

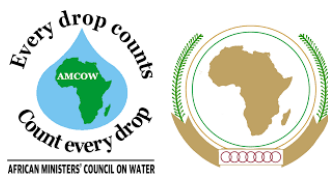
Groundwater resources management Online Course

Training Report 2022



January 2023

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This document reports on the online course entitled Groundwater Resources Management that took place in 2022. The course was financed by Federal Institute for Geosciences and Natural Resources (BGR), Germany. This is the first of two documents – the second reports on the online course Professional Drilling Management. Both reports can be downloaded from <https://www.rural-water-supply.net/en/>, <http://agw-net.org/> and <https://ask-for-water.ch>.

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In the past 10 years, several face-to-face 5-day short courses on Groundwater Management have been run in the regions of West, East and Southern Africa. They were implemented by AGW-Net, with the support of Cap-Net/UNDP along with partners like BGR, IAH/Burden Network, Senegal River Basin Organisation (OMVS), SADC-GMI, Coordination Régionale des Usagers et Usagères du Bassin du Niger (CRU-BN), among others.

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Summary

Thanks to funding from the Federal Institute for Geosciences and Natural Resources (BGR) in Germany, 2022 saw the online course on groundwater, targeting about 250 participants. The course, which ran over a four-month period (29th April to the end of August 2022), was developed, and implemented for water professionals, together with the partnership of about 40 key stakeholders from the water and higher education sectors.

The 2022 online course on groundwater resources management provides participants with a comprehensive overview of the multiple factors that impact upon groundwater. It was a self-paced course and was hosted on the virtual campus of Cap Net/UNDP. It comprised 5 modules; each one had a short introduction, goal, learning objectives and orientation video, as well as mandatory videos and reading materials. To progress to the next module, participants had to score at least 60% in a multiple-choice quiz.

There is clearly demand for this type of learning, with over 800 applications received rendering the selection process rather difficult. The courses have been designed for 250 participants. In terms of selection, government officials were prioritised, and make up half of the selected participants. Women were also prioritised, and so, despite being a male-dominated profession, over 20% of course participants for the course were female – an achievement indeed.

A total of 261 applicants were eventually selected and invited to the course. However, 196 of them have signed in the virtual platform; they came from 60 countries, of which 33 are located within Africa. At the end of the course 124 participants successfully completed the course.

In each module there was a discussion forum to trigger participation with a set of open questions defined to motivate an interaction amongst course participants. The course evaluation survey has shown that participants well appreciated the relevance of the course and the knowledge they gained, as well, their expectation has been met.

Introduction

Thanks to funding from the Federal Institute for Geosciences and Natural Resources (BGR) in Germany, 2022 saw two online courses on groundwater, targeting about 500 participants in total. The two courses, entitled **Groundwater Resources Management** and **Professional Drilling Management** were hosted by Cap-Net UNDP ¹ and managed by the African Groundwater Network (AGW-Net) and Ask for Water GmbH.

The courses, which each ran over a four-month period, were specifically developed for professionals working on groundwater resources management and the management of water well drilling projects, as well as those responsible for decision making. The training was offered free of charge to all participants, with the aim of building the capacity of government, NGO, and private sector staff, as well as academia in African member states and beyond.

This document reports on the 2022 Groundwater Resources Management online course. An accompanying course manual is also available for download. ²

Partnership

Both 2022 groundwater online courses benefitted from the establishment of an advisory group, which brought together about 40 key stakeholders from the water and higher education sectors. The members provided expertise for the content, and methodology of the course, raised awareness of the initiative and stimulated interest in building professional capacity and raising 'groundwater literacy'. The courses were reviewed, co-facilitated and supported by partner organisations as shown in the logos below. Annex 1 provides the list of the reviewers, lead and co-facilitators of the course.



¹ <https://cap-net.org/grm/>

² GROUNDWATER RESOURCES MANAGEMENT - ONLINE COURSE - a Training Manual, Africa Groundwater Network (AGW-Net), Federal Institute for Geosciences and Natural Resources (BGR), African Ministers Council on Water (AMCOW), UNDP Cap-Net, Ask for Water GmbH & Partenariat National de l'Eau du Sénégal. <https://doi.org/10.13140/RG.2.2.15060.07043>

1. The need for training on ‘Groundwater Resources Management’

An estimated 50% of the global and 75% of the African population rely on groundwater for their drinking water supplies. Groundwater supports social and economic development and will become increasingly important in the face of climate change, as groundwater resources are often less affected than surface water by climate change impacts. If groundwater is to provide reliable, safe and sustainable water supplies now and for future generations, the resource must be well-managed. This requires consideration of the entire system of policies & laws, strategies & guidance, monitoring & management as well as investments & projects. Good groundwater management needs sound capacities in water authorities. But at same time, as many elements of groundwater management fall in other sectors, a general understanding of groundwater management principles in sectors like agriculture and urban planning is key for its successful implementation. Therefore, the present course is also aimed to provide an introduction to groundwater management to professionals from other key sectors.

Furthermore, professional drilling of boreholes must also be considered, while water wells are vital to achieving universal clean drinking water, providing safe, affordable, reliable and available water sources. Unfortunately, due to a lack of training and mentoring opportunities, in many countries, it is difficult to develop skills and to raise awareness in this area. According to SDG6 monitoring data, groundwater management capacities lack behind those of surface water in many countries, especially in Africa.

While this online course is no substitute for face-to-face training, it does provide a relatively low-cost way to introduce a large number of professionals with a thirst for knowledge to the main aspects of groundwater resources management.

2. Course preparation

2.1 Planning of the online course

In terms of timeline, the Groundwater Resources Management run from 29th April to 29th Aug 2022. The announcement for the groundwater management course was sent out on the 22nd of March and open to Monday 11th April with successful participants informed by the 22nd of April. The whole process will continue until 2023 with the post course evaluation, as shown in the chart below, and the following activities were scheduled (Table 1):

- Planning and establishment of an advisory group
- Manual content preparation and review
- Course announcement and selection process
- Implementation of the online course
- Promotion of the course which started on March 22nd coinciding with the World Water Day dedicated to Groundwater, during a special session of the World Water Forum in Dakar.
- Post-course evaluation.

The overall output and related activities are summarized in Annex 2.

Table 1: Course activities planning

Activities	2022												2023	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Contract Preparation and Planning, Advisory group established and meeting regularly														
Prepare groundwater course manual														
Groundwater management course announcement & participant selection														
Groundwater Management Course Running														
Ex-post evaluation														
Promotion & events														

The course comprised 5 modules that were launched from 29th April to 29th Aug as shown below (Table 2). Once open, each module remained accessible until the end of the course.

Table 2: Modules schedule

	2 - 8 May	09 - 16 May	16 - 22 May	23 - 29 May	30 May - 5 June	6 - 12 June	13 - 19 June	20 - 26 June	27 June - 3 Jul	04 to 17 July	18 - 31 July	1 - 14 Aug	15 - 29 Aug
Module 1													
Module 2													
Module 3													
Module 4													
Module 5													
Key	Module Opens												
	Course will still be open but less interaction expected												

All modules were undergone peer reviewing, the table below gives details about resources persons involved in the review process as well as the facilitation (Table 3). Facilitators are presented in detail in Annex 1.

Table 3: List of lead-facilitators and co-facilitators

Module	Developer & Lead	Reviewers	Voluntary co-facilitation
1.	Martin Eduvie	Jorge Alvarez Sala, Tara Bartnik, Johannes Münch	Mahamadou KOITA, Alan MacDonald, Brighid Ó Dochartaigh, Moshood TIJANI, Johannes Münch
2.	Diana Mudimbu	Brighid Ó Dochartaigh, Arnaud Sterckx/Elisabeth Lictevout, Michael Eichholz	Bentje Brauns, Dan Lapworth, Arnaud Sterckx/Elisabeth Lictevout, Michael Eichholz
3.	Kawawa Banda	Florence Tanui	Harinaivo Anderson ANDRIANISA, Dan Lapworth, Florence Tanui
4.	Callist Tindimugaya	Jenny Grönwall, Levy Museteka, Michael Eichholz	Jenny Grönwall, Michael EICHHOLZ, Michael Eichholz
5.	Callist Tindimugaya	Jorge Alvarez Sala, Arnaud Sterckx/Elisabeth Lictevout	Levy Museteka, Alexandros Makarigakis, Arnaud Sterckx/Elisabeth Lictevout
	Moustapha Diene	Course manager	

2.2 Advisory group set up

An advisory group was formed. It brings together about 40 key stakeholders, mainly the water and higher education sector. The purpose of establishing the group was to draw on expertise for the content, and methodology of the courses, raise awareness of the initiative, foster ownership and stimulate interest in building professional capacity and raising 'groundwater literacy' with a view to uptake of training in the future.

Membership was reasonably gender balanced, with 13 women, and comprise all types of stakeholders (i.e., national governments, research institutions, multilateral and bilateral donor agencies, UN Agencies, NGOs and the private sector). The group meets every six to eight weeks with a rotating facilitator selected from the group. Through engagement with, and steering of the initiative from the outset, it was envisaged that the understanding of the need (and funding mechanisms) for groundwater capacity strengthening will be stimulated. In this line, a sub-group on future financing of the course was also established.

3. Course content and learning methods

The 2022 online course on groundwater resources management provides participants with a comprehensive overview of the multiple factors that impact upon groundwater. It set out to equip participants with knowledge on some major aspects of groundwater management: aquifer system characterization, groundwater monitoring & data use for management and communication, groundwater protection & the risk of pollution and quantity impairment, groundwater regulation and licensing, and the concept of transboundary aquifers, along with approaches and mechanisms for sustainable management. The five course modules are summarised in Box 1.

The course was hosted on the virtual campus of Cap Net UNDP, which currently uses software provided by edX³. The virtual campus enables participants to work scroll through text, watch embedded videos and read embedded texts, which can also all be downloaded. As set out in the course manual², each module had a short introduction, goal, learning objectives and orientation video, as well as mandatory videos and reading materials. In order to be able to progress to the next module, participants had to score at least 60% in a multiple-choice quiz for each module, comprising ten questions. Participants could take each quiz three times.

Additional recommended videos, reading and websites were also provided. However, the mandatory materials provide all the information needed to pass each quiz. Participants were also encouraged to respond to questions in a discussion forum, which is where the co-facilitators were able to respond and interact with the participants.

The course was self-paced, and participant led. Registration and modules commenced in late April 2022 and following an initial two-week period for participants to settle in, modules 2 to 5 were each opened one week after the other. The course remained open for four months in total, and so participants were able to progress at their own pace once all of the modules were open.

Participants did not have to undertake any assignments to pass the course. While this did limit the interaction with the facilitators, particularly to provide additional guidance, it meant that

³ <https://www.edx.org>

more participants could take the course. Marking of assignments by facilitators takes time and comes at a financial cost.

Engagement with the co-facilitators was possible in the discussion forum. Co-facilitators, working on a voluntary basis provided one to two hours per week to review and respond to the comments in the discussion forum.

Box 1: Groundwater Resources Management online course - overview of the five training modules

Module 1- Characterization of Aquifer Systems from a Management Perspective. The module has provided an introduction to:

- importance of aquifer characterization in groundwater resources management
- key properties of aquifers for better groundwater management
- differences of hydrogeological environments in relation to groundwater development
- groundwater occurrence and interaction between groundwater and surface water.

Module 2: Groundwater monitoring and data/information management & communication. The module has shared understanding of:

- the different objectives of groundwater monitoring and the importance of a target-oriented monitoring system
- the monitoring and information management processes and the tools used in information management.
- why and how to monitor groundwater levels, abstraction and quality
- the importance of information management outputs and how they can be disseminated
- the importance of communication amongst stakeholders in cost-effective management.

Module 3: Groundwater quality and source water protection. In this module participants will be capacitated to understand to:

- appreciate potential sources of groundwater pollution risk
- know methods for protecting groundwater quality and quantity
- understand the role of risk assessment and vulnerability mapping in managing groundwater quality.

Module 4: Groundwater regulation, licensing, allocation and institutions for aquifer management. By this module, it was expected from participants to:

- become aware of the rationale and benefits of groundwater regulation,
- understand how groundwater licensing and allocation systems are implemented,
- understand the provisions and conditions attached to licensing and water allocation systems, and
- appreciate the need for institutional frameworks for aquifer management to regulate use of groundwater resources.

Module 5: Transboundary aquifers in Africa: Approaches and mechanisms. This module made participants understand:

- the concept of transboundary groundwater and its management issues
- the location and extent of transboundary aquifers in Africa
- the legal frameworks for the management of transboundary aquifers
- the current management issues and approaches applied to transboundary aquifers.

4. Applicants and participants

4.1 Application process

The course was designed for professionals who are already engaged in water resources management or in drinking water supply in low- and middle-income countries. Participants were expected either to be already involved in groundwater management initiatives or to be working in this area in the future one to three years. Targeted participants include government, NGO, UN and donor organisation staff, as well as those working in the private sector. They may be also working in development or humanitarian aid/emergency contexts.

The call for course applicants launched on 22nd of March, and was widely promoted through social media (LinkedIn and Twitter), as well as directly to mailing lists, websites and through the networks of the course partner organisations.

There were 871 applications in total, of which 51 were duplicates. Thus, 820 people applied for the course through the application process. There was intent to also have a number of additional nominations through AMCOW, but the time was short to complete the process. Of the applicants, 84% were male, and 61% were from Africa.

4.2 Applicant selection and participation

The selection criteria gave priority to female participants with a target of 30%, and an emphasis on youth and mid-career professionals (26-55), with 150 out of the targeted 250 participants to be based in Africa or be nationals of African member states. Priority was also given to government staff. Combining all four criteria has provided high proportion of male applicants (71%) and relatively low proportion of government staff applicants (28%).

Finally, nearly 50% of participants invited were from public institutions, comprising government, water utility or river basin organisation staff, 73% were from Africa, and 32% were women. A number of 232 applicants were eventually invited to the course; however, not all of them have completed registration process on the virtual campus, by filling in their profiles, that is a requirement to start the course.

Among invited applicants, 196 signed into the virtual platform, and 124 successfully completed the course, and generated their certificate. The completion rate, the ratio between participants that completed their profile and those completing the survey and downloading their certificates, is high at 60%.

