empowerment, e-education and adaptive learning. To this end, the centres of excellence in water sciences and technology (CoEs) have to be strengthened into a fully functional, Africa-wide knowledge and excellence network. In turn, the network will play a significant role in fostering opportunities for development and water knowledge sharing across all AU Member States.
ii) Fostering transformation in the TVET sector to integrate flexibility, adaptability and continuous learning in education and training supply. For the water and sanitation sector, it is imperative to: a) develop and institute officially recognised vocations for the water and wastewater sectors; and, b) raise the level of prestige and attractiveness of sanitation related occupations.
iii) Supporting space science and astronomy research, teaching and outreach. There are numerous underdeveloped opportunities for the application of space science and technology to effectively manage resources such as water, land, forests, and marine ecosystems. The use of space technology is also of vital importance in generating sorely needed information to support decision making for the sustainable utilisation of the resources.
iv) Recognition of competences from non-formal and informal education and training. The overarching goal is twofold. First, enable tapping into existing technological preferences, cultural practices, local values and traditions of community learning to impart life skills. And, secondly, contribute to mainstreaming indigenous water and pollution management knowledge into lifelong learning systems.

Specific scientific, technical and institutional priorities are defined under each of the above mentioned broad themed categories. The specific priorities provide entry points for implementing the AMCOW human capacity development programme to address junior professional and technician level capacity challenges in Africa.

Outside the AU-NEPAD African network of centres of excellence in water sciences and technology (CoEs), the key identified institutional partners include: the pan-African University; the African Scientific, Research and Innovation Council (ASRIC); the African Observatory of Science, Technology and Innovation (AOSTI); the Africa Regional Centres for Space Science and Technology Education (ARCSSTE); the African Association of Remote Sensing and Environment (AARSE); African Centre of Meteorological Application for Development (ACMAD); the African Regional Institute for Geospatial Science and Technology (AfRIGST); the Association for the Development of Education in Africa (ADEA); the pan-African Institute of Education for Development (IPED); the Forum for African Women Educationalists (FAWE); the Global e-Schools and Communities Initiatives (GeSCI); the International Research and Training Centre for Rural Education (INRULED); the Africa Network Campaign on Education for All (ANCEFA); and the Pan African Association for Literacy and Adult Education (PAALAE).

An implementation, monitoring and evaluation framework is also defined. It delineates roles and responsibilities for the policy organs of the African Union and AMCOW; the AMCOW Secretariat; the Commissions of the African Union and the European Union; the EC Joint Research Centre (EC-JRC) and UNESCO-IHP; the regional networks of the centres of excellence; and the individual centres of excellence. These span leveraging of political and financial commitment; resources mobilisation; coordination of funding and implementing partners; periodic planning and reporting; and project management oversight and accountability for resources and results.

1. Introduction

The European Commission's Joint Research Centre (EC-JRC) – in collaboration with the UNESCO-IHP – is supporting and coordinating implementation of the African Networks of Centres of Excellence on Water Sciences (ACE WATER) project. As one of the activities under the project, the Water and Marine Resources Unit of the Institute on Sustainable Resources commissioned a review of available information to prepare two reports on: i) the *Human Capacity Development priorities in the Water Sector in Africa*; and ii) the *Development Priorities of the Water Sector in Africa placed in the context of Agri-Energy sectors*.

This report synthesises the human capacity development priorities of the water sector in Africa. They are drawn from a review of relevant continental and regional policies and strategies to develop the requisite human capital to actualise the African Union Vision of: "***an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena"*** (AUC, 2020)**.**

1.1 Overview of the ACE WATER II Project

The second phase of the African Networks of Centres of Excellence on Water Sciences (ACE WATER II) aims at fostering sustainable capacity development at scientific, technical, and institutional level in the water sector. The project supports 15 out of 21 AU-NEPAD African Network of Centres of Excellence in Water Sciences and Technology (CoEs). These are coordinated regionally through the: i) the University of Khartoum, for eastern and central Africa; ii) l'Université Cheikh-Anta-Diop for western Africa; and, iii) the University of Stellenbosch for southern Africa. The goal is twofold:

1. Facilitate high-end scientific research on water and related sectors, in order to provide effective scientific and educational support to governments. Through establishing common sector priorities for higher education institutions at regional level, the NEPAD CoE play a key role in supporting ongoing efforts by the African Ministers' Council on Water (AMCOW) to implement the Human Capacity Development Programme to address junior professional and technician level capacity challenges in Africa.
2. Implement human capacity development activities at regional and local level. The Human Capacity Development component of the project is aligned with AMCOW Governing Council Decisions EXCO/11/2013/CAIRO/17[1;] and, EXCO/12/2014/DAKAR/14[2] calling for concrete activities to address Junior Professional and Technician Level Capacity Challenges in the Water Sector in Africa. The aim is to maintain strong engagement with relevant policy processes and decision makers in the water sector (RECs, RBOs, National Technical Services) by promoting informed

[1]EXCO/11/2013/CAIRO/17: EXCO notes the growing human resources shortages to achieve water and sanitation goals in Africa and directs the Secretariat to work with the AUC and NEPAD Centres of Excellence to develop a Human Capacity Development Programme aimed at addressing junior professional and technician level capacity challenges in the water sector.

[2]EXCO/12/2014/DAKAR/14: GA appreciates the action taken by the AMCOW Secretariat and NEPAD Centre of Excellence and call on both institutions to follow up the request for the support of the 2nd phase of the project with the General Director of EuropAid of the European Commission, and to present the implementation plan of the Human Capacity Building Programme to the next EXCO meeting.

The 10th Session of AMCOW Governing Council noted – in annotated agenda item 14 - that with EC support, phase 2 of the project would be implemented in the period 2016 – 2019 and comprise two components. Component 1, led by the JRC, focussed on scientific activities including technical data analysis; management and sharing of an on-line Atlas on regional Water Cooperation; water security and SDGs; water -energy -food security NEXUS assessment. Component 2 on "human capacity activities" would be led by UNESCO.

decision-making on a range of important water sector and related policy priorities to boost their strategic planning performances and their resilience to pressures and constraints

1.2 Objectives of the assignment

Ongoing activities to implement the ACE WATER II project, which is scheduled for completion in November 2020, are geared towards achieving the following objectives:

i) establishing a human capacity development programme to addressing junior professional and technician level capacity challenges; and,
ii) establishing common sector priorities for higher education institutions at regional level.

Within this context, a desk review of the relevant strategic documents of the mandated institutions in Africa, and the outputs from the project activities was carried out to meet the following requirements:

1. identify actors and sector needs at regional level relevant for water and related sectors, including mapping the most relevant partners and stakeholders;
2. identify priorities with regional counterparts from the documents and discussions available and other strategy documents;
3. propose a draft of an implementation framework together with a Monitoring and Evaluation (M&E) framework; and,
4. summarise conclusion and recommendations to be addressed to AMCOW and the RECs.

1.3 Structure of the report

This report documents the insights into the water sector HCD priorities gained from the study. The priorities are inferred from expectations of action to respond to the urgent need to implement Africa's development agenda. Macro-level socio-economic development objectives – at continental and regional level – are distilled into specific scientific, technical and institutional priorities for action at national level. Framed by the pillars of the ongoing education reforms to transform society and economies in Africa, the analysis highlights the water sector related and or impacting objectives within the macro goals. The specific priorities, thus, derive from the necessary strategic interventions to bolster efforts to improve water wisdom, and – in turn – realise the Africa Water Vision 2025.

An implementation, monitoring and evaluation framework is defined. It is grounded in existing arrangements to operationalise; ensure accountability; and attain the desired impacts of both the AMCOW Strategy 2018 – 2030; and the AMCOW Strategic Operational Plan 2019-2024. With anticipation of continued intervention to consolidate the gains of the ACE Water project, roles and responsibilities are defined for the key HCD programme partners and stakeholders at technical and policy level. They constitute part of the recommendations to be made to the relevant organs of AMCOW and the Regional Economic Communities (RECs).

2. The demand: implementation of African Union Political Commitments

Overcoming the challenge of inadequate human capacity for planning, developing, utilising and managing Africa's natural resources base[3] (AUC, UNECA, AfDB, 2000; AUC, AMCOW, AfDB, GWP, 2019) is a key pillar of the political agenda to actualise both the African Union's Vision of:

> *an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena*

and the Africa Water Vision 2025 of:

> *an Africa where there is an equitable and sustainable use and management of water resources for poverty alleviation, socio-economic development, regional cooperation and the environment.*

AMCOW's Human Capacity Development Programme (HCD Programme) for the water sector, **thus responds to – and is motivated by – the need to plug the capacity development gaps identified in, among others, the policy initiatives and strategies listed below**:

1. the African Union Agenda 2063;
2. the Africa Water Vision 2025;
3. the African Development Bank human capital strategy for Africa;
4. the continental education strategy for Africa 2016 - 2025
5. the science, technology and innovation strategy for Africa 2024;
6. the African space policy;
7. the agreement on the African resources management satellite constellation;
8. the continental strategy for TVET;
9. the Sirte Declaration on integrated development of agriculture and water in Africa; and,
10. the Sharm el-Sheikh Declaration on accelerating the achievement of water and sanitation goals in Africa.