Table 4: Breakdown of applicant and participant type

Type	Details	Invited		Active	
		No	%	No	%
Gender	Man	152	66%	127	65%
	Woman	75	32%	64	33%
	I'd rather not say	3	1%	3	1%
	Other	2	1%	2	1%
	Don't know	0	0%	0	0%
	Total Gender	232	100%	196	100%
Region	Africa	170	73%	150	77%
	Non-Africa	62	27%	46	23%
	Total Region	232	100%	196	100%
Institution	Government	102	44%	85	43%
	Water Utility Entity	13	6%	8	4%
	River Basin Organisation	0	0%	0	0%
	Water Regulatory Commission	0	0%	0	0%
	Total Government	115	50%	93	47%
	Non-Governmental Organisation/Civil Society	27	12%	24	12%
	Academia/Research/Education	28	12%	25	13%
	Private Sector	26	11%	24	12%
	UN/Inter-Governmental Organisation	29	13%	25	13%
	Humanitarian Organization	1	0%	0	0%
	Independent Professional/Community Member	5	2%	4	2%
	Student	0	0%	0	0%
	Other	1	0%	1	1%
	Total Institution	232	100%	196	100%

4.3 Scoring and certificates of participants

This online course included a quiz by the end of each module. Participants usually had up to three chances to submit their responses with an approval rate set to 60% correct responses. It is worth noting that quiz was a prerequisite to move on to next module. Once a module was open, it remains open till the end of the course. Each module had a forum discussion, and participation of each forum was mandatory.

Participants who satisfied all listed above requirements were granted with a certificate of successful participation.

4.4 Profiles of participants

The registered participants came from 60 countries, of which 33 are located within Africa (Figure 1). The share per nationality has shown major attendance was from Eastern and Southern Africa (Figure 2); other parts of the world are also represented, mostly from Asia and South America, making the participation worldwide.

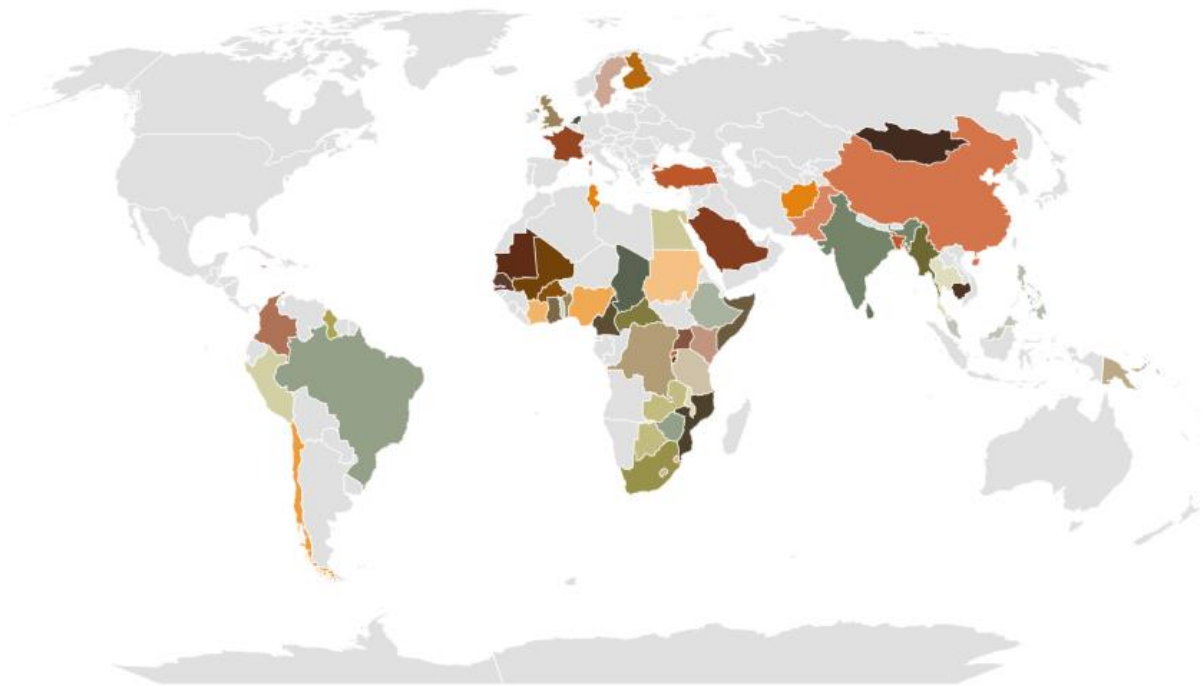


Figure 1: Map showing countries of registered participants

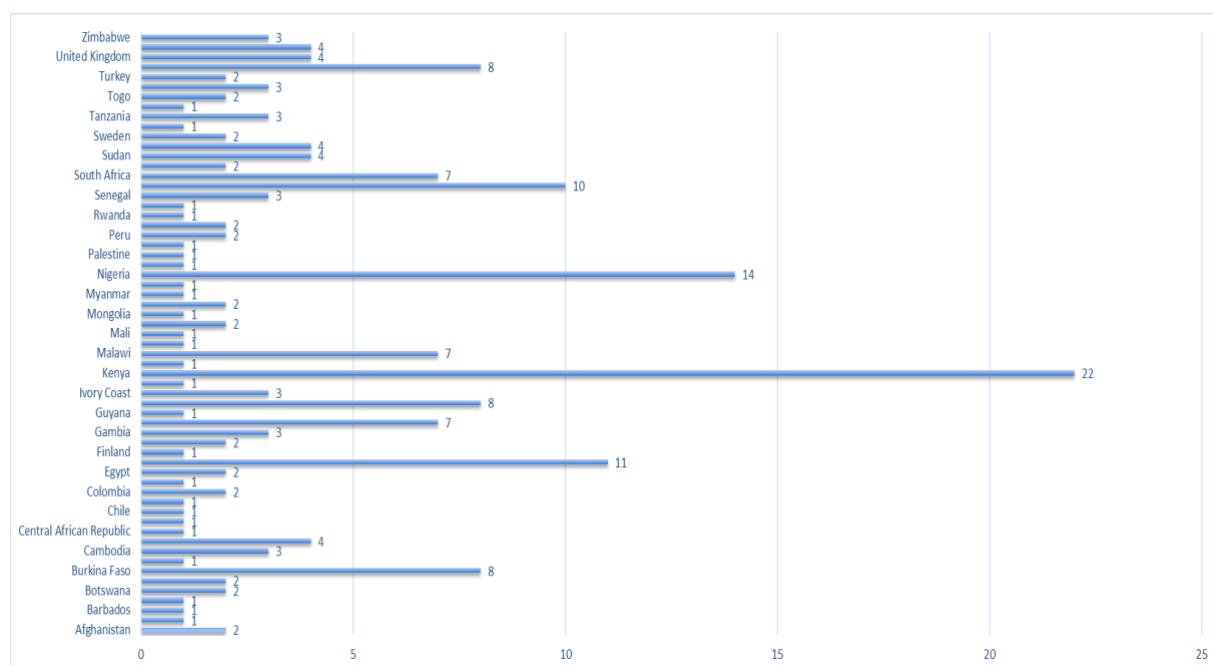


Figure 2: Distribution of participants by nationality

Participants were in their majority mid-terms carriers professional with more than 90% aged over 26 (Figure 3). They didn't have high background in groundwater since more than 60% stated having medium knowledge and as 23% experienced low knowledge on subjects related to groundwater topics (Figure 4). In fact, the profiles of participants were very diverse with a large array of background and scope of work, with the majority working on national scale, most in public or para-public institutions.

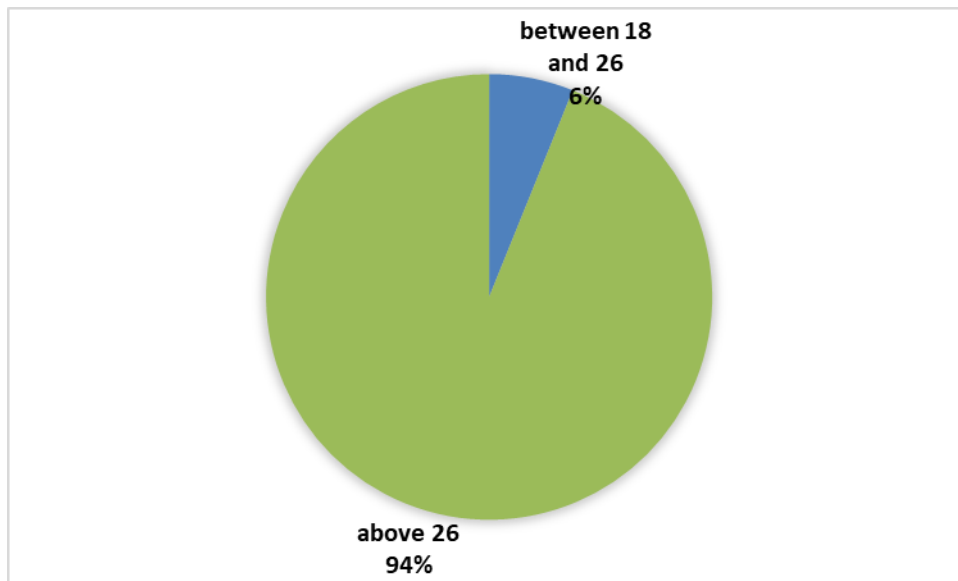


Figure 3: Age group of participants

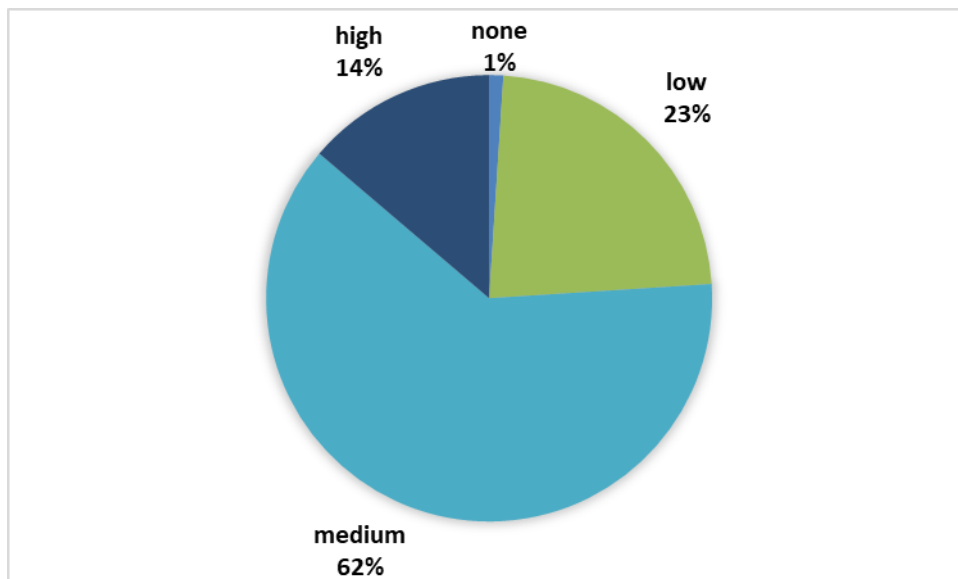


Figure 4: Knowledge/expertise of participants related to this course's theme and contents

5. Reflections from Forum discussions

Forum discussion is one of the main components of the online course, it is intended to trigger participation. Each module included a discussion forum with a set of open questions defined to motivate an interaction amongst course participants. The participants were invited to share their thoughts and experiences on one or more of those questions.

In the following, a summary will be made of what came out from the different discussion forums, module by module.

5.1 Participants' exchange in Module 1

In module 1, the first question to be discussed was as below:

1) Aquifers and geological formations are very relevant in groundwater systems characterization. Using your country as a case study, what are the main occurring hydrogeological features?

Participants were given opportunities to appreciate the importance of aquifers characteristics in groundwater management and to share the hydrogeological environments occurring in their country, if they already have knowledge about these, otherwise they were encouraged to find information. Not all participants have responded to the question, but those who participated in the discussion were from 13 countries, as summarized below:

Country	Main hydrogeological features
Burkina Faso	Burkina Faso, 80% of the country area is made up of a block of crystalline formations of Paleoproterozoic to Mesozoic. 20% is sediments of the Taoudéni basin on the south-eastern border and the Voltaian basin on the northern border
Cameroon	90% of the country is made up of hard rock aquifers which are plutonic and metamorphic rocks and the rest by sedimentary rocks
Colombia	23 hydrogeological provinces are identified, of which 16 are in sedimentary basins, The largest amount of groundwater is related to the large sedimentary basins existing in the country
Ethiopia	In Ethiopia, unconsolidated sediments (Alluvial), fractured volcanic rocks and consolidated sedimentary rocks are the main occurring hydrogeological features
India	India has large area with variety of consolidated, semi consolidated and unconsolidated formations.
Jamaica	In Jamaica, volcanic and volcanoclastic formations of the Cretaceous age form the geological basement and outcrop as inliers along the center of the island occupying 25% of the land area. Limestones of Tertiary age cover 60% of the island and Alluvium covers 15% of the island
Kenya	The Hydrogeological formation in Kenya is majorly Sedimentary - Unconsolidated and Semi consolidated; the other major hydrogeological formation is the Igneous Volcanic, occurring along the Great rift valley and that has water of poor quality with high fluorides rates
Lebanon	About 65 % of the surface area is covered with carbonate karstic formations
Malawi	Malawi geology is complicated but composed of pre-Cambrian formations and Precambrian crystalline basement rocks, overlain by more recent sedimentary rocks or volcanic rocks
Mozambique	In Mozambique there are four main lithostratigraphic groups: Precambrian Crystalline rocks of the Basement Complex (57%), Karoo sedimentary rocks (5%), Post Cambrian volcanic and igneous rocks (3%) and Meso-Kenozoic sedimentary rocks (35%)

Country	Main hydrogeological features
Nigeria	Crystalline basement rocks cover about 50% of Nigeria while sedimentary rocks cover the other 50.
Somalia	Main hydrogeological main Aquifers are made of sedimentary formations: consisting of limestone, evaporitic, sandstone
Uganda	The country's main hydrogeological units are mostly the pre-Cambrian crystalline rocks, sedimentary deposits in the northern, central part Uganda and the superficial deposits in some part of central Uganda

The second question was:

2) Considering the interaction between groundwater and surface water in your country, which natural processes or human activities affect these interactions?

The idea was to make the participants aware about interaction between groundwater and surface water and to exchange knowledge on process either natural or anthropogenic that can interfere in these interactions. Participants were provided opportunities to share or to discuss what they know about this topic in their country. This is summarized below.

Country of participant	Observed natural processes or human activities
Afghanistan	Climate change has greatly disrupted the snow and rainfall patterns Wastewater flow to streams, lack of sewerage and sludge mismanagement directly affecting the river, and impacted the quality of both surface and groundwater
Cameroon	Infrastructures on river beds in central town greatly influence the interaction of ground and surface water
Colombia	Infrastructures to controlling floods and facilitating navigability, generated interference in the connection between surface and groundwater
Eswatini	Farming of sugarcane, which is one of our largest economic activities. Extensive engineering to construct canal for irrigation has been the cause of significant modification in the interaction of ground water and surface water
Ethiopia	Groundwater exploitation, precipitation, and evaporation affect the interactions Changing wetlands to farm, diverting rivers channel, over irrigation of farm areas, and climate variability Illegal human settlement followed by deforestation, and the legislative framework coupled with lack of proper institutional capacity building has hampered the land use policy The ongoing construction of dams for irrigation and hydropower which has reduced the downstream recharging rate particularly in the low lands

Country of participant	Observed natural processes or human activities
Gambia	Climatical condition in term of rain fall is not favorable and the Aquifer recharge is mostly from rainfall. Geological formation is mostly sandy and the pollution level is getting higher in term of chemicals like nitrate, and saline intrusion
Ghana	Domestic waste discharge and agricultural activities
Kenya	Groundwater extraction by industry activities, mining firm, sugar industry and hotels; in addition, Industrialization has led to the pollution of groundwater sources and surface water sources Climate variation has put communities at risk of water scarcity, shallow aquifers that rely on the rain for recharge are particularly at risk
Lebanon	Sea water intrusion is the main challenge along the Lebanese coastal aquifers. GW in Lebanon is contaminated be it from raw wastewater especially under the current context
Malawi	climate change with frequent cyclones which resulted into flooding that later affect both surface and groundwater water quality deforestation and urbanization, accelerates the surface runoffs hence reduces the ground water recharge to the aquifers
Malaysia	Sewage Treatment Plant and Seawater Intrusion (through the river mouth), are two of the most critical source
Nigeria	Industrialization and domestic activities affect the interaction between groundwater and surface water Climate change in areas around Northern Nigeria where there is rapid deforestation and changing rainfall patterns Heavy pumping of aquifers especially around the coastal areas have resulted in the intrusion of saline seawater
Papua New Guinea	Land management usage in agriculture and other mining activities, lack of sanitation planning in communities in rural areas and lack of planning in Municipal services
South Africa	Interaction is increasingly variable rainfall associated with changing climate, through increased frequency and intensity of draught and flooding events Eucalyptus forestry plantations (phreatophytes) which have increased drastically over the past three decades and have even caused water level reductions in the KwaZulu-Natal Coastal Plain aquifer to such an extent that sea water intrusion has taken place
Sri Lanka	Agriculture management practices pollute and over extract groundwater

Country of participant	Observed natural processes or human activities
	Urbanization, deforestation significantly increase run off and reduces ground water recharge.
Tanzania	Irrigation, when irrigated water be more than needs of the crops/the irrigation water excess of the needs of crops Application of pesticides and fertilizers to croplands resulting in significant additions of contaminants to water resources Rapid urbanization and poor sanitation disposal systems
Uganda	Cultivation of land affects the infiltration and runoff characteristics Deforestation and bush burning also ends up affecting the hydrological cycle Improper disposal of industrial waste that ends up into the rivers, lakes through runoff and finally infiltrating into the aquifers

5.2 Participants' exchange in Module 2

Participants were asked to consider situations in their own country, and share what they know about how groundwater monitoring is being conducted nationally or at local levels by responding to the following questions:

- Is there an organization that is tasked with coordinating a national/local groundwater network system and have you ever taken part or received communication about it?
- Do you think there are any threats of over-abstraction or pollution to the groundwater reserves and whether any measures are in place to address these challenges? If none are in place, what would you suggest and where do you think resources could be sourced for the development of such a network?

Participant country	Organization coordinating the groundwater network system	Known threats to the groundwater (over-abstraction or pollution)
Cameroon		There is serious threat regarding pollution of ground water reserves. Most areas, people just do the wells boreholes located in old waste dump sites, near discharge savage (wild discharge)
Colombia	The entity in charge of monitoring water resources is the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) within the Ministry of Environment and Sustainable Development	
Jamaica	The Water Resources Authority is the organization tasked under the Water Resources Act (1995) to	Saline up-coning in wells due to over-abstraction and the inward advance of

Participant country	Organization coordinating the groundwater network system	Known threats to the groundwater (over-abstraction or pollution)
	coordinate national/local groundwater network system	the saline front along coastal limestone and alluvium aquifers Nitrate contamination resulting from inappropriate sewage disposal methods exists and still is a threat to the aquifers where unplanned settlements and urban areas still using soak away pits for sewage disposal occur
Kenya	Water Resources Authority (WRA), domiciled under the ministry of Water and Irrigation is charged with the responsibility of regulating and managing all aspects of water resource use including groundwater	there are threats of both over extraction and pollution of GW resources, However, lack of adequate funding has resulted in inefficiencies in data collection as there are almost non-existent observation wells in affected cities like Nairobi
Lebanon	Not really, but recommendations was made to implement a PMU within the Ministry to assist the staff in the management of groundwater	
Malawi	The Ministry of Water and Sanitation, Groundwater Division is responsible for groundwater network system	there are serious threats to groundwater, borehole drilling is becoming a hot business now rivers are drying up, implying the groundwater levels are dwindling too
Malaysia		over abstraction will impact groundwater reserves. especially in the alluvium aquifer, near the sea
Tanzania		groundwater resources are increasingly seen as a potential source of irrigation and domestic water in rural and urban areas the water security of shallow well and spring users is being threatened by increased groundwater exploitation by large, industrial users

5.3 Participants' exchange in Module 3

In this discussion forum, participants were invited to talk about groundwater quality and protection in their country. For that a set of questions were proposed:

- Discuss the nature & scale of the problem – is it anthropogenic or natural?
- How is the problem being managed, and who is responsible for the management?
- What have been the aims of the management, and how successful has it been?
- What would you need to change to improve the situation?

Participant country	Identified Problems	How is the problem being managed	how successful has it been?	What change to improve the situation?
Cameroon	ground water pollution is anthropogenic, groundwater without control in main towns and city			
Colombia	the problems of groundwater contamination are the management of solid waste and the lack of maintenance of the sewage networks.			
Ethiopia	Fluoride is the main problem we are facing in Ethiopia, in Main Ethiopian Rift	Researches are ongoing to find a way, in addition delineation and grouting of Fluoride enriched groundwater aquifer is also tried		
Jamaica	Groundwater pollution issues are saline intrusion along the south coast, saline up-coning in local well fields, nitrate contamination in localized areas where there are unplanned communities that use absorption pits and septic tanks for sewage disposal. Localized groundwater contamination is present where sugar factories and bauxite/alumina companies operated			
Kenya	The situation of ground water in Nakuru county, Rift valley is in dire need of a solution. The GW is naturally contaminated with fluorides Secondly, the GW has been contaminated through human activities such as agricultural practices	Effort has been put to prevent exacerbation of the ground water over abstraction and pollution. Kenya has clear legal and institutional framework to support groundwater protection	The efforts have not been so successful as there is limited access of other sources other than groundwater. Protection of the aquifers has not	Enhanced stakeholder participation Utilization of existing research on groundwater monitoring to enable evidence based planning Establishment of Intercounty groundwater management team

Participant country	Identified Problems	How is the problem being managed	how successful has it been?	What change to improve the situation?
			been fully achieved as well	
Malawi	mainly waste is the main pollutant in my country and this is mainly due to various anthropogenic activities such as industrial production, household wastes	the problem is being managed well with the Environmental Affairs Department enforcing much on a clean environment	the problem is being managed well	
Nigeria	the southeastern oil-producing states, have very low quality due to oil contamination, about 7000 oil spills have been recorded that have all resulted in groundwater contamination The northern part of the country is more agricultural prone and they make use of heavy fertilizers The crystalline basement southwestern part of the country has very shallow aquifers and uncontrolled drilling of private wells	little effort is put into its remediation		it can be in the form of enforcing regulations or creating awareness among the people
Tanzania	Generally, the natural groundwater quality in Tanzania is considered potentially good and acceptable for use, with notable exceptions such as High chloride concentration (salinity) is a problem in some coastal and central regions high levels of carbon dioxide have been reported in groundwater which causes issues with corrosion. High fluoride concentrations are a common problem in the areas surrounding the Rift valley system			

5.4 Participants' exchange in Module 4

A set of open questions were given for discussion on the existence of regulation system, and key challenges and considerations during implementation:

- Do you have a groundwater regulatory system for abstraction and pollution in your country? What are the challenges you are faced with during its implementation and enforcement; how are you addressing them?
- What are the key considerations during development and reform of rules regulating an allocation system for groundwater resources? For instance, what about sustainability, the precautionary approach and principles for participation and inclusion in data collection and sharing of information about groundwater?
- What are the possible mechanisms to employ during enforcement of groundwater regulations and permit conditions at national level?

Participant country	Existence of regulation system, and key challenges and considerations during implementation
Cameroon	we have the LOI N°98-005 du 14 Avril 1998 PORTANT REGIME DE L'EAU which state as the rules and policies governing groundwater abstraction. But is not known by everyone. Sensitization and communication need to be handled properly Coordination between various stakeholders like water companies realizing boreholes, individual, local and national administration
Ethiopia	the Ministry of Water resource; and energy has details on the regulatory system for abstraction and pollution. However, the system is not far from paperwork. The real challenge from this perspective is how to make the ice break in converting the rule on ground so that the public and institution are aware of the regulatory processes The key consideration that should be taken forward during the development and reform are stakeholder's awareness on the regulatory framework
Ghana	Water Resource Commission have been given the mandate with a governing Water Use Regulations Legislative Instrument (L.I.) 1692 (2001) or the issuance of water use permits or grant of water rights for various water uses
Jamaica	the groundwater regulatory system is the implementation of the Water Resources Act (1995) which is managed by the Water Resources Authority. Regulation of pollution falls under the Natural Resources Conservation Act and implemented by the National Planning and Environment Agency Enforcement is the main challenge with roadblocks such as weak monitoring systems, lengthy legal issues, inconsistent public education. Continuous public awareness campaigns and stakeholder sensitization is required to support the legislation
Kenya	GW regulatory system for abstraction which is Water Resources Authority and for pollution is National Environmental Management Authority

Participant country	Existence of regulation system, and key challenges and considerations during implementation
	The challenges: the political environment is not supportive towards - Limited resources for enforcement - Low public awareness.
Malawi	The National Water Resources Authority (NWRA), but are not widely known to some stakeholders hence poor enforcement Challenges: it is underfunded as such public awareness and enforcement of groundwater regulations is a tall order
Nigeria	There is the National Environmental (Surface and Groundwater) Quality Control and Regulation of 2010 The implementation is far from what should be For effective regulatory function by Government agencies in Nigeria, first, there is need for capacity development of the line Ministries and its regulatory managers. There is also need for detailed information and data sharing with stakeholders
Tanzania	no specific institutions dedicated for groundwater governance apart from water institutions that are established to govern surface water

5.5 Participants' exchange in Module 5

Module discussion forum was in form of open questions:

- Name two transboundary aquifers in Africa with potential or apparent transboundary issues in terms of development, use, and management.
- Categorize and rank the resources in terms of problems or possible solutions to human and environmental needs.
- What are the areas of joint priority for transboundary and cooperative management?
- What are the key technical and management interventions that could be best dealt with jointly to address transboundary management issues?
- What are interventions in terms of the benefits and trade-offs for the countries, in terms of addressing equity, sustainability and efficiency?
- Indicate where the institutional responsibility lies to carry out the proposed management interventions, highlight in particular the role / interventions that can be best carried out by the Transboundary Basin Organisation (TBO).

Since these were open questions, participants who engaged the discussions did not address all points. Therefore, the summary below focuses mainly on two issues of transboundary aquifer management: (i) the areas of joint priority for transboundary and (ii) cooperative management, and the key technical and management interventions that could be best dealt with jointly.

Participant country	Areas of joint priority	Key technical and management interventions
Cameroon	Join priorities for transboundary and cooperative management are base on the interest, values and sustainability of the resource	Groundwater quality management and monitoring
Cote d'Ivoire	Countries should set up national boundary commissions in charge of all cross-border issues	
Gambia	Substantive contented of the agreement to have equal rights and obligation all party should have equal assessed to agreement and understand the contend., sharing of benefit need to be transparent	
Kenya	The first initiative would be to acknowledge the existence of the TBA and how much of the coverage is in each of the countries Joint priority should be creating Transboundary organisations and establishing agreements between the region's sharing the TBAs	Geological and hydrogeological studies of the aquifer systems
Jamaica	A priority for cooperative management would most definitely be establishing political and technical agreement on management of the shared aquifers. Issues to overcome would be determining the importance of the aquifers to both countries, language barriers, technical expertise levels	
Nigeria	Establishment of structures and definitions of roles and functions Operations, including accountability mechanisms, financial and human resources needed	monitoring and evaluations, early warning mechanisms
Uganda		Countries must carry out joint monitoring on issues to do with pollution a cross boundaries, response

6. Course evaluation

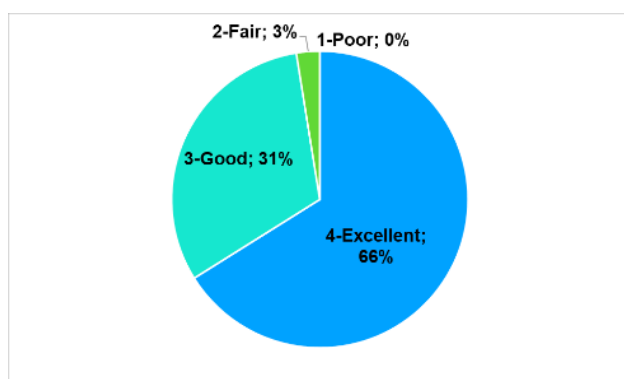
Participants who completed the online course are requested to fill a course evaluation survey at the end of the course. It enabled participants the opportunities to share their opinions about the course, and at the same time permits to course promoters to get the feedback from participants on various aspects of the online course.