In the sub-sections that follow, an overview is provided on each of the above listed initiatives and strategies. Emphasis is placed on highlighting their individual specific objectives that:

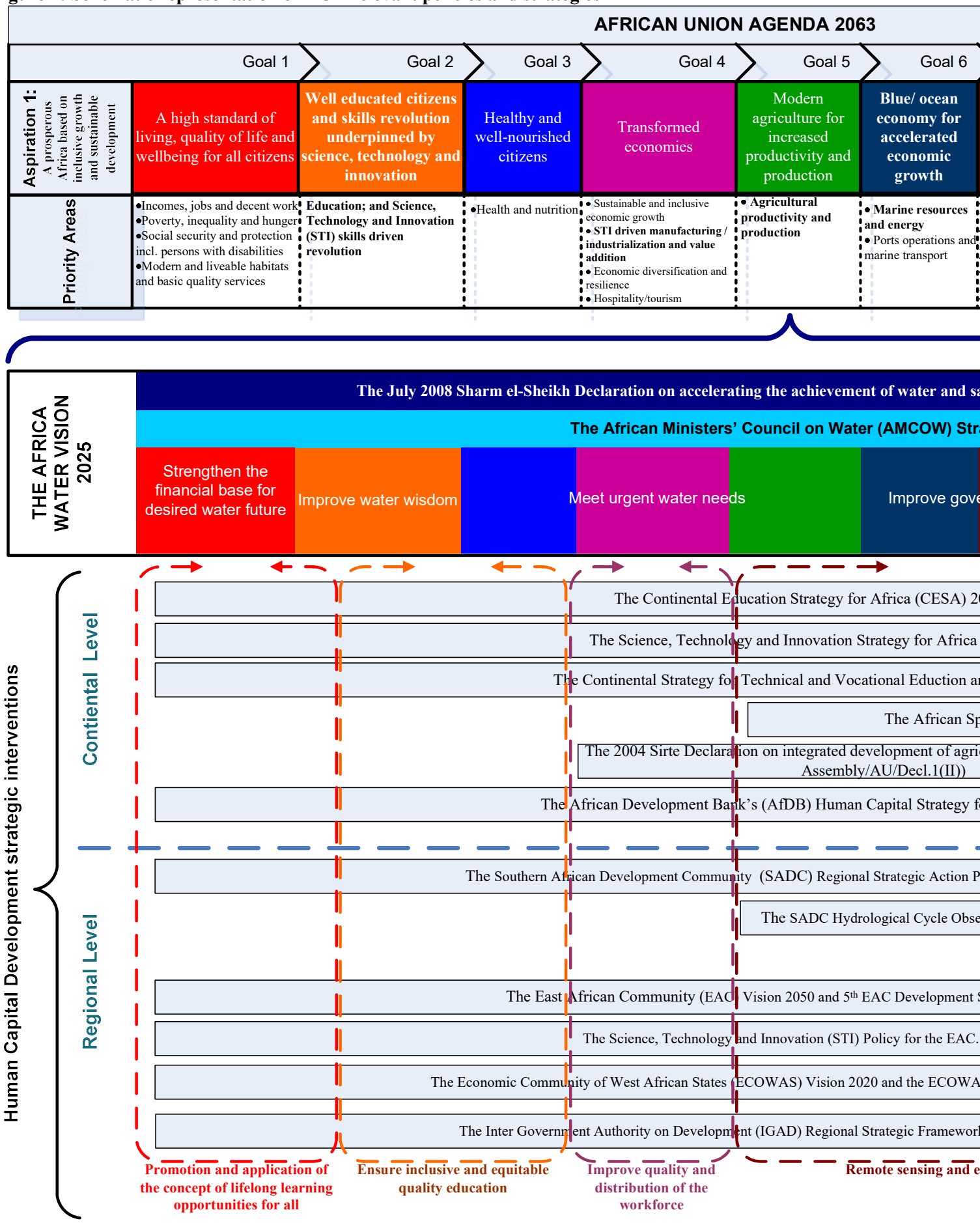
- either have a bearing on making improvements (efficiency, efficacy) on the development, utilisation and or management of water and related resources vis-à-vis increasing economic output from all sectors;
- or impact on education and training processes to generate knowledge and facilitate its application to assure water security, which is a necessary condition for sustainable development.

The analysis is extended to the related policy instruments and tools designed to foster regional integration; social inclusion; and labour mobility. In this respect, the spotlight is shone on the strategic goals of the RECs that deal with human capital development; gender mainstreaming and social inclusion; education reforms; and water resources assessment, monitoring and management.

A schematic representation of the interlinkages is presented in Figure 1 below:

[3]The natural resources base is the source of water and most of the potential wealth of countries, but is easily degraded if it is not protected and managed sustainably This comprises of wildlife; natural vegetation (grasslands, forests, wetlands, scrubland); land (including soils); water (groundwater, streams, rivers, lakes, waterfalls); and minerals.

Figure 1: Schematic representation of HCD relevant policies and strategies



2.1 The African Union Agenda 2063 and the Africa Water Vision 2025

The African Union Agenda 2063 and the Africa Water Vision respectively prioritise – among others: i) assuring water security; and ii) improving water wisdom.

UN-Water defines water security as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (UN Water, 2013). Thus, the economy as a whole is directly or indirectly dependent upon the output of sectors for which water is an important input[4], and is – by inference – sensitive to capacity constraints in the water sector. In this respect, improving water wisdom is a necessary condition for realising Africa's development agenda as encapsulated in Agenda 2063.

The African Union Agenda 2063: *"The Africa We Want"* provides the framework and roadmap to achieve the African Union Vision by 2063. It is premised on assuring self-reliance, regional integration, industrialisation and enhanced partnerships through:

- promoting science, technology and innovation;
- investing in human capital development;
- managing natural resources in a sustainable manner;
- effective private and public sector development and the promotion of public-private partnerships; and,
- innovative resources mobilisation.

Agenda 2063 describes the vision of Africa, in 50 years' time from 2013, with respect to different aspects of human wellbeing and socio-economic development. The vision comprises seven key aspirations of the people of Africa for the year 2063 with set quantitative targets. The aspirations are elaborated in the table below.

Table 1: The seven aspirations, goals and priority areas of Agenda 2063

Aspiration	Goals	Priority Areas
Aspiration 1: A prosperous Africa based on inclusive growth and sustainable development.	(1) A high standard of living, quality of life and wellbeing for all citizens	• Incomes, jobs and decent work • Poverty, inequality and hunger • Social security and protection including persons with disabilities • Modern and liveable habitats and basic quality services
	(2) Well educated citizens and skills revolution underpinned by science, technology and innovation	• **Education and STI skills driven revolution**
	(3) Healthy and well-nourished citizens	• Health and nutrition
	(4) Transformed economies	• Sustainable and inclusive economic growth • **STI driven manufacturing / industrialization and value addition** • Economic diversification and resilience • Hospitality/tourism

[4] These include agriculture, forestry, mining, energy resource extraction, manufacturing, electric power production, and labour/public water supply.

Aspiration	Goals	Priority Areas
	(5) Modern agriculture for increased productivity and production	• **Agricultural productivity and production**
	(6) Blue/ ocean economy for accelerated economic growth	• **Marine resources and energy** • Ports operations and marine transport
	(7) Environmentally sustainable and climate resilient economies and communities	• **Sustainable natural resource management and biodiversity conservation** • **Sustainable consumption and production patterns** • **Water security** • **Climate resilience and natural disasters preparedness and prevention** • **Renewable energy**
Aspiration 2: An integrated continent; politically united and based on the ideals of Pan-Africanism and the vision of Africa's Renaissance.	(8) United Africa (federal or confederate)	• Framework and institutions for a united Africa
	(9) Continental financial and monetary institutions are established and functional	• Financial and monetary institutions
	(10) World class infrastructure criss-crosses Africa	• Communications and infrastructure connectivity
Aspiration 3: An Africa of good governance, democracy, respect for human rights, justice and the rule of law.	(11) Democratic values, practices, universal principles of human rights, justice and the rule of law entrenched	• Democracy and good governance • Human rights, justice and the rule of law
	(12) Capable institutions and transformative leadership in place	• Institutions and leadership • Participatory development and local governance
Aspiration 4: A peaceful and secure Africa.	(13) Peace security and stability is preserved	• Maintenance and preservation of peace and security
	(14) A stable and peaceful Africa	• Institutional structure for au instruments on peace and security
	(15) A fully functional and operational apsa	• Fully operational and functional APSA pillars
Aspiration 5: An Africa with a strong cultural identity, common heritage, shared values and ethics.	16) African cultural renaissance is pre-eminent	• Values and ideals of pan Africanism • Cultural values and African renaissance • Cultural heritage, creative arts and businesses
Aspiration 6: An Africa, whose development is people-driven, relying on the potential of African people, especially its women and youth, and caring for children.	(17) Full gender equality in all spheres of life	• **Women and girls empowerment** • Violence & discrimination against women and girls
	(18) Engaged and empowered youth and children	• Youth empowerment and children
Aspiration 7: Africa as a strong, united, resilient and influential global player and partner.	(19) Africa as a major partner in global affairs and peaceful co-existence	• Africa's place in global affairs. • Partnership
	(20) Africa takes full responsibility for financing her development	• African capital market • Fiscal system and public sector revenues • Development assistance

Source: (AUC, 2014a)

The Africa Water Vision 2025 (AWV2025) constitutes one of the strategic continental policy frameworks for the realisation of Aspiration 1 of Agenda 2063 – that is: "*a prosperous Africa, based on inclusive growth and sustainable development*" (AUC, 2014a).