The survey, comprising ten questions is standard for all courses in Cap-Net's virtual campus, and includes space dedicated for comments for participants after responding to a question. The survey responses are inserted in Annex 3; in the following lines, the responses, along with comments will be summarized.

6.1 The experience about the virtual platform

The survey of participants has expressed a high rate of satisfaction about their experience with virtual campus, as 97% of participants declared having good to excellent experience with the platform, and 91% described it as great to life-changing tool (Figure 5). Participants consider the virtual platform as user friendly with good layout and simple features, despite some issues raised by some people.

Can you please rate your overall experience using Cap-Net's Virtual Campus?



Which of the following words would you use to describe Cap-Net's Virtual Campus?

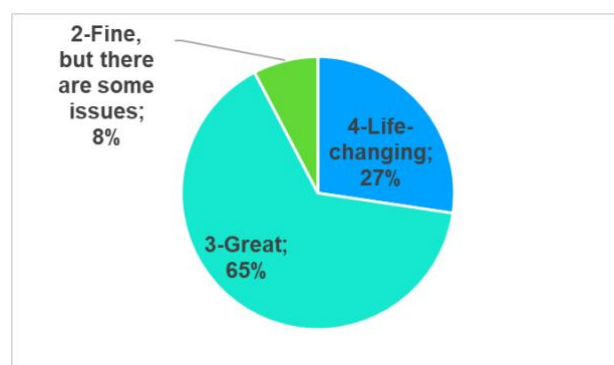


Figure 5: Participants experience using the virtual campus

6.2 The relevance and benefice of the course

Participants were asked about the relevance and about the benefits they draw from the course. Almost all respondents (~100%) found the online course beneficial regarding the learning objectives, as well as relevant in connection to the broader aspect of sustainable water management (Figure 6).

Both professionals and non-professionals engaged in this online course found it beneficial and relevant, as well, in their current work, for instance related to monitoring, regulation and licensing, delivery of water supply or community-based water management. They also got tools to better understanding of groundwater resources management approach & solutions, and tools to promoting advocacy and awareness raising for access to water.

How beneficial was the course to your overall learning objectives?

How relevant was this course to your work in connection with sustainable water management?



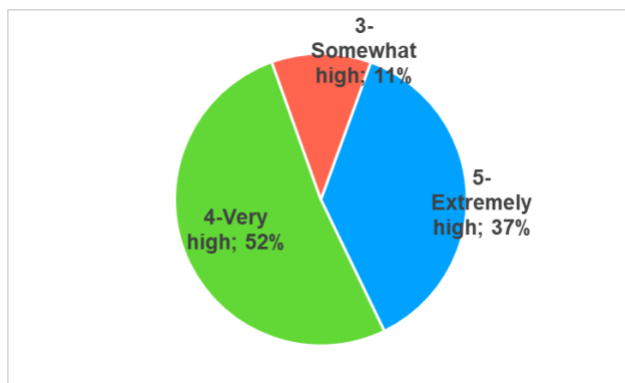
Figure 6: Participants feedback about the benefit and relevance of the course

6.3 About knowledge gained and expectation of participants

The participants were asked about the knowledge they acquired from the course and how their expectations were met in respect to the resources delivered in the online course (Figure 7). Large majority of respondents admitted having gained high knowledge (~90%), and that the course had met fully their expectation (~85%). This is in line with the objective set by participants in their application forms, since most of them wanted to get new knowledge.

Even though the selection criteria allowed participation of persons of different groundwater background, from low, middle to high, they acquired knowledge in various topics related to, for example, groundwater governance, water security, groundwater quality control and monitoring and transboundary aquifers. They found the course content beyond basic knowledge and had appreciated well the materials provided through documents, videos, and training manual.

To what degree did you acquire new knowledge through this course?



How well did the course meet your expectations?

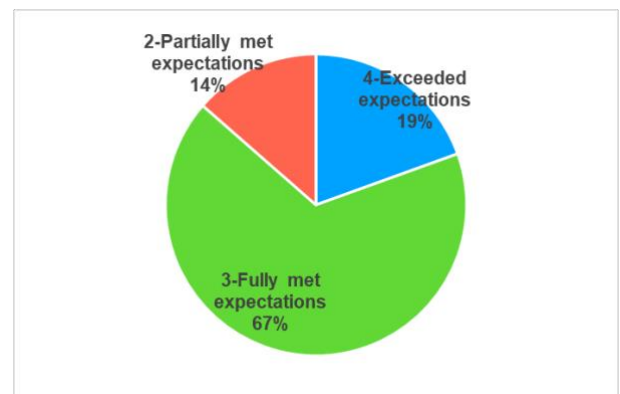


Figure 7: Participants feedback about knowledge gained and their expectations

6.4 Interest in knowledge application and interaction with participants

The survey has shown the interest expressed by participants to interact to share data and experience through their own works in various parts of the globe. They almost state that they would likely to pursue interactions (Figure 8), unfortunately it was not clear through which means, since communicating contacts of participants was not envisaged. Half of participants surveyed are keen to apply the gained knowledge in their daily work (water or university sectors), about 25% would share their knowledge inside or outside their institutions/organization (Figure 9).

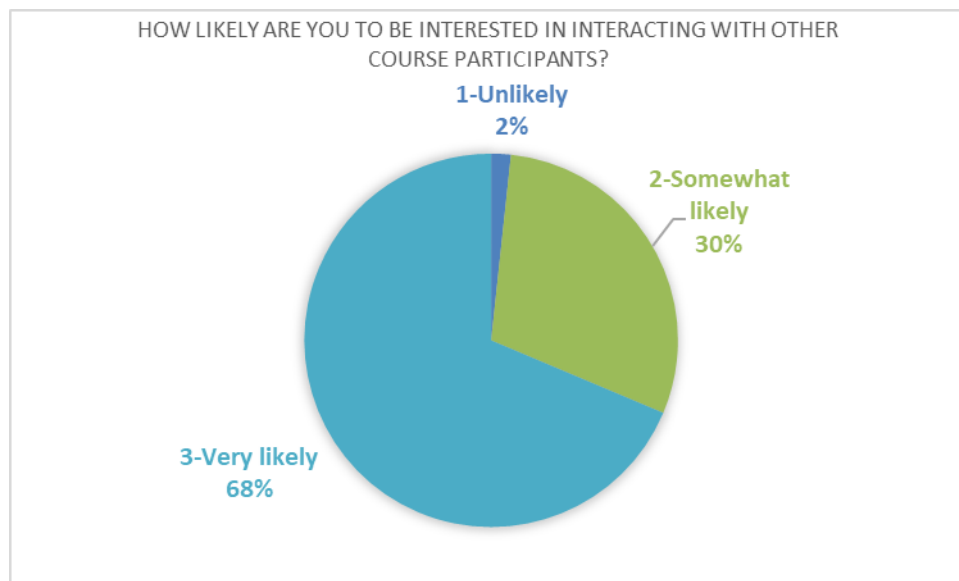


Figure 8: Participants interested in interacting with fellow participants

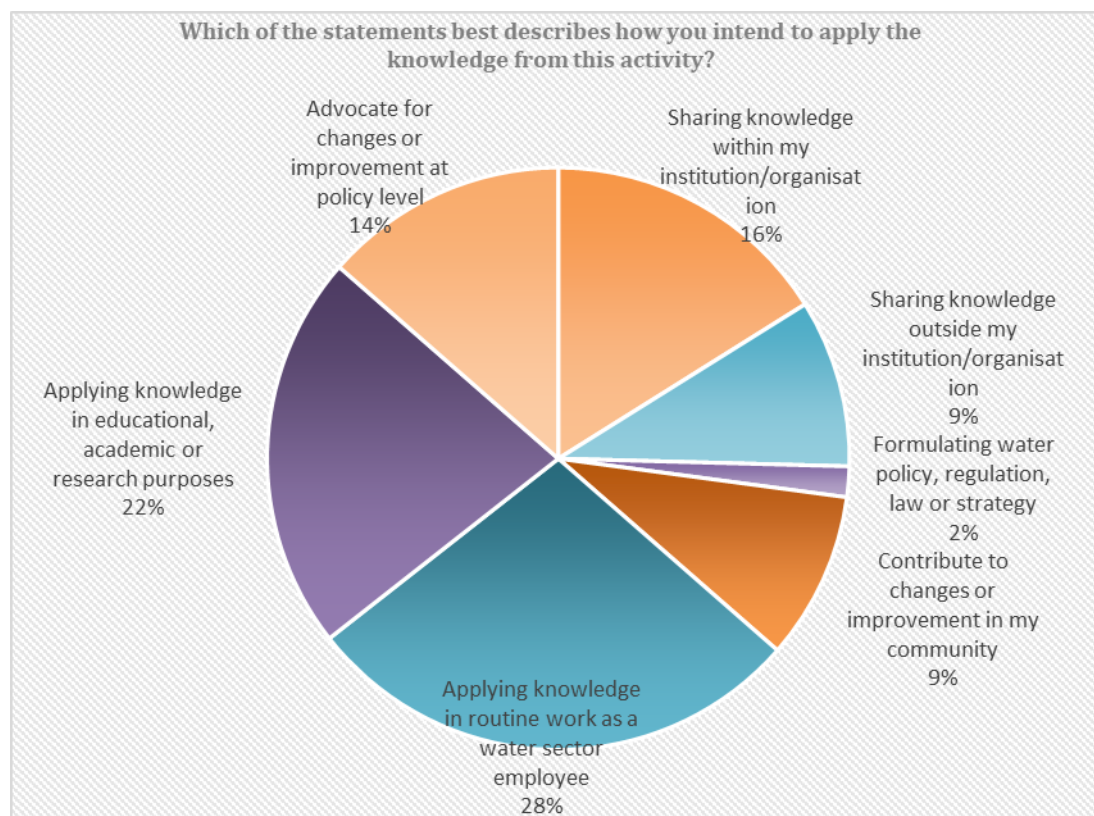


Figure 9: Participants feedback about knowledge application

6.5 Other feedbacks and reflections from participants

Apart from questions described above, participants were asked about:

- **The most valuable concept or resource introduced in this course.** The question was diversly appreciated to make a consistent analysis, however almost all topics developed in the course were noted par respondents.
- **The topic(s) that would have covered deeper.** Like the previous question, the responses were diverse, and encompassed diverse topics, some were specialized like groundwater

modeling, borehole siting (covered elsewhere), groundwater vulnerability, the use of GIS tools in groundwater management; other proposed topics are of wider extent and almost developed in the course: transboundary groundwater, groundwater regulation, monitoring, groundwater quality

- **Additional comments, recommendations, or suggestions.** At the end of survey, participants are requested for comments/recommendations/suggestions, what they did in most cases. Some of these reflections are selected below (Box 2) showcasing some ideas for the course improvements, for instance about more active interactions, and some issues were raised, as well.

Further details are presented in Annex 3.

Box 2: Some reflections and recommendations quoted from participants

Recommendations:

'As this course is very important for water sector actors, I highly recommend to continue this virtual campus training to reach wider audience in the future. This course does not need detachment from routine job location, and it enriches professional skills and knowledge.'

'I am not sure if I might have missed the feature, maybe a live session in addition to tutorials would also be interesting'

'I appreciate the organizers for putting together all the inspiring courses. I will recommend live interactive sessions to better discuss and share our knowledge.'

'It should contain hands-on practice and workshops if possible'

'In the future, would you include case studies and management activities, as well as findings?'

'Please consider offering diploma courses'

Thank you Capnet However, I would suggest learners or students are scheduled to meet with the trainers or facilitators at least per module to allow more interactions that may enhance further learning.

Issues raised:

'I had some challenges with the connection. My account was blocked, I sent several emails but never got any reply. I kept trying to sign in and one day I got in. It will be great to have feedback when a concern is raised. I appreciate the fact that you sent several emails to remind about the deadline to complete the course.'

'The course was generally good. Some of the recommended material was too bulky.'

Gratefulness

'It is a thrilling course. And keep it up. I apply information in routine work in the water area, for instructive, scholarly, or research purposes and I contribute to changes or enhancements locally. Thanks'

'It was a good opportunity for me to participate and gain crucial knowledge that will help me in my work. I thank all of you and hope to see you in other courses!'

'The course was amazing, and I enjoyed watching the introduction videos. The reference sites were also very great, they gave me access to information I did not know existed. Overall, the course was greatly put together.'

7. Reflections from the co-facilitators

At the end the online course, a survey was shared with co-facilitators who were volunteering to engage in this online course. The purpose was to get their feedback and evaluate success and failure to improve the course in the future. The survey outcomes are inserted in Annex 4. They are summarized, below in the following lines.

7.1 Time dedicated to co-facilitation

Although the course lasted for 4 months (May to August), large majority of co-facilitators (92%) has participated in the animation of forums discussion during at least 2 weeks; the third of them (34%) has co-facilitated for 4 weeks. The average time per week they spent to co-facilitating is less than 30 min for half (50%) of them, and less than 1 hour for 75% of co-facilitators (Figure 10 and Figure 11).

This can provide an estimate of the time load of co-facilitators, but it does not take into account the level of interactivity of discussion forums. Nevertheless, it may enhance future engagement of resource persons to support the facilitations of future courses.

2. For how many weeks did you co-facilitate

12 réponses

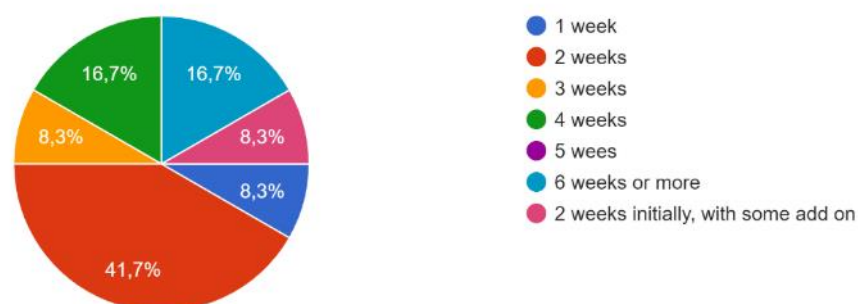


Figure 10: Time (weeks) spent by co-facilitators

3. On average how much time per week did you spend co-facilitating?

12 réponses

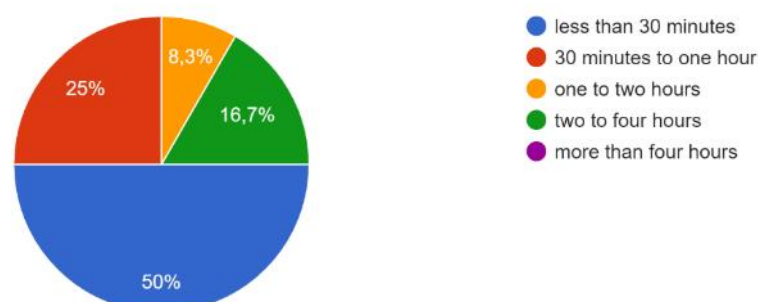


Figure 11: Average time per week spent by co-facilitators

7.2 Orientation and support of co-facilitation tasks

Most of co-facilitators were satisfied with the support and orientation they received to ease their tasks (Figure 12); more than 90% expressed satisfaction about information given and orientation provided to navigation through the virtual platform to perform their tasks. However, some issues were raised:

- To finding the right discussion page and the right cohort⁴ through the platform
- To getting a notification when comments are posted on the courses being facilitated

One of the proposed recommendations may overcome these issues: *"...a very short online meeting / kind of meet and greet and brief demonstration of the online system rather than doing it via email online."*

4a. Please tell the extent to which you were satisfied with the orientation and support that you received throughout your co-facilitation of the course. Select one of the following.

12 réponses

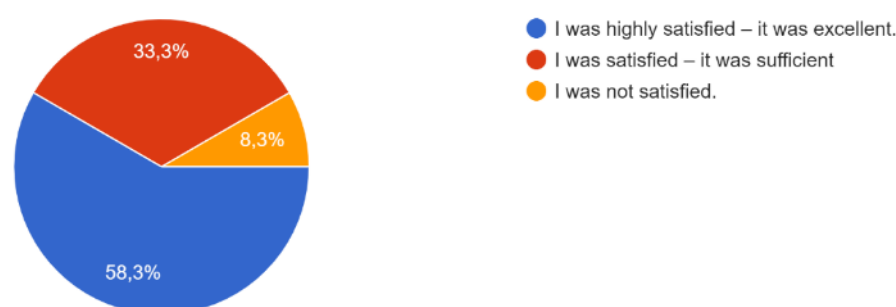


Figure 12: Level of satisfaction of facilitators

7.3 The level of interaction within the discussion forum

The discussion forum was divided into 4 cohorts, and the questions for discussion were the same in each cohort. Apart from the lead-facilitator, co-facilitators were supervising the cohorts, composed of near 60 persons each, by supporting discussions, either between participants, or/and between facilitators and participants, as well.

The level of interaction in these cohorts was not satisfactory for many co-facilitators; only 33% of them were happy with the discussion forum activities (Figure 13), since either participants never replied to responses from facilitators, with a lack of reaction from participants, or little exchanges were occurring between participants.

⁴ There were 4 cohorts of 'students' in the discussion forum; each co-facilitator was affected to at least one, but he or she had the possibility to access to other cohorts too.

9a. Were you satisfied with the level of interactions within the discussion forum?

12 réponses

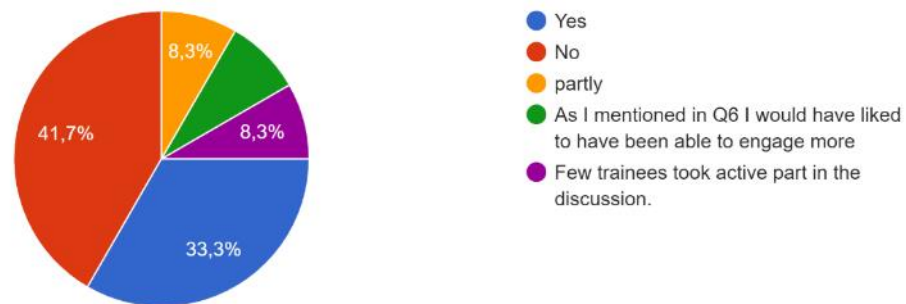


Figure 13: Feedback by co-facilitators about interaction within discussion forum

7.4 Recommendations from co-facilitators

Quoting co-facilitators, here are some recommendations that emerged from the survey:

1. Add a webinar/discussion session mid-way in the course and keep the one at the end. Depending on numbers enrolled to make the groups small enough.
2. Increase the interaction and the participation of the students, e.g. with live lectures and Q/A sessions, homework and assignments, preparing a short thesis, exams, etc.
3. Get a notification when comments are posted on the courses being facilitated.
4. Provide some more explanation at the beginning would have been useful.
5. Set times (allowing for time differences) on set days when people are 'live online' for discussions, as well as having the discussion forum open all the time. Or/and maybe including some more open-ended questions
6. The course should be offered in a regular basis in the future

8. What's Next

These two 2022 courses are neither the beginning, nor should they be the end of this type of training. The 2022 Groundwater Resources Management course modules were actually only part of a more comprehensive face-to-face training on the Integration of Groundwater Management into Transboundary Basin Organisations, which has been run regularly in the past. The Professional Drilling Management course was as adaptation of a more intensive online course, that ran in 2018 and 2019, and required participants to pass assignments as well.

Less than half of the applicants were invited to participate in the 2022 course. With priority was given to women, African and government applicants, there remain, in particular a large number of male applicants from NGOs and the UN who were not able to take the 2022 course.

Looking into the future, the advisory group is striving to enable these courses to be rolled out, in different languages, and managed by African Institutions. So, if you are interested, or even applied for the courses this time round were not successful, they will hopefully be available once again.

Annex 1 Managers, course facilitators and peer reviewers

Dr Moustapha Diene



Course Manager, responsible for developing the course, leading its facilitation, reporting and the supervision of co-facilitators.

Moustapha Diene is hydrogeologist, Senior Assistant Professor at University Cheikh Anta Diop, Dakar – Senegal. He gained a long experience in groundwater management, water supply and sanitation, through research and national/international projects. He is the former Network Manager of the Africa Groundwater Network (AGW-Net), and currently member of the Steering Committee; he has implemented and facilitated many training courses on integrated groundwater management in Africa.

Dr Kerstin Danert



Course Manager, responsible for developing the course, leading its facilitation, reporting and the supervision of co-facilitators.

Kerstin Danert is a water specialist, researcher and facilitator with over 20 years of experience, and who has worked in over 15 countries in sub-Saharan Africa. Her passion is water supply and groundwater resources in sub-Saharan Africa. She has spent a decade and a half of trying to improve the quality of boreholes in the sub-continent, and more recently has been examining problems with handpump component selection, quality and supply chains.



Dr Callist Tindimugaya has been working with the Ministry of Water and Environment in Uganda for 32 years and is currently, Head of the Water Resources Planning and Regulation Department. He holds a PhD in groundwater resources management, University of London, 2008. He has been very key in establishing groundwater resources management and development frameworks in Uganda and was a Regional Vice President for the International Association of Hydrogeologists (IAH) in charge of Sub-Saharan Africa from 2012 to 2020. He is also a Steering Committee Member of the African Groundwater Network (AGW-NET) and has represented Uganda on various regional and international organizations such as the Nile Basin Initiative (NBI), Inter Government Authority on Development and UNESCO's Intergovernmental Hydrological Program.

Dr Martin O. Eduvie



Dr Eduvie is presently, the Director/Head of Rural Water Supply and Sanitation Centre at National Water Resources Institute, Kaduna Nigeria. He had his B.Sc in Geology in 1983, M.Sc in Hydrogeology in 1991 and a Ph.D from Ahmadu Bello University Zaria-Nigeria in 2004. As a Hydrogeologist/Geophysicist, he was responsible for groundwater research, borehole drilling and geophysical investigations projects. He also worked as a Project Manager, Rural Water Supply and Sanitation Centre/JICA from 2010-2014 at the National Water Resources Institute, Kaduna and a former Head of the Training Department, NWRI (2016-2020).

Dr Bentje Brauns



Bentje is a hydrogeologist at the British Geological Survey with 10 years' experience in groundwater monitoring and design of small-scale monitoring networks. Her research interests include water resources in Africa and Asia (recharge, water quality, impacts from agricultural activities) and groundwater-surface water interactions.

Brighid Ó Dochartaigh



Brighid is a UK-based hydrogeologist with 25 years experience, particularly in groundwater resource assessment and management in challenging (e.g. low permeability, dryland, arctic or urban) and data-scarce hydrogeological environments; groundwater mapping; and communicating hydrogeological information. She has worked across the UK and in countries across Africa, in Asia, the Middle East, and South America; and is a recognised expert on groundwater resources in Scotland.

Daina Mudimbu



Ms Dee holds an MSc in Remote Sensing and GIS from the University of Greenwich and a first degree is a BSc General in Geology and Biological Science also from the University of Zimbabwe. She is an earth and spatial scientist with interests in environmental geochemistry, medical geology and hydrogeology. In a professional career of over 24 years, she has used a combination of skills in multi-disciplinary research teams and development projects, in environmental and groundwater monitoring and management, land use planning and environmental impact assessments. She is currently in the final year of DPhil studies in Medical Geology at the University of Zimbabwe (UZ).

Dr Kawawa Banda



Dr. Kawawa Banda is a Senior Lecturer in Hydrogeology and Remote Sensing in the Department of Geology in the School of Mines at the academic at the University of Zambia in Zambia. He holds a PhD degree in Environmental Engineering (strong focus on groundwater hydrology), from the Technical University of Denmark (DTU) in Copenhagen. He holds a Master's degree in Integrated Water Resources Management and a Bachelor's degree in Geology from the University of Zambia. Currently, he is the Network Manager for the Africa Groundwater Network supporting knowledge dissemination on groundwater in Africa. He is also a technical committee member for the technical Committee for development of groundwater regulations for Zambia coordinated by Water Resources Management Authority (WARMA).

Dr Arnaud Sterckx



Arnaud Sterckx is a hydrogeologist with a background in geology and geography. He completed a Ph.D. thesis in groundwater modeling at Laval University (Canada) in 2017. At IGRAC since 2018, he has been involved in several regional and transboundary assessment projects, mostly in Africa. His work also includes the development and the maintenance of the Global Groundwater Information System, capacity-building activities and various MAR initiatives. Arnaud is co-chair of the IAH Commission on Transboundary Aquifers and a member of the IAH Commission on Managed Aquifer Recharge.

Michael Eichholz



Michael Eichholz is a Policy Advisor at the German Federal Institute for Geosciences and Natural Resources in Hannover, Germany. He holds a doctorate degree in Geography from the University of Bonn and did research on how people organize around water in urban settings. His areas of expertise include management and governance of groundwater and water supply with reference to approaches on universal water access, groundwater resource protection and climate resilience.

Dr. Jenny Grönwall



Jenny Grönwall is an Advisor on Water Policy and Rights with the Stockholm International Water Institute, and the organisation's human rights focal point. With a background in law, Jenny has an interdisciplinary PhD in water management and more than 20 years of experience in the field, focusing on groundwater governance and self-supply in India and sub-Saharan Africa. Her research also involves sustainable textiles manufacturing and zero liquid discharge methods.

Johannes Münch



Johannes Münch is a Hydrogeologist working as a Policy Advisor at the German Federal Institute for Geosciences and Natural Resources (BGR). He gained his M.Sc. in Hydrogeology at the University of Tübingen. In course of his professional career he gained experiences in the field of groundwater research and exploration, groundwater monitoring and groundwater modelling.

Dan Lapworth



Dan Lapworth is a Principal Hydrogeochemist at the British Geological Survey and chair of the IAH Groundwater Quality Commission in partnership with UNESCO-IHP and IGRAC. Dan has over 20 years experience in applied groundwater research providing evidence to underpin groundwater development policy. His research focuses on the potential of groundwater for adaptation, groundwater resilience and replenishment and anthropogenic impacts on water quality, recharge and groundwater use.

Jorge Alvarez-Sala



Jorge Alvarez-Sala, works at UNICEF in New York HQ, as WASH Specialist leading the water supply portfolio, which includes water access, quality and sustainability. He is in charge of a UNICEF initiative of professionalization of WASH services, which included the development - together with RWSN/Skat Foundation- of a toolkit on professional drilling operations. Jorge has 20 years of experience in the WASH sector, most of them at field positions in a variety of countries including humanitarian, transitional and development contexts in Europe, South America, Middle East, Africa and South East Asia. His previous job was with UNICEF in Ethiopia, where he was the manager of both the WASH Sector Coordination and the Emergency WASH pillars. In the particular field of groundwater, he has experience in the expansion of groundwater exploitation for a bottling company in Spain, drilling emergency boreholes in Darfur (Sudan), or using state of the art remote sensing to identify deep groundwater aquifers in the Somali region of Ethiopia

(600m deep); and also advocating for the standardization of water point monitoring systems in Ethiopia as part of the second phase of the OWNPN.

Dr KOITA Mahamadou



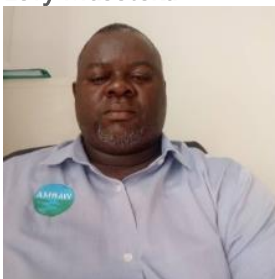
KOITA Mahamadou (PhD) is senior lecturer in Hydrogeology at International Institute for Water and Environmental Engineering in Burkina Faso since 2011. He works on hydrogeological characterization and modelling. He is involved as a lead investigator in various international projects on the integration of new scientific knowledge of aquifer characterisation, testing of new groundwater planning tools.