A framework for action towards attainment of the vision was defined along with milestones and quantitative, time-bound targets. The Vision's framework of indicators and targets are categorised under four themes namely (1) improving governance of water resources; **(2) improving water wisdom;** (3) meeting urgent water needs; and (4) strengthening the financial base for desired water future. These are presented in the table below.

Table 2: Targets of the Africa Water Vision for the year 2025

Africa Water Vision 2025 Targets
1. By 2025, 100% of countries should have completed development of IWRM policies and carried out institutional reform.
2. By 2025, enabling environment for regional cooperation on shared waters should be in place for 100% of river basin organisations in Africa should have in place
3. By 2025, systems for information generation, assessment and dissemination should be established in 100% of countries and 100% of transboundary water basins.
4. By 2025, review of global experiences should be completed, and sustainable financing for information generation and management implemented in 90% of the countries, and in three established basins.
5. By 2015, public awareness on capacity building for Integrated Financial Resource Management (IFRM) completed in 100% of countries; partnerships for strategic assistance formed in 60% of the countries; national research institutes should be established in 2 countries; and gender and youth concerns mainstreamed in 100% of countries.
6. By 2025, reduce by 95% the proportion of population without access to safe and adequate water supply, and safe and adequate sanitation.
7. By 2025, increase by 60% the water productivity of rain-fed agriculture and irrigation; and increase by 100% the size of irrigated area.
8. By 2025, develop 25% of potential of water for agriculture, hydropower, industry, tourism, and transportation at national level.
9. By 2025, implement in 100% of river basins measures for conservation and restoration of environment, biodiversity, and life-supporting ecosystems.
10. By 2025, measures for effective management of drought, floods and desertification should be operational in 100% of countries.
11. By 2025, 100% of countries should be implementing pricing and full cost recovery for water investments; there should be increasing participation of the private sector in water and sanitation financing, and the financing required for urgent water needs should be secured from national and international measures.

Source: (AU; UNECA; AfDB, 2000)

2.2 The AfDB Human Capital Strategy for Africa

The African Development Bank's (AfDB) Human Capital Strategy for Africa 2014 – 2018 seeks "*to harness the potential of one billion Africans by building skills and promoting technologies for better jobs, equal opportunities and workforce competitiveness"* (AfDB, 2014). It details the Bank's operational framework to build human capital[5] in Africa. This is aligned to the implementation of the AfDB Strategy 2013 – 2022, which emphasises skills and technology as crucial for a productive workforce and competitive economies towards inclusive and green growth agenda for Africa.

The strategy is premised on the following specific objectives:

i) Cashing in on the demographic dividend.

[5] Human capital is in economic terminology, an input (a necessary condition) to achieving inclusive and green growth. The World Economic Forum defines it as "the acquisition and deployment of skills, talent, knowledge and experiences of individuals and/populations and their value to organisations, economies and society". The four key aspects of human capital are education; workforce and employment; wellness including health services; and enabling environment including safety nets. Together, they result in returns on human capital and human development outcomes.

ii) Building a knowledge economy based on productivity and competitiveness.
iii) Tackling the issues of youth and women unemployment and underemployment; job creation; and retaining skilled workers.
iv) Improving the quality of education and training services provision.
v) Attracting more investments, improving accountability, and providing more value for money in education and training services delivery.
vi) Tackling widening income inequality and gender disparities.

2.3 The Continental Education Strategy for Africa

A key goal of Agenda 2063's Aspiration 1 is to deliver a ***"well educated*** [African ***citizen***ry through a] ***skills revolution underpinned by science, technology and innovation".*** In this regard, the Assembly of the African Union adopted the Continental Education Strategy for Africa (CESA 16-25) as the framework for transforming education and training systems in Africa (AUC, 2015). To cover all aspects of the education system from pre-vocational education to tertiary education, CESA 16-25 emphasises the concept of the education-and-training continuum.

CESA 16-25 is driven by the desire to set up a "qualitative system of education and training to provide the African continent with efficient human resources adapted to African core values and therefore capable of achieving the vision and ambitions of the African Union. Those responsible for its implementation will be assigned to reorient Africa's education and training systems to meet the knowledge, competencies, skills, innovation and creativity required to nurture African core values and promote sustainable development at the national, sub-regional and continental levels" (AUC, 2015, p. 7).

The strategy articulates 12 strategic objectives as follows.

i) Revitalise the teaching profession to ensure quality and relevance at all levels of education.
ii) Build, rehabilitate, preserve education infrastructure and develop policies that ensure a permanent, healthy and conducive learning environment in all sub-sectors and for all, so as to expand access to quality education.
iii) Harness the capacity of ICT to improve access, quality and management of education and training systems.
iv) Ensure acquisition of requisite knowledge and skills as well as improved completion rates at all levels and groups through harmonisation processes across all levels for national and regional integration.
v) Accelerate processes leading to gender parity and equity.
vi) Launch comprehensive and effective literacy programmes across the continent to eradicate the scourge of illiteracy.
vii) Strengthen the science and math curricula in youth training and disseminate scientific knowledge and culture in society.
viii) Expand TVET opportunities at both secondary and tertiary levels and strengthen linkages between the world of work and education and training systems.
ix) Revitalise and expand tertiary education, research and innovation to address continental challenges and promote global competitiveness.
x) Promote peace education and conflict prevention and resolution at all levels of education and for all age groups.
xi) Improve management of education system as well build and enhance capacity for data collection, management, analysis, communication, and use.
xii) Set up a coalition of stakeholders to facilitate and support activities resulting from the implementation of CESA 16-25.

2.4 The Science, Technology and Innovation Strategy for Africa 2024

The Science, Technology and Innovation Strategy for Africa – 2024 (STISA-2024) is the "continental framework for accelerating Africa's transition to an innovation-led, knowledge-based economy within the overall framework of the AU Agenda 2063" (Assembly/AU//Dec.520(XXIII)[6]). Human capital development; innovation; value addition; industrialisation; and entrepreneurship are singled out as the focus areas of the strategy to foster social transformation and economic competitiveness (AUC, 2014b).

The focus of STISA-2024 is to address the aspirations identified under the Agenda 2063. It also aims to link those achievements realised under ongoing implementation of the Consolidated Plan of Action (CPA)[7], together with future opportunities from the development of Science, Technology and Innovation (STI) in Africa. STISA-2024 is a short term incremental strategy designed to address Africa's challenges, with the ultimate goal of contributing significantly to the AU vision. STISA-2024 responds to the demand for science, technology and innovation to impact on critical sectors including agriculture, energy, environment, health, infrastructure, mining, security and water among others (AUC, 2014b).

2.5 The African Space Policy

The African Space Policy (HRST/STC-EST/Exp./15 (II)) is aimed at providing the framework for an enabling environment for the development of a knowledge-based economy. To this end, the policy (AUC, 2017) focuses on releasing the potential benefits of applying space science and technology for the improvement of the quality of life and the creation of wealth for all in part through knowledge generation and exploitation. Key among the specific objectives of the policy, is the need to develop the requisite human resources for addressing user needs that include improving weather forecasts for effective early warning systems for, among others, ecosystem and geological events; heavy or lack of precipitation; heat waves; dust storms; health risks; and, red tides and tsunamis. The other potential benefits are listed as:

- monitoring and conducting assessments of the environment;
- managing the use of natural resources;
- providing early warnings of and managing natural disasters;
- providing education and health services in rural and remote areas;
- improving access to transportation services;
- pro-active management of disease outbreaks;
- peace keeping missions and conflict resolution; and,
- connecting Africa with people around the world.

The African Space Policy is the first step to instituting a continent-wide regulatory framework to guide the implementation of a continental space programme. And, in turn, systematically coordinate the development and utilisation of Africa's space resources towards the improvement of the quality of life

[6] Assembly/AU//Dec.520(XXIII): African Union Decision on Strategy for Science Technology and Innovation in Africa 2024 – Doc. EX.CL/839(XXV)

[7] The CPA was approved to be implemented to address the following clustered key flagship research and development programmes: Cluster 1: Biodiversity, Biotechnology and Indigenous Knowledge: Including (i) Conservation and Sustainable Use of Biodiversity; (ii) Safe Development and Application of Biotechnology; and (iii) Securing and Using Africa's Indigenous Knowledge Base; Cluster 2: Energy, Water and Desertification: Including (i) Building a Sustainable Energy Base; (ii) Securing and Sustaining Water; and (iii) Combating Drought and Desertification; Cluster 3: Material Sciences, Manufacturing, Laser and Post-Harvest Technologies: Including (i) Building Africa's Capacity for Material Sciences; (ii) Building engineering capacity for Manufacturing; (iii) Strengthening the African Laser Centre (ALC); and (iv) Technologies to Reduce Post harvest Food Loss; Cluster 4: Information and Communication Technologies: Including (i) Information and Communication Technologies and (ii) Establishing the African Institute of Space Science; and (5) Cluster 5: Mathematical Sciences: including the Next Einstein Initiative.

and the creation of wealth for all in part through knowledge generation and exploitation. One such example of collaborative development of space resources for livelihoods improvement is the agreement on the African resources management satellite constellation highlighted below.

2.6 Agreement on the African Resources Management Satellite Constellation (ARMC)

The initiative, involving Algeria, Kenya, Nigeria and South Africa, is aimed at developing a constellation of satellites to provide real time, unrestricted and affordable access to satellite data to support effective environmental and resources management in Africa. A Memorandum of Understanding signed by the governments of the four countries on 7 December 2009, lays the foundation for easing access to satellite data for disaster management, food security, public health, infrastructure, land use, and water resources management (Adebola, 2009).

2.7 The continental strategy for TVET

The continental strategy for Technical and Vocational Education and Training (TVET) is aimed at preparing Africa's youth to become more of job creators[8]. This is motivated by the urgent need to address the negative public perception – in Africa – of TVET as a refuge for those who failed in academic education. The Strategy posits that even the most sophisticated qualifications require prior training, which is within the broader framework of TVET (AUC, 2015). The proposed approaches thus cover all aspects of training and skills acquisition – formal, non-formal and informal – as well as continuous learning.

This strategy thoroughly examines the possibilities of TVET as a response to facilitate the promotion of national development, social cohesion, political stability, poverty reduction and regional integration. It draws on recent regional and international initiatives aimed at promoting TVET to foster youth employment. The main objective of the strategy is to promote skills acquisition through training focused on the response to the demand of the social economic milieu through employability tests, sustainable livelihoods and responsible citizenship; and also building capacity to create and innovate, anchored on a spirit of entrepreneurship and inventiveness.

The specific objectives are summarised as follows:

i) Promoting an efficient and cost-effective system of quality TVET.
ii) Ensuring the relevance of training and employability of trainees.
iii) Developing creativity, innovation and entrepreneurship.
iv) Improving the legal and political environment as well as coherence and management of training provision.
v) Promoting continuing apprenticeship.
vi) Strengthening the status and attractiveness of TVET.

2.8 The 2004 Sirte Declaration (Ex/Assembly/AU/Decl.1(II))

In the 2004 Sirte Declaration on integrated development of agriculture and water in Africa, the African Union Heads of State and Government (AU-HoSG) commit to: i) developing the continent's human resource potential through education, training, skills development and exchange of expertise; and, ii) ensuring gender balance in access to training, education, land, natural resources, loans and development programmes.

[8] Assembly / Dec.525 (XXIII): African Union Decision on the AU Continental TVET Strategy –Doc. EX.CL/840(XXV)

2.9 The July 2008 Sharm el-Sheikh Declaration [Assembly/AU/Decl.1(XI)]

At the 11th Ordinary Session of the Assembly of the African Union in Sharm El-Sheikh, Egypt in June/July 2008, the AU-HoSG undertook to accelerate the achievement of water and sanitation goals in Africa. Of particular relevance to the AMCOW HCD programme for the water sector is the commitment to *"build institutional and human resources capacity at all levels … for programme implementation; enhanc[ing] information and knowledge management, as well as strengthen[ing] monitoring and evaluation".*

Activities to implement the Sharm el-Sheikh Declaration have resulted in the formulation and ongoing implementation of the understated capacity development policies and strategies:

1. The African Ministers' Council on Water (AMCOW) Strategy 2018 – 2030.
2. The **2014 AMCOW Policy and Strategy for Youth in the Water and Sanitation Sector in Africa** – to address constraints to youth engagement including: inadequate education, limited knowledge; an inability to access information, and lack of marketable skills.
3. The **2011 AMCOW Policy and Strategy for Mainstreaming Gender in the Water Sector in Africa**, which serves as a guiding framework for AU Member States and other stakeholders, to mainstream gender in their sector policies, programmes, actions and investments (AMCOW, 2011). A clarion call is made to undertake strategic research and collection of operational information on gender; develop human and institutional capacity to support gender equality interventions; and allocate adequate human and financial resources to gender mainstreaming.

2.10 Regional water sector capacity development and research policy initiatives

Subsidiary implementing arrangements for the continental policies and strategies are fostered at regional level by the Regional Economic Communities (RECs) and River and Lake Basin Organisations (RLBOs) – for water sector related issues. Table 3 below captures the related regional instruments for furthering human capacity development in Africa.

Table 3: Regional level instruments for Human Capacity Development in Africa

Region	Instrument	Goal
Southern African Development Community (SADC)	Regional Strategic Action Plan, Phase IV (RSAP IV) 2016-2020	Programme 4: Human Capacity Development and Research Objective: implement the SADC Strategic Human Capacity Development Plan for the water sector (2014-2020), strengthen institutions and support research in water on agreed themes. According to Beukman (2018, p. 13), of particular relevance to the ACE-Water project are the following: • That capacity development will form a continuum from addressing knowledge gaps into skills and meta-competencies in support of the implementation of the RSAP IV. • That WaterNet is entrusted by SADC to play a leading role in the implementation of the capacity development component of the RSAP IV, as WaterNet is a subsidiary institution of SADC. Other implementing agencies for the regional water programme will be chosen based on their already existing capacity to carry out the implementation. • The Capacity development in the RSAP IV is focused on individual capacity development. • SADC commissioned a consultative project in 2014 (during the RSAP III implementation) to develop the *SADC Water Sector Human Capacity Development (SHCD) Plan (2014-2020)*. The RSAP IV capacity development programme prioritises the implementation of this SHCD plan
	SADC Hydrological Cycle Observing System (SADC HYCOS)	SADC-HYCOS IV: a regional component of the World Hydrological Cycle Observing System (WHYCOS) Objective: develop and/or strengthen national and regional capacity in the fields of water resources assessment, monitoring and management. Phase III of the project – implemented between 2011 and 2015 – focussed on achieving a fully functional and calibrated monitoring network, as well as strengthening the capabilities of the National Hydrological Services (NHS) to effectively manage their water resources (SADC, 2008; Mbaziira, SADC Hydrological Cycle Observing System (SADC HYCOS): A Regional Approach to water related Disaster Risk Reduction, 2019a). This included, among others, i) the implementation of the Hydstra Hydrological Information System; ii) Data Exchange; and, iii) development of Hydrological Products to meet varying user needs
	i. SADC Protocol on Gender and Development; and, ii. the SADC Handbook on Gender Mainstreaming in the Water Sector	Goal: facilitate gender mainstreaming into systems and institutions, for the attainment of gender equality and equity at national and regional level Specifically: institute an inclusive approach to transboundary water management that ensures adequate incorporation of all voices and gender equality concerns. The SADC Protocol on Gender and Development has several provisions that seek to facilitate gender mainstreaming into systems and institutions, for the attainment of gender equality and equity at national and regional level through gender responsive planning and budgeting initiatives; policy development and implementation; gender capacity building and training; and the collection of gender disaggregated data (SADC, SARDC ,

		2016; Mbaziira, 2019b). The SADC Handbook on Gender Mainstreaming (SADC, 2015) in the Water Sector recommends a strategic approach to gender mainstreaming centred on i) reducing gender inequalities; ii) creating conditions for equal participation in planning; iii) women empowerment; and iv) enhancing both service provision and sustainability.
East African Community (EAC)	i. EAC Vision 2050 ii. 5th EAC Development Strategy 2016/17 – 2020/2021	Human Capital Development Pillar Goal: Well-educated and healthy human resources, as well as equipping the youth with the right skills to enter the workforce.
	Science, Technology and Innovation (STI) Policy for the EAC. (Oct 2019 draft)	Goal: application of STI, in terms of human skills; capital goods; practices; and organisations, to drive economic growth and sustainable development in the EAC. The East African Regional STI Policy is anchored on the following pillars: i) Capacity building for skills and STI Infrastructure; ii) Research, Innovation and Entrepreneurship; iii) Resource mobilisation, partnerships and collaborations; and iv) Enabling environment. On the other hand, the priority (sector) areas for the East African Regional Policy for Science, Technology and Innovation (STI) are: (1) Agriculture and Food; (2) Health and Life Sciences; (3) Human Resource Development/ Education; (4) Infrastructure; (5) Energy; (6) ICT and Big Data (7) Industrialization and Trade; (8) Environment and Natural Resources Management; (9) Climate Change; (10) Traditional and Indigenous Knowledge; and (11) Space Science and Technology. Earth Observation tools
Economic Community of West African States (ECOWAS)	i. ECOWAS Vision 2020 ii. ECOWAS Human Capital Strategy (in preparation)	*Education, Skills and Labour participation* is one of the 3 priority thematic areas for the advancement of the HCD agenda in the region towards Vision 2020 of *"an inclusive society achieved through human capital development and empowerment."* It underlies ongoing activities to develop an integrated human capital development strategy for the ECOWAS region
Inter Government Authority on Development (IGAD)	IGAD Regional Strategy	Two of the strategic outputs of the IGAD Regional Strategic Framework and Implementation Plan 2016-2020 are: Capacity building; and Research, science and technology. They underpin aspirations for "*a more peaceful, prosperous, and socio-economically and politically stable IGAD region."*
Union du Maghreb Arabe (UMA)		a "new social contract" between governments and citizens to, among others, turn a disempowered citizenry into a knowledge-based, productive society by improving human capital and promoting social inclusion (Larbi & Christensen, 2017).