**Harinaivo Anderson
ANDRIANISA**



Harinaivo A. Andrianisa is an Associate-Professor of Water and Environmental Engineering and Head of the Water, Sanitation and Hydro-Agricultural Development Engineering Department at the International Institute for Water and Environmental Engineering (2iE) in Burkina Faso, with 22 years of experience in education and capacity building, project management, R&D, and consultancy related to water, sanitation and environmental issues. His research interests include the impact of sanitation systems, and mining activities on water resources pollution.

Levy Museteka



Levy Museteka has worked in the water sector in Zambia for the last fifteen years with progressive professional experience in hydrochemistry and hydrogeology. He has been involved in a number of groundwater research studies in Zambia. He also possesses experience in conception, development and implementation of groundwater regulations.

Dr. Moshood N. TIJANI



Moshood N. TIJANI is presently the Groundwater Desk Officer and Climate Lead at the African Ministers' Council on Water (AMCOW), Abuja, Nigeria. He holds a doctorate degree in Hydrogeology and Hydrochemistry from the University of Muenster, Germany as well as a Post-graduate Certificate in Hydrogeology from University of Tuebingen, Germany. He was, before now, a Professor of Hydrogeology and Environmental Geology at the Department of Geology, University of Ibadan, Nigeria. His areas of professional competence include groundwater resources assessments with reference to groundwater exploration, aquifer characterization and groundwater quality and environmental contamination issues.

Elisabeth Lictevout



Elisabeth Lictevout, director of IGRAC since January 2022. Hydrogeologist, with a background in geology, Ph.D from the University of Montpellier, France. 26 years of worldwide experience in diverse contexts (Europe, South-East Asia, Middle East, North Africa, and Latin-American), in different sectors (Private / public / academic) and diverse fields of intervention (Humanitarian and Development sector, Research and Development). Fields of research: groundwater management; hydrogeology of arid regions; groundwater-dependent ecosystems; participative local and ancestral knowledge; groundwater heritage.

Tara Bartnik



Tara Bartnik, works for WaterAid UK as Programme Support Advisor for Water, supporting WaterAid country programmes teams on water supply, climate resilience, gender inclusion, systems strengthening and construction quality. Recently led an internal review on processes for procurement of mechanical drilling services, and is passionate about professionalisation of the sector. Tara has a background in civil engineering, and has previously worked in Australia, Norway and Timor-Leste.

Dr Florence Tanui



Florence Tanui is a Principal Research Associate in the FCDO-funded REACH (Kenya) Programme. She has vast experience in groundwater quality with respect to geogenic and anthropogenic factors. She completed her PhD in the hydrogeology of a strategic urban alluvial aquifer in the arid region of Northwestern Kenya in 2021. Fields of research: sustainable urban groundwater development, climate resilience, groundwater and poverty, and environmental monitoring. Other interests include research into policy, groundwater governance, and drone mapping applications in geoscience.

Alexandros Makarigakis



Total of more than 25 years of progressively responsible experience in the field of environmental sciences, 20 of which on the international platform on issues of development in developing and developed countries with focus on natural resources management (water and environment). Extensive work on groundwater bioremediation and modelling. Responsible for the establishment of the Internationally Shared Aquifer Resources Management (ISARM) in SADC and IGAD regions. Initiated and implemented multiple projects on groundwater resources assessment around Africa.

Alan MacDonald



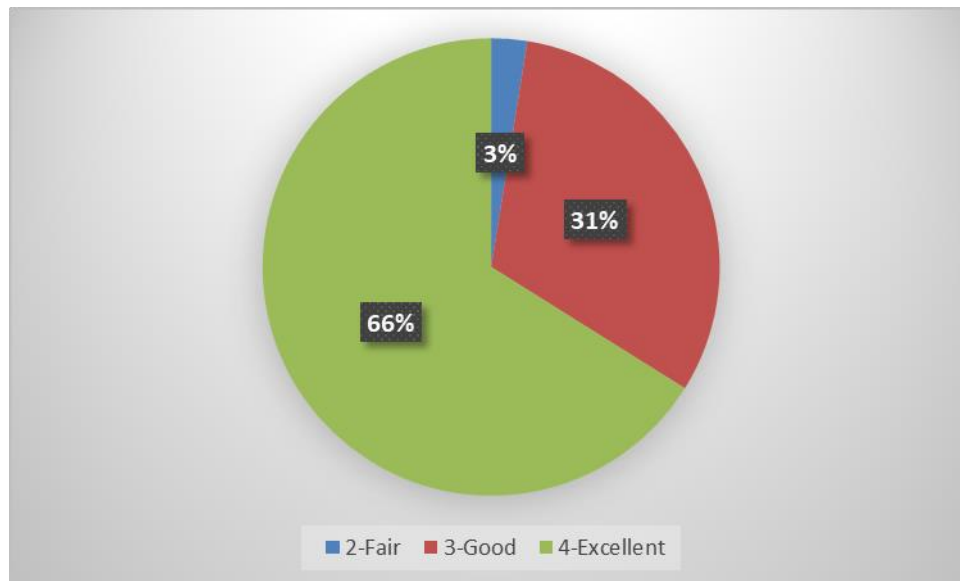
Alan MacDonald is a hydrogeologist with 30 years' experience mainly working on groundwater projects in Africa and South Asia. He currently leads International Groundwater Research at the British Geological Survey and is chair of the International Association of Hydrogeologists Burdon Network for International Development. He has particular expertise in rural groundwater supplies and wrote the textbook *Developing Groundwater: A Guide for Rural Water Supplies*.

Annex 2: The course activities and outputs

Output	Activities	Lead
1. Advisory group established and meeting regularly	1.1 Selection of members 1.2. Invitation of members 1.3 Meetings 1.4 Minutes of meetings circulated	Dr Kerstin Danert
2. Course manual – groundwater resources management participant-led course	2.1 First draft manual prepared 2.2 Internal review 2.3 Second draft manual prepared 2.4 External peer review 2.5 Final manual prepared	Dr Moustapha Diene
3. List of participants – groundwater resources management participant-led course	3.1 Contact AMCOW member states, L/RBOs, AFWA, IWA, municipality associations, AquaFed, RWSN partners and members. 3.2 Develop a method for promoting the course, application and participant selection. 3.3 Run process and select participants.	Cap-Net involving APAGroP & Dr Moustapha Diene
4. Report – Groundwater resources management course report	4.1 Course hosting 4.2 Selected participants sign up to the platform 4.3 Launch course 4.4 Manage course & prepare course report 4.5 Cross-Course Exchange and Learning with Professional drilling course	Dr Moustapha Diene
5. Report - ex-post evaluation for both courses	5.1 Prepare, review and launch questionnaire 5.2 Finalise report	Cap-Net
6. Promotion Materials & Events	6.1 Course announcements to coincide with World Water Day (Special session in 9 th World Water Forum in Dakar - Senegal) 6.2 Course blogs 6.3 Webinars about the course and learning	APAGroP

Annex 3: participants' survey responses

1. Can you please rate your overall experience using Cap-Net's Virtual Campus?



It is user friendly and very clear. I did not experience any problems

Better layout with simple features

Especially references and knowledge checks

Globalement, la plateforme Campus Virtuel de Cap-Net a été conviviale et assez simple dans l'utilisation. L'organisation du forum de discussion est très bien faite et les sujets de discussion très bien organisés.

I am able to compare the data and the information provided in the course with the realities and current challenges in my area and working out the best sustainable method socio-culturally acceptable

I didn't face any challenges

I really appreciated all the resources: power point, video, very good websites and the great number of documents

I've subscribed to Cap-virtual net's campus and obtained really beneficial resources. Documents are included, as well as check the new training courses and other opportunities.

It is user-friendly and very clear. I did not experience any problems on this regard.

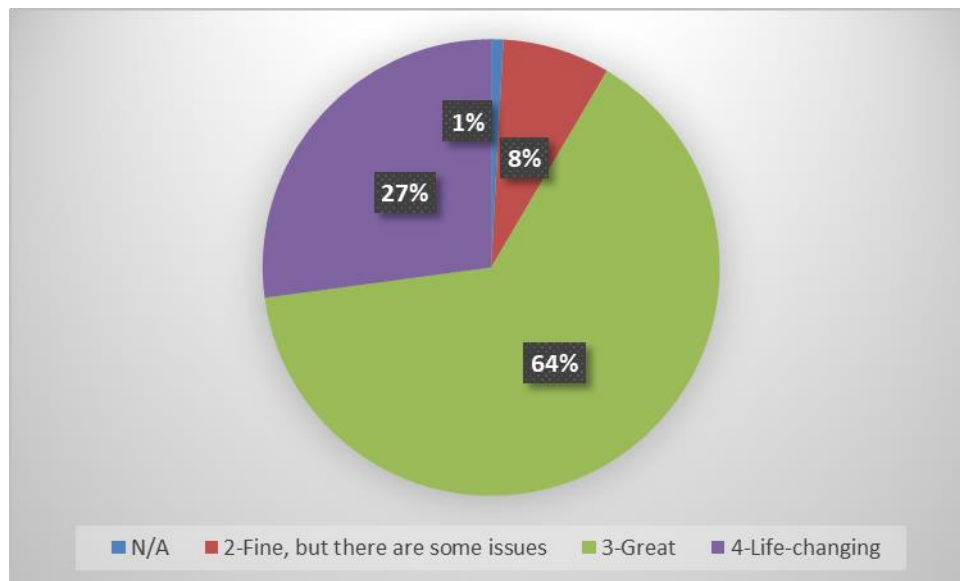
It is very simple and user friendly.

It was good having virtual campus, but it has given me knowledge on ground water management and is ideal for my professional experience

J'ai beaucoup appris sur les aquifères transfrontaliers

Learned a lot

2. Which of the following words would you use to describe Cap-Net's Virtual Campus?



Changed my perspective about groundwater management

Coz I know how to manage our water resources and its aquifers.

Gained a lot in terms of TBAs and will certainly go a long way in the way I make my everyday decisions as regards to groundwater management

Get the chance to understand more TBA, RBA etc.

Have always followed Cap-Net since 2001 till at present.

I have invited some few colleagues and friends who after doing a course with cap-net are inspired to act immediately on the knowledge they have gain.

La plateforme est géniale. J'ai non seulement appris avec les cours et les documents suggérés mais aussi dans le forum de discussion à travers les partages d'informations

NO

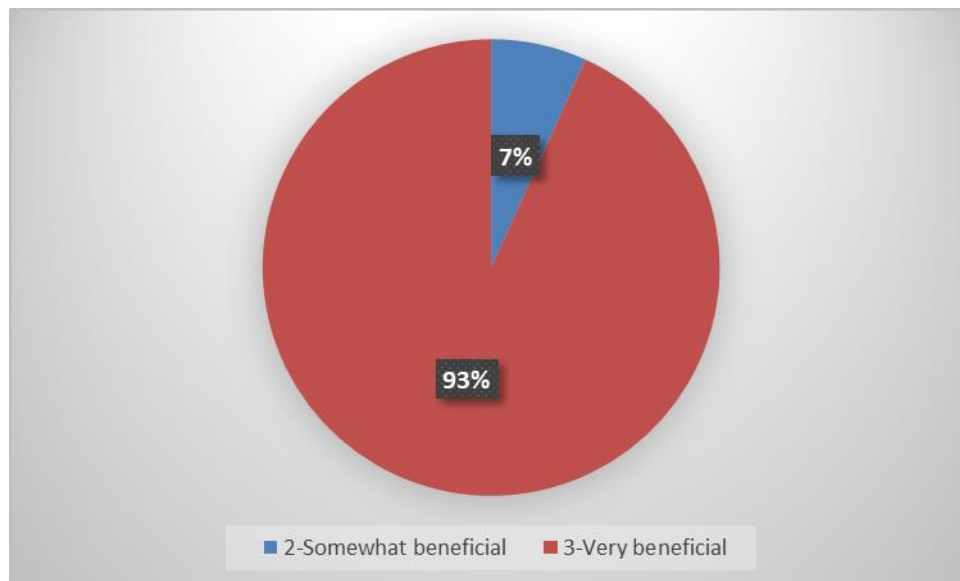
On peut apprendre facilement, à son rythme et très bien organisé.

THANKS FOR YOUR CONSIDERATION

The campus has enabled access and awareness to the need for integrated management of surface and ground water by personnel in water sector, specifically TBO.

The modules have been made way to understand n relate

3. How beneficial was the course to your overall learning objectives?



A professional can draw a lesson and can design his own ground water monitoring methods based on the local context and many more can be drafted ...and thank you a lot.

Ce cours a été très bénéfique pour moi dans la mesure où il va de paire avec mon plan de carrière à savoir la gestion durable des ressources en eau et l'accès à l'eau pour tous.

I HAVE LEARNT MORE ABOUT GROUNDWATER

I am the head of groundwater in my department and this information is very handy.

I gained a lot of new stuff especially on regulation and licensing

I have learnt a great deal about groundwater resource management

I predominantly work in the development of rural water sources, including the drilling of boreholes, and this ground water management course helps me with the management of ground waters, so this course is very advantageous for me

I work in water resource management entity in my region

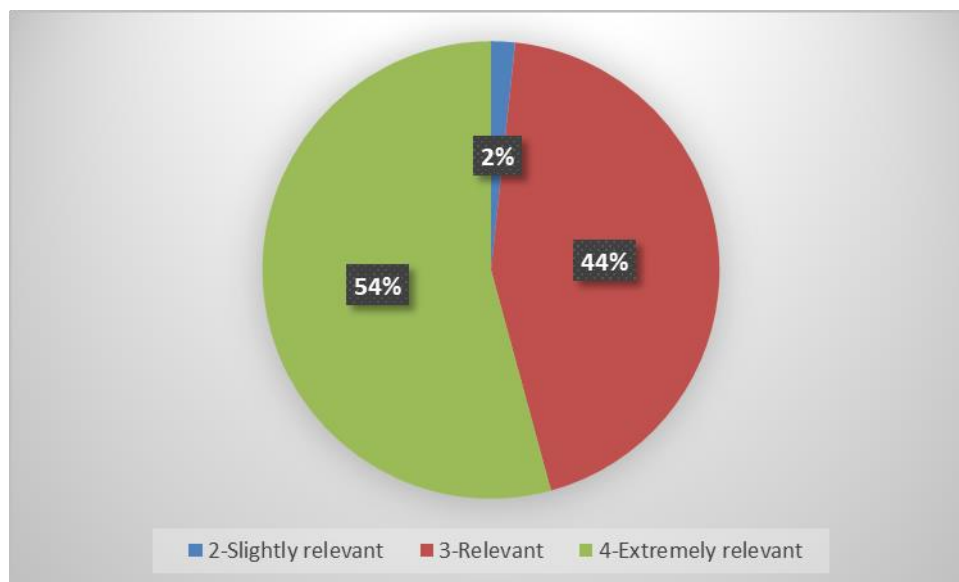
It will benefit not only me but all the communities that will working in and the people I work with

It's very much applicable to my profession and current job

Keep it up

Made my objective clear on ground water

4. How relevant was this course to your work in connection with sustainable water management?



Since I am a hydrogeologist who works for an international NGO (Save the Children) and my top priority is the development of sustainable water sources and integrated water resource management, the course is highly relevant to my work

A good tool to promote our advocacy campaigns for access to water.