3. HCD Priorities deriving from the continental and regional education policy and strategy framework

The demand for human capacity development in the water sector is defined by the role water plays in Africa's ambitions for socio-economic development as elaborated in Agenda 2063. To the extent that every sector of the economy is influenced by water[9], the realisation of sustained economic growth and social transformation in Africa is dependent on ensuring water security. The observed trends in Africa's population growth; urbanisation and lifestyle changes have implications for water demands. The anticipated impacts of climate variability and climate change will ravel the form, intensity and timing of water demand; affect water availability; and increase the risk of water-related hazards. A high level of technical ingenuity is, therefore, required to develop the requisite water infrastructure base to release Africa's development potential. A similar level of social ingenuity is also required to adjust to water scarcity and prepare for the adverse impacts of climate change.

Ergo, the need for improved water wisdom. First, to cope with and compensate for the consequences of the anticipated changes in water demands in all economic sectors. And, more importantly, to reliably satisfy those demands to deliver robust, competitive and climate resilient economies; and inclusive socio-economic development and livelihoods improvement.

Implementation of the decision of the Executive Committee of AMCOW – EXCO/11/2013/CAIRO/17 – to *"…develop a Human Capacity Development Programme aimed at addressing junior professional and technician level capacity challenges in the water sector"* reflects the broad continental sentiment to underpin aspirations of a prosperous Africa on a skills driven revolution. The African Union Specialised Technical Committee on Education, Science and Technology (STC-EST) is mandated to develop the requisite human capital to sustain the vision of an integrated, prosperous and peaceful Africa. To this end, the STC-EST is spearheading implementation of strategic reforms in the education and training sector as highlighted in the preceding chapter. These are broadly categorised into:

1. science, technology, innovation and skills development;
2. application of space science and technology;
3. technical and vocational education and training (TVET); and,
4. non-formal and informal education and training (NFET).

The HCD programme – and the overall drive to improve water wisdom – represent one of the facets of the STC-EST's mandated revolution to a knowledge-based and productive society. And as such, the water sector HCD priorities presented in Table 4 are identified within the framework of the strategic reforms in the education and training sector.

The table also provides a list of key partners and stakeholders contributing to and or influencing implementation of specific reform themes. The specific roles of key strategic partners in the reform process are summarised in Figure 2 and reiterated in Appendix I.

[9] According to Kenessy (1987), direct use of water in the extraction sectors (agriculture, forestry, mining, energy) creates a ripple effect in the processing (utilities, manufacturing, and construction); delivery (transportation, trade); and information (finance, insurance, real estate, public administration) sectors as goods and services are produced and transferred through supply chains until they reach the final consumer.

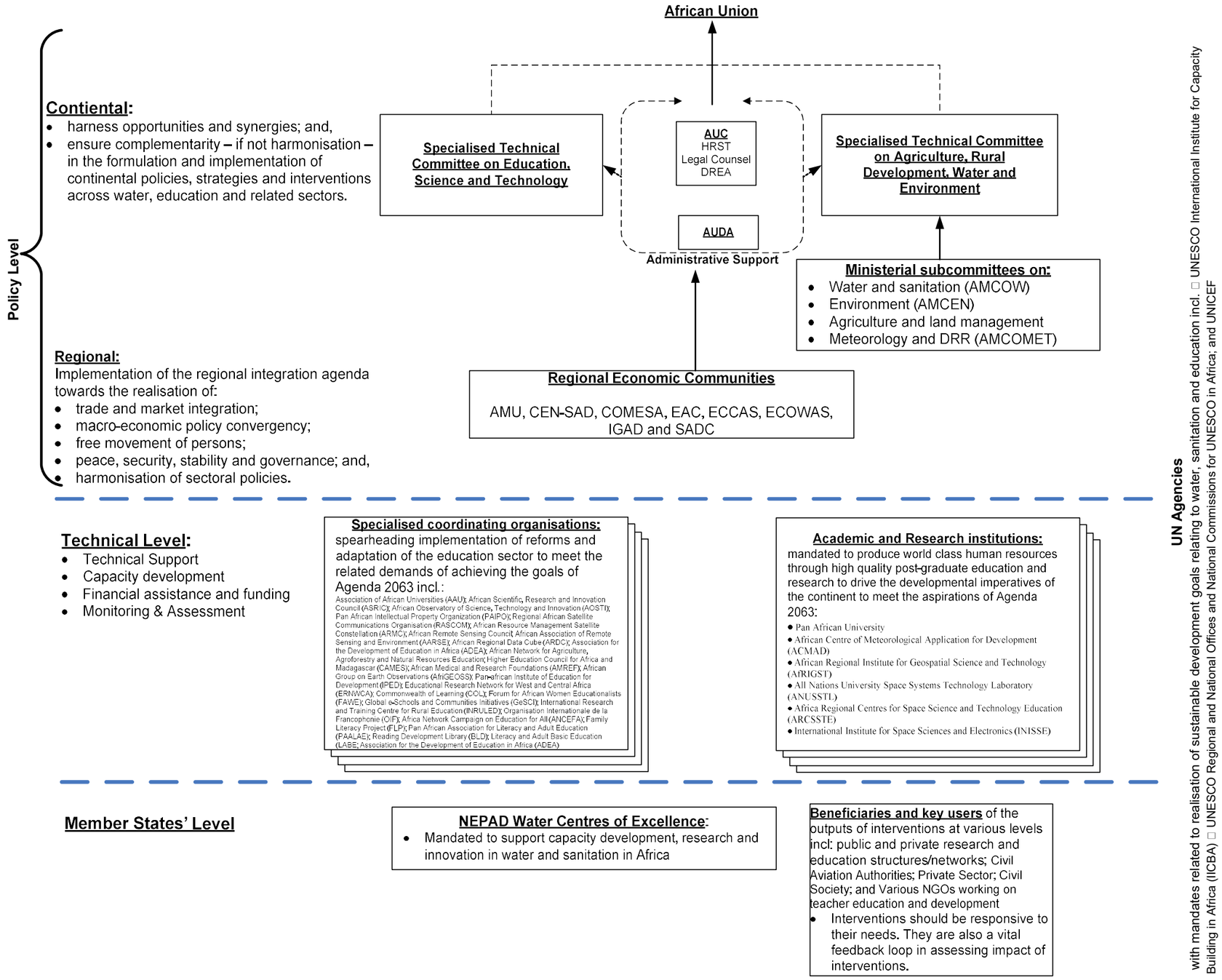
Table 4: Water sector HCD Priorities and key actors derived from continental and regional policies and strategies

Thematic Goal	Key General Priorities	Water related/impacting objectives	Water sector-specific priorities			Partners/ stakeholders
			Scientific	**Technical**	**Institutional**	
Science, technology, innovation and skills development	1. Skills, Human Capital, and Education Revolution; 2. Ensure inclusive and equitable quality education; and, 3. Promote lifelong learning opportunities for all	1. Knowledge generation and application to assure water security 2. Blue/ ocean economy for accelerated economic growth	1. Research on new water science and technology directions in Africa incl.: • transitioning to a green economy in water • economic analysis of green water technologies • water saving management, incl. reimagining urban water infrastructure towards efficient water use • Sustainable Urban Drainage Systems • tools for environmental sustainability evaluation as applied to water systems • appropriate technologies for climate variability and climate change mitigation; • marine resources development and utilisation • improving low commodity yields, and practicable mechanisms for assuring stability of farm-gate prices • entrepreneurial innovation based on Open Data	1. Design and operationalisation of decision support systems for water security and climate resilient development 2. Technological adaptation and promotion of climate smart water services and water resources management 3. Piloting low-cost green water provision and water use technologies e.g. • onsite grey water and non-potable water reuse systems • water consumption monitoring systems • solar and wind powered piped water systems • rainwater harvesting (in-situ and ex-situ) 4. information exchange; and development of experiential learning tools for establishing and managing marine legal and institutional frameworks 5. developing and implementing flagship programmes on water vis-à-vis eradication of hunger; nutrition, food and energy security; public health and human well-being; physical and intellectual mobility; wealth creation; and social transformation 6. Big Data and Internet-of-Things (IoT) solutions for precision agriculture water management	1. Strengthening implementation of education policies and strategies as relates to the water sector through: • consolidation and expansion of water centres of excellence as well as identifying and providing support to related educational think tanks • curriculum development for water related disciplines; • targeted teacher training, deployment, professional development and improvements in working and living conditions; • development and upgrading of research and innovation facilities (teaching and engineering laboratories); • development and upgrading of physical and digital infrastructure and resources; • establishment and operationalisation of National Research and Education Networks; • institutionalisation of regulatory frameworks for monitoring quality and relevance; and, • provision of requisite learning materials 2. Design and implementation of continuous learning programmes for the water and sanitation sector aimed at achieving cross-sectoral human capital development policy objectives 3. Cross-sectoral coordination and integration of water knowledge/education objectives into national development plans and complementary interventions in all sub-sectors; 4. Harmonisation – at all levels – to define a common range of skills and knowledge according to age and grade level; 5. Development and implementation of a policy framework and strategy(ies) for: o green technology research in the water sector o blue economy; and, o financing innovation 6. Facilitating the implementation of incubator projects and mentorship programs within the water and sanitation sector 7. Strengthening Intellectual Property Rights (IPR) and regulatory regimes at all levels through sensitisation and training on use of patent information and intellectual property rights for creation of new water	• African Union Specialised Technical Committee on Education, Science and Technology • African Union Development Agency (AUDA-NEPAD) • African Scientific, Research and Innovation Council (ASRIC) • African Observatory of Science, Technology and Innovation (AOSTI) • Pan African Intellectual Property Organization (PAIPO) • RECs and Member States' public and private research and education structures/networks • African Ministers' Council on Water (AMCOW) • NEPAD Water Centres of Excellence • Pan African University • Association of African Universities (AAU) • Association for the Development of Education in Africa (ADEA) • African Network for Agriculture, Agroforestry and Natural Resources Education • Higher Education Council for Africa and Madagascar (CAMES) • African Medical and Research Foundations (AMREF) • Civil Aviation Authorities • Academic and Research institutions • UN Agencies – UNESCO, UNICEF etc • International Institute for Space Sciences and Electronics (INISSE) • Regional African Satellite Communications Organisation (RASCOM) • African Resource Management Satellite Constellation (ARMC)

Thematic Goal	Key General Priorities	Water related/impacting objectives	Water sector-specific priorities			Partners/ stakeholders
			Scientific	Technical	Institutional	
					technologies and their translation into everyday use 8. Resource mobilisation, partnerships and collaborations	• African Remote Sensing Council • African Group on Earth Observations (AfriGEOSS) • African Association of Remote Sensing and Environment (AARSE) • African Centre of Meteorological Application for Development (ACMAD) • African Regional Institute for Geospatial Science and Technology (AfRIGST) • All Nations University Space Systems Technology Laboratory (ANUSSTL) • Africa Regional Centres for Space Science and Technology Education (ARCSSTE) • African Regional Data Cube (ARDC) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • Private Sector • Civil Society • Funding agencies
Space Science and Technology	Remote Sensing and Earth Observation	1. Monitoring and conducting assessments of the environment; 2. Managing the use of natural resources; 3. Providing early warnings of and managing natural disasters; 4. Providing education and health services in rural and remote areas;	1. Research on use of space technologies for: • urban and land use planning for water and related services provision • maritime and sub-maritime exploration, as well as improving knowledge of the water cycle, river systems and river basin management; • improving weather forecasts for effective early warning systems for ecosystem and geological events; heavy or lack of precipitation; heat waves etc • water-related aspects of managing natural resources and the environment; disaster risks; and marine and coastal areas; • assuring energy and food security, and climate change mitigation and adaptation; and, • exploitation and management of mineral, forest, aquatic and marine resources	1. Aerial surveys and evaluation of remote sensing images/photographs 2. Provision of technological know-how, data access, and operational services and products on, among others: • surface water bodies, aquifers, hydrography, ambient water quality, pollution • Coastal zone degradation and fishing potential • Meteorological services • Ecosystems, biodiversity, vegetation and land cover • agricultural production, crops distribution, soil and land suitability, pests and disease vectors • water and environment related risk and vulnerability • infrastructure networks and intelligent transportation systems 3. Enabling easy access to open data and processing tools to facilitate capacity development in the use and dissemination of geospatial data and information	1. Mobilising political commitment for the introduction of space education in national curricula, as well as the development of space programmes and related industries 2. Disseminating information on the application of space technologies for efficient, cost effective and sustainable utilisation of Africa's natural resources 3. Developing a regulatory framework to support space programmes in Africa, including a protocol on cooperation on meteorological services 4. Developing space education programmes and necessary tools for promoting widespread use of space technologies for, among others, enhancing early warning systems. 5. Strengthening the capacity of the Pan African University Space Science Institute, as well as establishing regional and sub-regional centres of space competencies 6. Building and operating requisite earth observation infrastructure 7. Establishing platforms for joint management of infrastructure and programmes of mutual interest, as well as cooperation on data management, sharing and documentation 8. Leveraging Africa's strategic location to attract mega-science projects in astronomy and space physics studies 9. Develop optical fibre networks across Africa to secure broadband capacity	
Technical and Vocational Education and Training (TVET)	1. Tackle youth unemployment and underemployment 2. Improve quality and distribution of the workforce	1. Meeting demand for water management and services skills; 2. Improving employability and versatility; 3. Improving ability for self-employment; and, 4. Providing opportunities for retraining and continuing apprenticeship	1.Improving environmental sector skills development, planning and implementation within the national education, training and skills development system	1. Mainstream indigenous water and pollution management knowledge, learning systems, technological preferences, cultural practices and local values, 2. Specialised technical training in: • Water and environmental planning and management (social and strategic impact assessments; problem-based environmental technology development; statistical and modelling tools for water quality monitoring and assessment at watershed level; application of conceptual and computational models for maintaining environmental integrity in relation to human development) • Municipal Water and Infrastructure (operating and maintaining public and private water treatment plants; water distribution systems;	1. Raise the level of TVET enrolment as a first step to its elevation as a priority policy area. 2. Develop and institute officially recognised vocations for the water and wastewater sectors. 3. Develop and implement water and sanitation sector pre-employment; retooling/retraining; and upgrading training programmes. 4. Strengthen national regulatory frameworks and strategies; and review of curricula to facilitate: • streamlining of TVET management and policy implementation structures for: i) improved system efficiencies; ii) effectiveness of inter-sectoral linkages;	• African Union Commission (AUC), the Regional Economic Communities (RECs) and UN Economic Commission for Africa (ECA) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • UNESCO International Institute for Capacity Building in Africa (IICBA) • UNESCO Regional and National Offices and National Commissions for UNESCO in Africa

Thematic Goal	Key General Priorities	Water related/impacting objectives	Water sector-specific priorities			Partners/ stakeholders
			Scientific	**Technical**	**Institutional**	
				wastewater treatment plants and wastewater collection systems; wastewater disposal and the regulated treatment of waste; water quality analysis and wastewater treatment supervision) • Water Management (developing, monitoring and maintaining surface water control structures; river bank and beach management; catchment management; flood control, including operating and maintaining barrages, reservoirs and holding tanks; water resources monitoring and regulation, including ambient water quality) • Water Engineering (modelling techniques and information technology for water management; water resources quality and quantity assessment; environmental survey and planning; coastal engineering design techniques; technologies for irrigation, drainage, flood protection, land reclamation and consolidation; hydraulic, hydrological and geotechnical engineering), • Meteorology • Customer care and business orientation • Data management (GIS)	and iii) creation of common platforms for joint TVET initiatives for all sectors • raising the level of prestige and attractiveness of TVET in general; and sanitation related occupations in particular (waste disposal, wastewater management) • water sector skills development from the basic level to the higher education level • inter-sectoral linkages and collaboration between training institutions and employers for targeted and demand-driven skills development • accreditation and regulation of training structures for all types of training (formal, non-formal, informal) • standardisation and quality assurance of evaluation and certification; and – in turn – portability of qualifications • elimination of gender inequities; • bridging the funding and investment gap for TVET in general	• Association for the Development of Education in Africa (ADEA) • Pan-african Institute of Education for Development (IPED) • Educational Research Network for West and Central Africa (ERNWCA) • Commonwealth of Learning (COL) • Forum for African Women Educationalists (FAWE) • Global e-Schools and Communities Initiatives (GeSCI) • International Research and Training Centre for Rural Education (INRULED) • Organisation Internationale de la Francophonie (OIF) • Various NGOs working on teacher education and development.
Non-formal and informal education and training (NFET)	Application of the concept of lifelong learning for all	Developing a society with an aptitude for sustainable living, as well as water and environment management			1. Providing community learning centres in both rural and urban areas 2. Establishing a NFET qualifications framework to offer official recognition of the knowledge and skills developed through NFET and thus expand learning opportunities 3. Instituting community-based mechanisms for: • providing life skills and other key aptitudes such as sustainable living; • promoting the passing-on of traditional water and environment management knowledge in local languages; • systematising data collection and analysis on NFET; and, • promoting indigenous scientific knowledge and culture	• Africa Network Campaign on Education for All (ANCEFA) • Family Literacy Project (FLP) • Pan African Association for Literacy and Adult Education (PAALAE) • Reading Development Library (BLD) • Literacy and Adult Basic Education (LABE)

Figure 2: Roles of key strategic partners in the pursuit of water sector HCD priorities



4. Implementation, Monitoring and Evaluation

AMCOW's Human Capacity Development Programme (HCD Programme) constitutes one of the key actions of Strategic Priority 1 (***ensure water security)*** of the AMCOW Strategy 2018 – 2030. As such, the framework and mechanisms for implementing, monitoring, evaluation and reporting approved for the AMCOW Strategy 2018 – 2030 applies to the HCD programme. The principles of accountability, transparency, integrity, horizontal and vertical coherence and efficacy that underlie the implementation arrangements for the AMCOW Strategy 2018 – 2030 shall be upheld and reflected in ongoing regular and annual work plans for the programme.