Establishment of monitoring wells so as to monitor quality of the water source, am working on rural water supply and some of our main sources of water are ground water sources

Everyone is turning to underground water especially in a country endowed in ground water resources like mine Cameroon. Surface water is already a threat in towns and cities and there are more people engage in ground water exploitation both individually and small scales (family size exploitation) hence the need to better understand this resource properly

Extremely relevant as my work involves IWRM and Sanitation.

I HAVE ADVANCED IN MY KNOWLEDGE

I still have more interest in ground water pollution and monitoring as especially after an increased use of chemicals due to corona pandemic poor food waste disposal (leaching from bio-pits/ oils from fat traps).

I was able to refresh on technical approaches and solutions

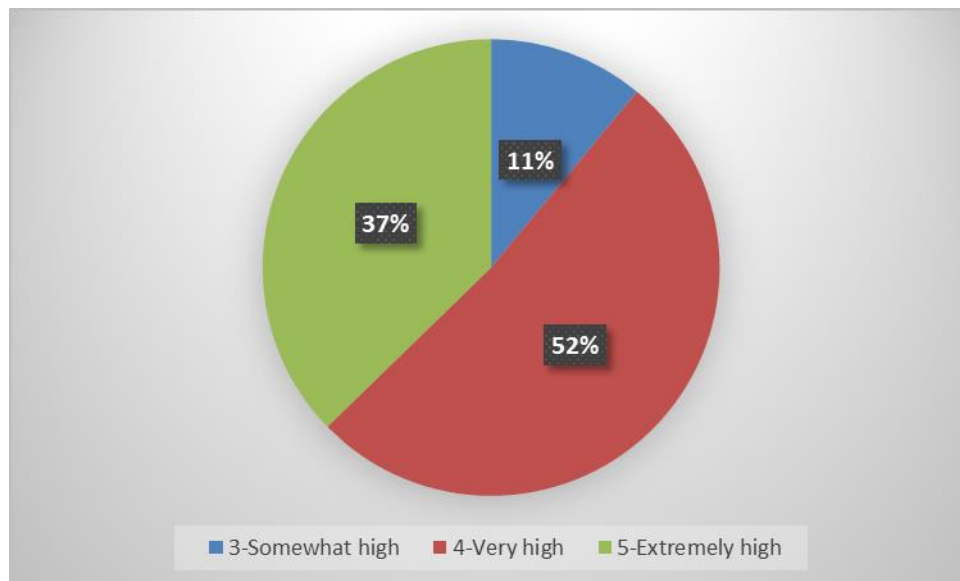
I work in a water utility company the course help realize important of water resources management

In the delivery of water supply, it is important to ensure that water is sustainable. This I have learnt from this program.

Je trouve ce cours pertinent dans le domaine de la gestion durable de la ressource en eau dans la mesure où pour pouvoir gérer une ressource, il faut connaitre ses paramètres, ses propriétés et les défis auxquels elle fait face

One can draw a lesson to draft activities related to the sustainable development and use of this invisible and precious resources.

5. To what degree did you acquire new knowledge through this course?



At some point consider running diploma courses

Bien qu'ayant une certaine connaissance dans le domaine de l'hydrogéologie et des ressources en eaux souterraines, ce cours m'a permis d'aiguiser mes connaissances et d'en acquérir de nouvelles

Coz it cover various topics on water resources, water governance, and water security and quality control

I have learnt new knowledge

I learn a number of concepts added to the ones I have been using and knowledge being very cumulative, I very much appreciate the upgrade

IT WAS VERY POWERFUL TO MY KNOWLEDGE OF UNDERSTAND

NO

The course was totally different from my knowledge of water, which was interesting to get new knowledge.

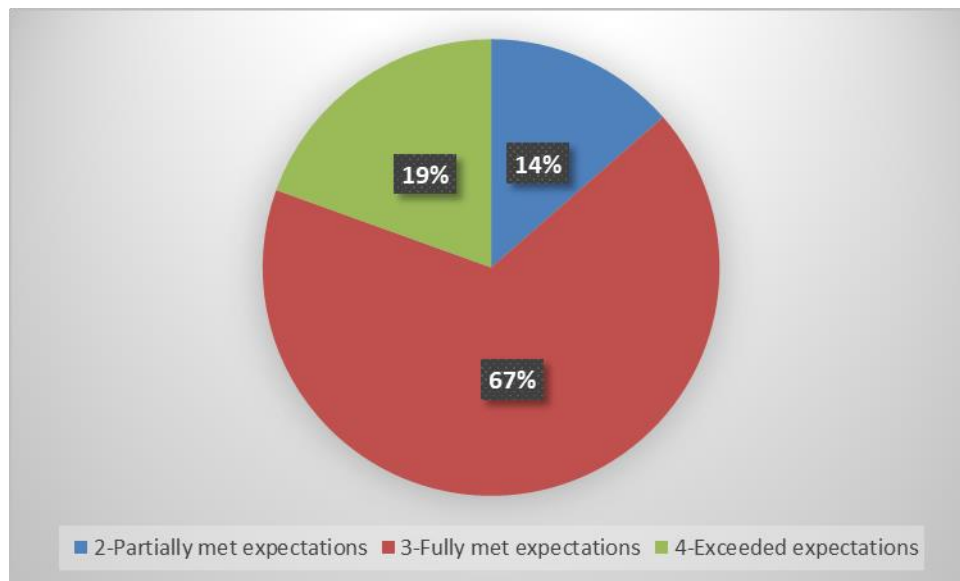
There was no person from my country, so I felt a little off.

during my IWRM, the main emphasis was on surface water as a large quantity from the surface water percolate the ground and result in groundwater.

it has increased my knowledge especially on transboundary aquifers

it offered me new perspective

6. How well did the course meet your expectations?



had thought it would be more basic, however, the content learnt was beyond what I had expected.

I was expecting topics like underground hydrogeological investigation will be considered but was not there.

I was hoping that we will discuss more on criteria for test and verification. Physical and cost-effective methods of testing and evaluating ground water before use. Example is that some are very reach in fluorine and one visit some villages with many people suffering from dental fluorosis and other mineral related water challenges caused by natural/spring/well water usage

It was interesting in finding out how other countries/ regions are dealing with groundwater challenges

It was worth it

Le cours a pleinement répondu à mes attentes du point de vue des informations à capitaliser et des connaissances et compétences acquises

MORE KNOWLEDGE AND EXPERIENCE

NO

On water relations, managing water resources, aquifers management and understanding underground water systems

Reading Materials, Websites and Video are very good and Training Manual practical.

The courses met my optimal expectations for this course, and it covered most of the topics that were on my mind when I was applying for this course.

I was expecting

7. What was the most valuable concept or resource introduced in this course to you?

This course was highly beneficial to me, I gained a valuable experience and knowledge, I wish that I will have other courses like this one.

All modules

All modules but especially module 4.

Aquifer management

Aquifer management through IWRM based on river basins

Characteristics of Aquifer systems

Characterization of Aquifer Systems from a Management Perspective for i was able to develop a working board paper and presented to top management for understanding.

Characterization of groundwater systems

Concept of Transboundary aquifers management

Consideration of Surface and groundwater together in water source management

Data required for groundwater management

Every concept introduced was most valuable. I cannot really say of only one. I am so glad to have been one of the beneficiaries on this course.

Every module gave a deeper insight to the knowledge I currently have.

General course content is valuable holistically.

Gestion des ressources en eau souterraine

Ground water Quality Monitoring

Ground water management

Ground water monitoring

Ground water monitoring

Ground water monitoring and information management, Gender and ground water management, management of transboundary aquifers, ground water hazards, and others.

Ground water regulation and licensing. this is because this is still theoretical in my country and as a change maker, was very much interested on what is done in other places that have significantly improve ground water ...

Groundwater Quality and Source Water Protection

Groundwater data management.

Groundwater management upholds social and financial turn of events and will turn out to be progressively significant notwithstanding environmental change, dry spells, and floods. To participate in the administration of ...

Groundwater management

8. What topic(s), if any, do you wish the course would have covered in greater depth?

Modélisation hydrogéologique

The topics that I recommend to be included in this course are that before learning the ground water management course, it is good to have a brief introduction of the development of ground water resources, including borehole and analysis of pump test data.

Water quality

groundwater vulnerability

Recharge zone mapping and protection

ground water modelling and data collection. because first we have to know what we have to manage it.

None

Groundwater monitoring and data/information management & communication

Manual borehole drilling in Africa

Monitoring

Areas adequately addressed. Looking forward to groundwater management for islands.

study the ability of the actual water bassin in Africa to manage the groundwater ressource

Transboundary aquifer

Regulations

NONE

groundwater sitting and drilling

Exploration methods for groundwater resources in different geologic formation

TBA

Groundwater Management

NA

N/A

les eaux transfrontalières

Groundwater Regulation, Licensing and Allocation

NA

All were well covered

La gestion intégrée des ressources en eau et le changement climatique

Professional drilling management and licensing

GW monitoring and an in depth investigation and case studies on transboundary aquifers.

1. Community-lead management of groundwater resource; how community will engage for early development of water resource.

Using GIS on the groundwater management

Transboundary aquifers

Groundwater-surface water interactions.

in my opinion the course covered all the topics with in greater depth

Integrated water resources management

A more enhanced overview on the legal frameworks for the management of ground water and the impact of each decision / decree in order to compare and make adequate decisions at a later phase

Regulation and licensing
Groundwater regulation, licensing, allocation and institutions
ground water aquifers
N/A
Some data may be slightly outdated.
policy measures on TBAs
Transboundary Aquifer management and analysis
ground water quality and solute transport
GW quality management
Ground regulation and licensing
Groundwater monitoring and information management/communication
Monitoring systems of the groundwater management and coordination mechanisms between countries
assessment of GW quality
knowledge in routine work as a water sector
None. All topics were properly covered
Design of groundwater structures
Les mécanismes mis en place pour la gestion des aquifères transfrontaliers
Modelling
the transboundary aquifers
Non
Groundwater Modelling
Transboundary aquifers and their management using real case studies
Transboundary aquifer management
Groundwater Quality and Source Water Protection
Le sujet de la caractérisation des aquifères afin de mieux comprendre les enjeux de la gestion des aquifères transfrontaliers
n/a
Hydrogeological investigation
None. I was satisfied
Borehole drilling and development
Ground water monitoring and information management, management of transboundary aquifers, ground water hazards.
Transboundary Aquifer Conflict management scenarios in Africa-real life experiences
Aquifers
Policy formulation to manage groundwater especially in developing countries.
Mineralogy of groundwater. Various groundwater mineral content and significant/impacts on use and health.
All topics were covered in depth and me being from a non-hydrological background, I have understood all courses thoroughly
Point to be considered when water abstraction issued
n/a
Mechanisms and approaches of managing TBAs
Transboundary aquifers

Hydrogeological modelling of aquifers using GIS

Groundwater Pollution, it is also interesting to understand the reason some of the dry areas like we see in Botswana experience an increase in salinity problem, most groundwater sources have an ever increasing salinity issue and less challenges in quantities or borehole yields. I will also like to learn more on aquifer recharge projects that are becoming common in our region, the geotechnical impacts and general effects on natural groundwater flow.

The topic that would have been covered in greater depth is groundwater monitoring and data management communication.

Groundwater monitoring

GROUND WATER MANAGEMENT

Groundwater regulation, licensing, allocation and institutions for aquifer management.

how to consider groundwater allocation for long-term management

How to clean-up polluted aquifers

all topics are covered deeply and very interesting.

Groundwater quality and remediation

IWRM and Water Wars.

IWRM and Water Governance and leadership

Néanmoins, il serait intéressant pour la prochaine édition d'intégrer les concepts de modélisation des écoulement qui pourrait quand même être un bon tremplin dans le processus de gestion durable de la ressource en eau souterraine.

Approfondir sur comment se négocie entre les États, sur la gestion commune (et les étapes de mise en place de la gestion commune / ou partagée) des bassins d'eau transfrontalière en Afrique.

WATER QUALITY

I wish practical tools for measuring. Some workshops could have included or exercises. Interaction with the fellow participants were not possible. We are not aware of them.

Bore hole designs technical specifications

With funding available participants should be given an assignment to document any TBA in their country that they feel can be saved from pollution

Integrated water resource management

Je souhaiterais le cours traite plus en profondeur la collecte, traitement et stockage des données sur les ressources en eau souterraine.

Manejo de zonas contaminadas por la mineria

groundwater licensing

Licensing

Assessment of Aquifer Vulnerability.

the topic that would have been covered in greater depth is groundwater monitoring and data management and communication. The effect of poor water quality/ polluted water on human health/ecosystem.

Groundwater Quality and Source Water Protection.