The AMCOW Secretariat and the regional nodes of the AU-NEPAD African Network of Centres of Excellence in Water Sciences and Technology (CoEs) – SANWATCE, WANWATCE and CEANWATCE – alone, however, cannot impact all the HCD priorities outlined in The demand for human capacity development in the water sector is defined by the role water plays in Africa's ambitions for socio-economic development as elaborated in Agenda 2063. To the extent that every sector of the economy is influenced by water, the realisation of sustained economic growth and social transformation in Africa is dependent on ensuring water security. The observed trends in Africa's population growth; urbanisation and lifestyle changes have implications for water demands. The anticipated impacts of climate variability and climate change will ravel the form, intensity and timing of water demand; affect water availability; and increase the risk of water-related hazards. A high level of technical ingenuity is, therefore, required to develop the requisite water infrastructure base to release Africa's development potential. A similar level of social ingenuity is also required to adjust to water scarcity and prepare for the adverse impacts of climate change.

Ergo, the need for improved water wisdom. First, to cope with and compensate for the consequences of the anticipated changes in water demands in all economic sectors. And, more importantly, to reliably satisfy those demands to deliver robust, competitive and climate resilient economies; and inclusive socio-economic development and livelihoods improvement.

Implementation of the decision of the Executive Committee of AMCOW – EXCO/11/2013/CAIRO/17 – to *"…develop a Human Capacity Development Programme aimed at addressing junior professional and technician level capacity challenges in the water sector"* reflects the broad continental sentiment to underpin aspirations of a prosperous Africa on a skills driven revolution. The African Union Specialised Technical Committee on Education, Science and Technology (STC-EST) is mandated to develop the requisite human capital to sustain the vision of an integrated, prosperous and peaceful Africa. To this end, the STC-EST is spearheading implementation of strategic reforms in the education and training sector as highlighted in the preceding chapter. These are broadly categorised into:

5. science, technology, innovation and skills development;
6. application of space science and technology;
7. technical and vocational education and training (TVET); and,
8. non-formal and informal education and training (NFET).

The HCD programme – and the overall drive to improve water wisdom – represent one of the facets of the STC-EST's mandated revolution to a knowledge-based and productive society. And as such, the water sector HCD priorities presented in Table 4 are identified within the framework of the strategic reforms in the education and training sector.

The table also provides a list of key partners and stakeholders contributing to and or influencing implementation of specific reform themes. The specific roles of key strategic partners in the reform process are summarised in Figure 2 and reiterated in Appendix I.

Table 4. The AMCOW Secretariat is, therefore, committed to leading by example and will continue cultivating partnerships with the European Commission's Joint Research Centre (EC-JRC), UNESCO-IHP, as well as other organisations and entities interested in supporting implementation of different elements of the HCD priorities.

Furthermore, due cognisance is taken of the need to align pursuit of the identified HCD priorities with ongoing implementation of the strategic and operational plans of the individual centres of excellence within the network. The ACE-WATER II project – and or its successor intervention – will thus aim to build synergies and complementarities, and – above all – strive to avoid duplication of efforts, while making optimal use of available resources to maximise results and impacts.

4.1 Implementation Arrangements

Table 5 presents the hierarchy of roles within the implementation, monitoring and evaluation framework for the AMCOW HCD programme.

Table 5: Implementation structure

Level	Role
AMCOW Secretariat	1. mobilise political leadership for the HCD Programme to address junior professional and technician level capacity challenges in the water sector in Africa 2. provide over-arching programme oversight and institutional coordination 3. provide leadership in formulation, implementation and monitoring of strategic operational plans 4. ensure effective liaison with, and two-way information flow on programme implementation among AU Member States, RECs, RLBOs and implementing and funding partners
AMCOW Governing Council **African Union Commission (AUC)** **European Commission (EC)** **Relevant organs of RECs and RLBOs**	1. Leverage high level political support for the realisation of water sector HCD priorities 2. Leverage financial, technical and material resources from a variety of sources including the private sector
EC Joint Research Centre (EC-JRC), UNESCO-IHP	1. Provide HCD Programme support 2. Provide ACE-Water project management oversight and accountability for resources and results 3. Prepare progress reports for the consideration of the policy organs of AMCOW as well as the relevant organs of the African Union and the European Union 4. Monitoring, evaluation and reporting on the HCD Programme to the AMCOW Secretariat as well as funding partners 5. Provide support to resources mobilisation and technical backstopping to regional networks
Regional Networks – SANWATCE, WANWATCE and CEANWATCE	1. Coordinate the preparation and implementation of complementary work programmes and work plans among constituent centres of excellence 2. Develop an appropriate M&E system and indicator framework for monitoring pursuit of HCD priorities at all levels 3. Coordinate regular reporting to AMCOW, RECs, RLBOs and partners 4. Coordinate resources mobilisation activities
Individual Centres of Excellence	1. Technically facilitate development, coordination and implementation of strategies and action plans to achieve water sector HCD priorities at national level

Level	Role
	2. Ensure mainstreaming of water sector HCD priorities into national planning processes 3. Engage national and regional level actors towards implementation of priorities 4. Resources mobilisation 5. Manage the monitoring and evaluation cycle 6. Provide inputs for periodic reporting, budgeting, and accountability at all levels 7. Provide technical backstopping to national level actors

4.2 Stakeholders Engagement

The AMCOW Secretariat has over the years established and maintained mechanisms for building partnerships with stakeholders and other actors – particularly with the Member States, AUC, AUDA-NEPAD, RECs, R/LBOs and partners – in advancing Africa's water and sanitation agenda.

The African Union Commission (AUC) and the African Union Development Agency (AUDA, formerly the NEPAD Planning and Coordination Agency – NPCA)**:** mechanisms are in place for regular consultation, joint planning and operationalisation and review on water issues. Similarly, various fora exist for engagement with the Regional Economic Communities (RECs) and River and/or Lake Basin Organisations (R/LBOs) to ensure seamlessness between regional priorities and Africa's continental agenda. In addition, and as stipulated in the ongoing reforms of the African Union, the RECs and AUDA will play a leading role in efforts to integrate continental and regional strategy, policy and legal frameworks into national development plans and laws; as well as ensuring implementation, monitoring and evaluation at national level.

On relationships with other **AU Organs**, the AMCOW Secretariat – through both the AUC Department for Rural Economy and Agriculture (DREA) and the Specialised Technical Committee on Agriculture, Rural Development, Water and Environment (STC-ARDWE) – has been closely working with the Permanent Representatives Committee (PRC) on various policy matters relating to implementing its mandate. This includes leadership of the sub-committee on Water and Sanitation of the STC on ARDWE to spearhead implementation of related programmes.

Outside the AU, the partnership with EC-JRC and UNESCO-IHP has been instrumental in mobilising technical and financial resources to support implementation of the HCD programme. Continuity of these arrangements is expected in the course of implementing the ACE-Water II project, as well as soliciting new commitments for partners to contribute to efforts pursue the identified water sector HCD priorities. In the same vein, deliberate measures shall be taken to fully implement existing and new engagement plans to realise agreed results to the mutual benefit of all the partnering organisations.

4.3 Monitoring, Evaluation and Reporting

The AMCOW Strategic Operational Plan 2019-2024 (AMCOW SOP) details a monitoring and evaluation framework. The framework is guided by the principles of:

- participation by all to ensure joint ownership of processes and outcomes;
- transparency to ensure openness and support consistent and convergent behaviour by all parties;
- accountability assigned to technical and implementing partners; and,
- SMART indicators and targets.

It specifically intends to:

i. provide information on an annual basis to the policy organs of AMCOW on progress towards the level of attainment of the anticipated results/milestones;
ii. serve as the platform for regular review and updates of the inputs, actions, outputs, indicators and the targets;
iii. enhance evidence-based decision making at operational level; and,
iv. link results/outputs to resources (human and financial) expended – to ensure operational efficiency.

The ACE-Water project will facilitate monitoring of progress towards attainment of the relevant capacity development targets of the AMCOW Strategic Operational Plan 2019-2024. This will include analytically monitoring:

i) the inputs from the centres of excellence;
ii) the breakdown of the outputs/deliverables; and,
iii) the financial resources associated with each supported activity.

In doing this, emphasis will be placed on monitoring and evaluating the project's contribution to the HCD programme in terms of Relevance, Efficiency and Effectiveness.

4.4 Implementation plan

The European Commission Joint Research Centre (EC-JRC), in collaboration with the UNESCO-IHP, will be responsible for:

i) coordinating elaboration of both a comprehensive strategy, and an action plan to achieve the identified water sector HCD priorities; and,
ii) operationalising a monitoring and reporting system.

Oversight in this process, as well as facilitation of reporting to the policy organs of AMCOW and the African Union shall be provided by the AMCOW Secretariat, with support from relevant administrative structures of participating RECs and RLBOs.

4.5 Enabling conditions

Targeted and concerted actions are underway to leverage the political commitment and aspirations of AMCOW, the AU and the EU towards ensuring provision of the enabling conditions that follow:

i. Buy-in from key stakeholders based on demonstrated value addition of the HCD programme to their interests. In this regard, the need cannot be overemphasised for the formulation and implementation of a sustained advocacy and awareness creation campaign.
ii. Commitment by Member States to the implementation of the required institutional interventions, reforms, and sector investment.
iii. Operational efficiency, synergy and effective coordination of implementing arrangements among and within all centres of excellence and implementing partners.
iv. Adherence to the principles of prioritisation, accountability and transparency, harmonisation, subsidiarity and complementarity within the AU-NEPAD African Network of Centres of Excellence in Water Sciences and Technology (CoEs) and between the AUC, AMCOW-Sec, AUDA-Nepad, RECs and RLBOs.
v. Aligned, effectively coordinated and harmonised support by partners.
vi. Existence of a robust Monitoring and Evaluation mechanism
vii. Enhancement of the HCD programme management staff complement commensurate with the requirements for partners' coordination and technical facilitation.

5. Conclusion and Recommendations

The summary recommendations that follow derive from the review of the relevant continental and regional policies and strategies highlighted in Section 2 of this report.

5.1 Skills, technological empowerment, e-education and adaptive learning

These elements should underlie implementation of the Water Sector HCD priorities. The focus should be to build critical skills – particularly as relates to sustainable development, utilisation and management of water and related resources – to enhance economic growth and social transformation.

It is, thus, imperative to grow and strengthen the AU-NEPAD African Network of Centres of Excellence in Water Sciences and Technology (CoEs) into a fully functional, Africa-wide knowledge and excellence network fostering opportunities for development and water knowledge sharing across all AU Member States. The CoEs should, in turn promote innovation to tackle challenges of labour market skills mismatch; and low productivity. They should equip African youth with flexible skills needed for tomorrow's job market through facilitating the development of such new skill profiles as digital water management specialists and green/smart water use technologists.

5.2 Foster transformation in Technical and Vocational Education and Training (TVET)

Invariably, all continental and regional policy and strategy documents reviewed for this study emphasise the need to integrate flexibility, adaptability and continuous learning in education and training supply. As such, transformation of the TVET sector is necessary to make it suited to impart skills in all areas of training and learning, be they formal, informal or non-formal. This is vital to improve employability, relevance and distribution of the workforce.

Key first steps for the water and sanitation sector include:

1. Developing and instituting officially recognised vocations for the water and wastewater sectors.
2. Raising the level of prestige and attractiveness of sanitation related occupations in particular (waste disposal, wastewater management), as well as eliminating gender inequities.
3. Review of curricula to facilitate water sector skills development from the basic level to the higher education level.

5.3 Support space science and astronomy research, teaching and outreach

Potential abounds for the application of space science and technology to improve the quality of life and the create wealth for all in Africa. This includes:

i) monitoring and conducting assessments of the environment;

ii) managing the use of natural resources;

iii) providing early warnings of and managing natural disasters; and,

iv) providing education and health services in rural and remote areas.

In essence, space-based solutions are necessary for the effective management of resources such as water, land, forests, marine ecosystems and their productive utilisation. Indeed, many of the space-derived services and products currently used in Africa are imported.

To actualise the vision of "*an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena",* the development of indigenous capacity to operate and maintain core space capabilities cannot be overemphasised. For the water sector, the implications are clear and germane. Developing remote sensing and earth observation capabilities will enhance the effectiveness of early warning systems. In turn, this will

i) improve related disaster risk preparedness;

ii) assure water, energy, food and ecosystems security; and, therefore,

iii) ensure climate resilient development.

Against the background of the foregoing, the NEPAD-CoEs should – through the HCD Programme – champion:

i. the development of skills and expertise in earth observation and remote sensing applications and their use;
ii. the development of earth observation services and products;
iii. development of specialised curricula, materials and teaching aids to introduce:
   - space science teaching and research at universities; and,
   - space science and astronomy teaching and outreach at primary and secondary education level
iv. awareness raising among the public, users, and policy and decision makers; and,
v. knowledge sharing among African experts, users and stakeholders

5.4 Recognition of competences from non-formal and informal education and training (NFET)

There is an urgent need to mainstream indigenous water and pollution management knowledge into lifelong learning systems through:

i. adopting a competence-based approach to curriculum reform within a lifelong learning framework;
ii. improving understanding of, and responding to the demands for individual, community and societal core skills and competences;
iii. creating more opportunities for adult education and community learning opportunities (including NFET schools); and,
iv. tapping into existing technological preferences, cultural practices, local values and traditions of community learning and imparting of life skills.

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Appendix I: Roles of key strategic partners in the pursuit of water sector HCD priorities

	Category of key strategic partners	Mandate/Role in Africa's Human Capital development aspirations
1	• African Union Specialised Technical Committee on Education, Science and Technology • African Union Specialised Technical Committee on Agriculture, Rural Development, Water and Environment	Specialised technical committees of the African Union mandated to: i) harness opportunities and synergies; and, ii) ensure complementarity – if not harmonisation – in the formulation and implementation of continental policies, strategies and interventions across water, education and related sectors. They are policy level organs of the African Union with technical coordination structures supported by the relevant department of the African Union Commission, namely: the department of rural economy and agriculture (ARDWE); the department of science, technology and human resources management (EST); the office of the Legal Counsel
2	African Union Development Agency (AUDA-NEPAD)	The development agency of the African Union, coordinating and executing priority regional and continental development projects to promote regional integration towards the accelerated realisation of Agenda 2063 – Africa's vision and action plan. Mandated to strengthen capacity of Member States and regional bodies.
3	Regional Economic Communities	Recognised as the building blocks of the African Union. There are eight, namely: AMU, CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD and SADC. They are responsible for the implementation of the regional integration agenda towards the realisation of: i) trade and market integration; ii) macro-economic policy convergency; iii) free movement of persons; iv) peace, security, stability and governance; and, v) harmonisation of sectoral policies. These goals constitute the pillars of the African Union vision.
4	African Ministers' Council on Water (AMCOW)	Leadership of the sub-committee on Water and Sanitation of the STC on ARDWE. Mandated to implement the Human Capacity development programme for the water sector
5	• Association of African Universities (AAU) • African Scientific, Research and Innovation Council (ASRIC) • African Observatory of Science, Technology and Innovation (AOSTI) • Pan African Intellectual Property Organization (PAIPO) • Regional African Satellite Communications Organisation (RASCOM) • African Resource Management Satellite Constellation (ARMC) • African Remote Sensing Council • African Association of Remote Sensing and Environment (AARSE) • African Regional Data Cube (ARDC) • Association for the Development of Education in Africa (ADEA) • African Network for Agriculture, Agroforestry and Natural Resources Education • Higher Education Council for Africa and Madagascar (CAMES)	Technical level specialised coordinating organisations spearheading implementation of reforms and adaptation of the education sector to meet the related demands of achieving the goals of Agenda 2063

	Category of key strategic partners	Mandate/Role in Africa's Human Capital development aspirations
	• African Medical and Research Foundations (AMREF) • African Group on Earth Observations (AfriGEOSS) • Pan-african Institute of Education for Development (IPED) • Educational Research Network for West and Central Africa (ERNWCA) • Commonwealth of Learning (COL) • Forum for African Women Educationalists (FAWE) • Global e-Schools and Communities Initiatives (GeSCI) • International Research and Training Centre for Rural Education (INRULED) • Organisation Internationale de la Francophonie (OIF) • Africa Network Campaign on Education for All (ANCEFA) • Family Literacy Project (FLP) • Pan African Association for Literacy and Adult Education (PAALAE) • Reading Development Library (BLD) • Literacy and Adult Basic Education (LABE • Association for the Development of Education in Africa (ADEA)	
6	• Pan African University • African Centre of Meteorological Application for Development (ACMAD) • African Regional Institute for Geospatial Science and Technology (AfRIGST) • All Nations University Space Systems Technology Laboratory (ANUSSTL) • Africa Regional Centres for Space Science and Technology Education (ARCSSTE) • International Institute for Space Sciences and Electronics (INISSE)	Academic and Research institutions mandated to produce world class human resources through high quality post-graduate education and research to drive the developmental imperatives of the continent to meet the aspirations of Agenda 2063
7	• NEPAD Water Centres of Excellence	Mandated to support capacity development, research and innovation in water and sanitation in Africa
8	• UNESCO International Institute for Capacity Building in Africa (IICBA) • UNESCO Regional and National Offices and National Commissions for UNESCO in Africa • UNICEF	UN Agencies with mandates related to realisation of sustainable development goals relating to water, sanitation and education
9	• Member States' public and private research and education structures/networks • Civil Aviation Authorities • Private Sector	Beneficiaries and key users of the outputs of interventions at various levels. Interventions should be responsive to their needs. They are also a vital feedback loop in assessing impact of interventions.

	Category of key strategic partners	Mandate/Role in Africa's Human Capital development aspirations
	• Civil Society • Various NGOs working on teacher education and development	
10	• Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).	Funding and or implementing agencies