Monitoring of water quality in transboundary aquifers

Monitoring of water quality in transboundary aquifers

Transboundary aquifers

Groundwater monitoring is still a concept most stakeholders don't see value in hence little financing is injected in it yet monitoring is very important for protection of aquifers for future generations but also from contamination

All topics were adequately covered

Licensing and regulations

aquifer pollution

geological effect in groundwater

monitoring and evolution of ground water

ground water pollution

integrated watershed management

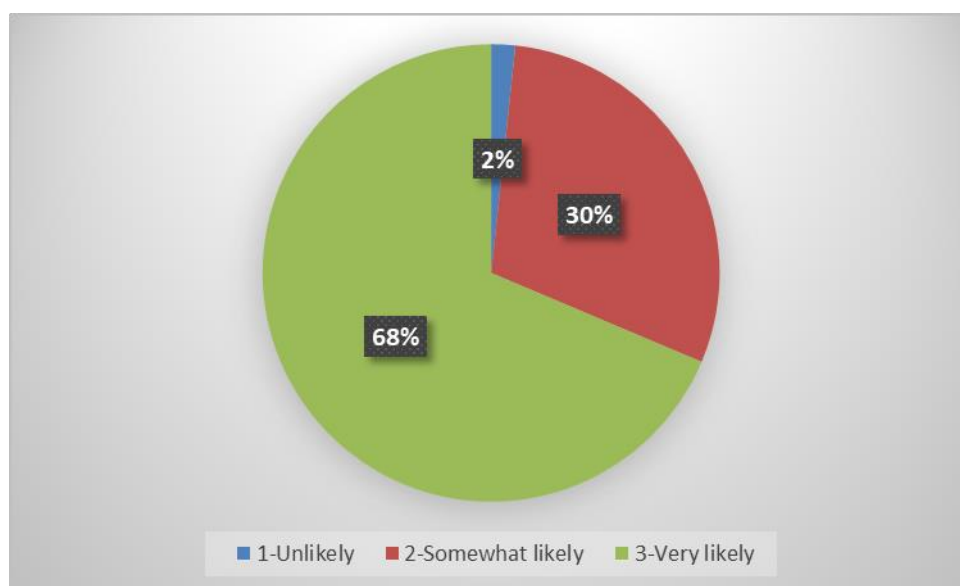
water quality

Aquifer systems characteristics to Groundwater management and groundwater regulation, licensing, allocation and institution

Gestion et politique de l'eau

Transboundary groundwater Quality monitoring, Groundwater in IWRM

9. How likely are you to be interested in interacting with other course participants?



Yes

Réglementation des eaux souterraines, autorisation, allocations et institution pour la gestion des nappes aquifères

I have learn that collaboration and coordination is key in sustaining any resource and project and hence must stay in contact with others to share data and get inspired by their own works in various parts of the globe.

AMAZING, Thankyou for choosing me as one of the members for the course

VERY HELPFUL

If they keep committed on the platform .

There is something new to learn in groundwater resource management

Les discussions dans le forum ont été plutôt instructifs. C'était un réel cadre d'échange et d'information.

NO

it's a life changing course

improve the resource

I was very interesting

the platform of interaction is very good prompting to someone to thick specifically of what they are doing in their country and also sharing what they know about their country

10. Provide additional comments, recommendations, or suggestions for the course

As this course is very important for water sector actors, I highly recommend to continue this virtual campus training to reach wider audience in the future. This course does not need detachment from routine job location, and it enriches professional skills and knowledge.

As water supply professionals, we would like to use this opportunity to share experiences with colleagues across Africa. Establishment of discussion groups out of the participants would increase our network of professionals and improve our knowledge base.

Could you kindly open a course regarding dissolved organic carbon in water laboratory practicals

Course was well prepared

Gratitude to Cap-Net UNDP and partners for the great and impactful work they have been doing. I think the platform is significantly easy to navigate on. I will suggest that maybe, one can receive notification especially on response and questions address to a person particularly. This can go a long way to facilitate the knowledge sharing amongst participants and facilitators

Great Job!!!!

Great online training to encourage reading references

I am not sure if I might have missed the feature, maybe a live session in addition to tutorials would also be interesting.

I appreciate the organizers for putting together all the inspiring courses. I will recommend live interactive sessions to better discuss and share our knowledge.

I had some challenges with the connection. My account was blocked, I sent several emails but never got any reply. I kept trying to sign in and one day I got in. It will be great to have feedback when a concern is raised. I appreciate the fact that you sent several emails to remind about the deadline to complete the course.

I suggest that in future a broader look into the choice approach as compared to essay responses.

I would like to continuously have an input on discussions until the end of the course as I did not actively participate in discussions due to time constraints.

I would like to suggest the increase of more content on water quality monitoring and the effect of poor quality/polluted water at human health/ecosystem.

If there is a practical part will be so beneficial like some data and apply the general concept on it throughout the course

It should contain hands-on practice and workshops if possible

If u can make an institutional water resources meetings for leaner and also doing some practical research for the syllabus

In the future, would you include case studies and management activities, as well as findings ?

Introduce more courses or water resource development and sustainability

It is a thrilling course. And keep it up. I apply information in routine work in the water area, for instructive, scholarly, or research purposes and I Contribute to changes or enhancements locally. Thanks

It was a good opportunity for me to participate and gain crucial knowledge that will help me in my work. I thank all of you and hope to see you in other courses!

It was excellent.

It's grateful if we could have course manual attached with reference to revisit.

Je recommande de prévoir des cours plus approfondis à savoir par exemple la modélisation hydrogéologique, le transport de contamination, la recharge...

Le cours a été très utile pour moi pour approfondir mes connaissances sur les bassins d'eau transfrontalière.

NO

Networking from the fellow participants would be a great asset. It would be great if such networking could be developed.

Nice Educational on-line course,

Please consider offering diploma courses

Please produce more learning materials as video and have more interactive Zoom call

RECOMMANDATIONS : Les modules doivent être renforcés par des cours bien détaillés, plutôt qu'accentuer sur la documentation, ajouter des questionnaires axés sur la pratique

Recomendar hacer una curso de manejo de zonas contaminadas

Thank you all for the opportunity! It was a great occasion to review some concepts and learn a lit bit more about groundwater management!

Thank you Capnet for considering my application to take on this course. It has been a very beneficial one with some good information even for future reference and employment. My community must be glad I have more knowledge for service. I also believe my Master's journey in a related or similar course is higher now... However, I would suggest learners or students are scheduled to meet with the trainers or facilitators at least per module to allow more interactions that may enhance further learning. My thoughts. Thank you so much.

Thank you so much for this course. It is a boost to my career in sustainable water management.

The course is well organized but there is a need to improve the topics.

The course was amazing and I enjoyed watching the introduction videos. The reference sites were also very great, they gave me access to information I did not know existed. Overall , the course was greatly put together.

The course was generally good. Some of the recommended material was too bulky.

The course was generally good. Some of the recommended material was too bulky.

The presentations by the guest lecturers was too short.

The self-pace learning was very good, because I had the opportunity to refer to different materials in order to understand or learn however, the discussion forum has not been very active. My recommendation would be perhaps to conduct moderated discussion to enable an interactive session

This has been a great experience. The knowledge gained will help me a lot in my career. Thank you for the opportunity.

This was a good course and very timely

great course

I don't have more

I want to thank the cap - net for this amazing course and I am happy to participate also the other opportunities

I would like to offer my gratitude to CAP-NET for offering me this amazing course which I have gained a lot of knowledge through it ,I can freely say this was one of the best and interesting online course I ever had, and it amazed my expectations .

interesting course; Thank you

it has been very good experience for me in attending this course as my knowledge has been improved.

it would be better to share some project works related to the given topics

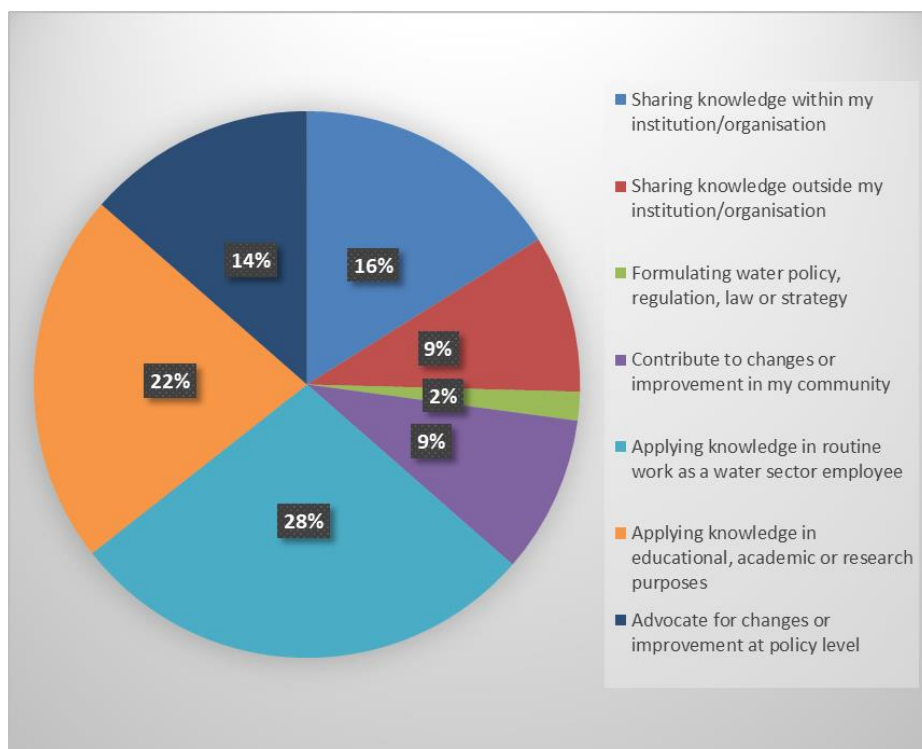
Merci pour le cours

thanks a lot

well with thanks

Which of the following statements best describes how you intend to apply the knowledge gained from this activity?

- Sharing knowledge within my institution/organization
- Sharing knowledge outside my institution/organization
- Formulating water policy, regulation, law or strategy
- Contribute to changes or improvement in my community
- Applying knowledge in routine work as a water sector employee
- Applying knowledge in educational, academic or research purposes
- Advocate for changes or improvement at policy level



Annex 4: Other responses of co-facilitators' survey

4b. What improvements would you recommend for the future with respect to orientation and support of you as co-facilitators?

Perhaps a bit more interaction with the team members of the entire course to help with the overall vision and flow.

The need for more interactive sessions

It was organized very effectively

n/a - think it was good

Maybe just a very short online meeting / kind of meet and greet and brief demonstration of the online system rather than doing it via email online.

Make it fool-proof to find the discussion pages and one's cohort.

participants should be encouraged to interact between themselves. most of the time, they express less their opinions.

Get a notification when comments are posted on the courses being facilitated.

The overall set-up of the course was unclear, e.g. lectures, homework, forum discussion (it was our first participation in this sort of course). Some more explanation at the beginning would have been useful. We also missed a live walk through in the online discussion forum platform.

As we discussed at one of the facilitators' meetings, it would be great if the course discussion between students as well as student / facilitators was more engaged - ie people got more involved in (group?) discussions rather than limited question/answer. But I really don't know how we could enable this! I think it's a lot to do with the course software. but maybe there could be, for example, set times (allowing for time differences) on set days when people are 'live online' for discussions, as well as having the discussion forum open all the time? Or/and maybe including some more open ended questions?

5. Please tell us what you learned from undertaking this co-facilitation.

A lot of insights into the situation in different African Countries

Online and self paced though more flexible makes it challenging to get group discussions going.

Interesting doing the facilitation, though I was constrained by time on my side

The fact that there are so many common issues of concern re water quality & protection

Reflections on challenges facing drilling companies (delayed payment, lack of equipment and spare parts for rigs, cashflow, inflation...) were interesting since I'm used to considering more the challenges facing the client.

It was very interesting to see the variety of background of the course participants and to learn about the different GW monitoring systems in their country of origin.

I learned sharing my knowledge with others and I also appreciate the diversity of participants. I learned what their hydrogeological context is compared what I usually observed in west Africa

Students had the context of the courses being offered and would raise relevant points

We appreciated the following: o There was a lot of candidates and participants, there is obviously a large demand for online hydrogeology courses o A lot of partners were available to support the course, including several groundwater experts from Africa. The base of support is there for organizing such courses. o Long-duration of the course (not one-off webinar, more like a regular university course)

A lot about specific circumstances in individual countries - really interesting & useful. And also great to learn more about some of the many different sector backgrounds of people working / involved with groundwater

6. What were the main challenges that you faced?

Sometimes a lack of exchange and participation from the participants

packaging the content into small "bite size" portions was at first quite challenging.

Time constraint on my side due to other competing activities, thus limiting my interaction with participants

For me it was my lack of availability during this time which was the most challenging aspect, I would have like to have been more engaged

In most cases when Kerstin or I replied and asked a follow up question, there was not a response, so it was hard to generate discussion.

Time-constraints on my end - I would have loved to spend more time looking at some of the responses from other groups.

Not always managing to find the right discussion page.

the diversity of hydrogeological context

N/A

The interaction with the participants was extremely limited. Therefore we wonder whether the participants have integrated the skills and the knowledge that this course was supposed to provide.

Trying to stimulate discussion in the forum

7. Assuming that the course was to remain the same length, in terms of five modules, are there any changes that you recommend be made to the content of the course?

Include more Video Materials. E.g. the Material that is available in written format may be prepared in an attractive video learning format

I would maybe add a webinar/discussion session mid-way in the course and keep the one at the end. Depending on numbers enrolled to make the groups small enough.

Regional specific deployment of the Modules

None that spring to mind immediately

no

N/A

We strongly recommend increasing the interaction and the participation of the students, e.g. with live lectures and Q/A sessions, homework and assignments, preparing a short thesis, exams, etc. The content of the course should be adapted to the background of the candidates. Therefore, it would be interesting to know the field and level of education of the participants.

I don't think so

8. Are there any improvements that you recommend to the Cap-Net virtual campus platform?

None. Great platform!

Organizing the course on regional basis within Africa, so that some regional specific case studies can be presented.

I think it worked well

yes , it possible to have some alert message in our box in order to remind the facilitator when the participants ask questions

No

9b If you were not satisfied with the level of interaction within the discussion forum, what improvements do you suggest?

Maybe we can include interactions as part of group exercises

From 7 above I would add a webinar/discussion session mid-way in the course and keep the one at the end. Or also add live chat sessions (not sure of platform) timing for time zones accommodation would need attention.

NA

Would it be possible that participants receive an email notification when there is a reply to a thread they have contributed to?

Some students never replied to responses from facilitators which then felt a little discouraging, but overall I enjoyed the experience

there is little reaction of participants. I suggest to aware them on importance of interaction between themselves

See above.

as above. Also maybe could mention the forum more in the course videos , ask questions specifically for answering?